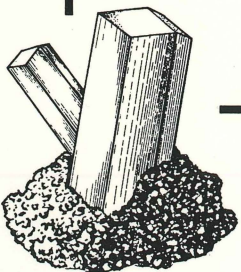


Mineralogy of Maine



Volume 1: Descriptive Mineralogy

by Vandall T. King and Eugene E. Foord



Maine Geological Survey
DEPARTMENT OF CONSERVATION
Walter A. Anderson, State Geologist

Mineralogy of Maine

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Cover photograph:

*Fluorapatite, Pulsifer quarry, Auburn, Maine (2.2 cm specimen),
Harvard Mineralogical Museum collection.
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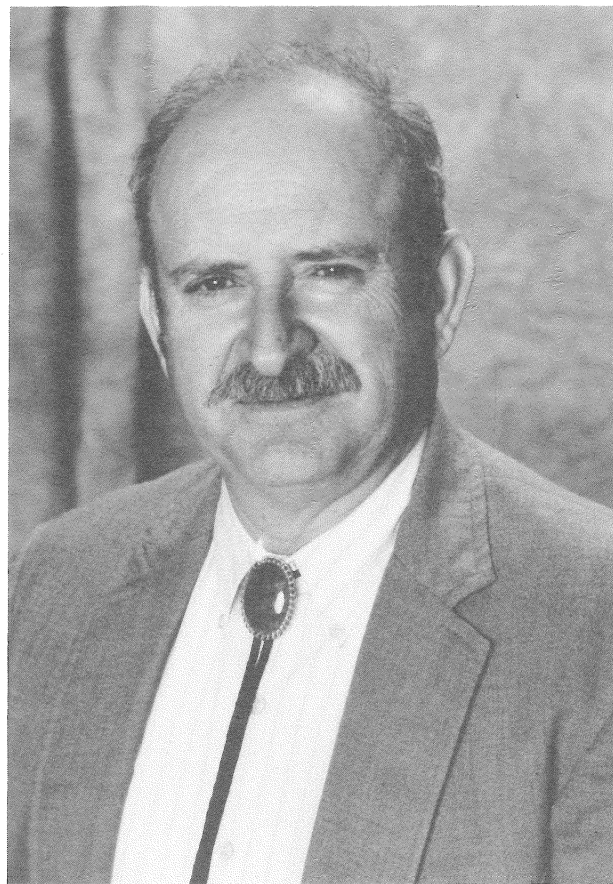
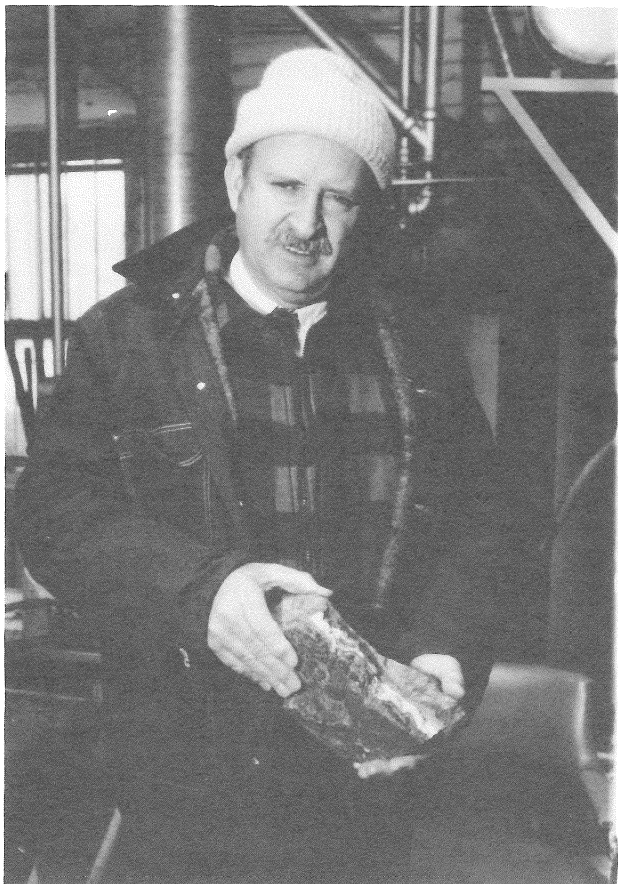
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This volume is dedicated to

Richard Philip Hauck

Richard P. Hauck was born in Bloomfield, New Jersey on June 30, 1935. He has been actively involved in numerous mineral clubs including the Franklin-Ogdensburg Mineralogical Society, acting in various capacities including president and director. As a scholar of mineralogy, he has been an indefatigable researcher and collector of mining history. Among his specialties may be mentioned his attention to Parker Cleaveland, John Webster, Nathan Perry, and George Kunz, all of whom were important in Maine mineralogy. He has authored numerous historical and descriptive articles, frequently concerning Maine personalities, in the major mineralogical magazines including *Rocks and Minerals*, *Mineralogical Record*, and *Matrix*. In 1980, the mineral hauckite was named in his honor. Dick's deep concern for the fate of the Sterling mine in Ogdensburg, New Jersey, and his intense interest in mining history led him to purchase the mine in order to form a living museum so that it would remain accessible to the mineralogical community. Through his efforts, the Sterling mine has been declared a national historic landmark.

The authors wish to acknowledge the suggestions, encouragement, and support from Dick which resulted in the *Mineralogy of Maine* becoming a reality. His unselfish donation of reference material, search for key Maine specimens, and his door-opening influence are greatly appreciated. One could not hope to have a better friend than "Hauck."

Introduction

The introduction to a book is often best written after the volume is mostly completed, when the author has the advantage of looking back at the finished project. In retrospect, two thoughts come to mind regarding the present work:

- 1. If the authors were more widely read, this book would have been better.**
- 2. If we had known how much work was involved, we might not have begun.**

The *Mineralogy of Maine* was a labor of love for many contributors. The two volumes have provided a forum for a variety of writers with a story to tell concerning Maine's minerals and mining history. The ranks of invited contributors have diminished significantly since the earliest days of this project, as some of the proposed articles were unable to reach fruition. The authors regret that there was not enough room to include additional papers, but the references cited are a good guide to the literature for the interested reader. We opted to present original material whenever possible. In our experience, paraphrasing and rewriting by earlier Maine writers in some cases have greatly muddled the contents of earlier works, and the original sources were often far more informative than any subsequent efforts to summarize them. Another reason for providing original quotations is the inaccessibility or unavailability, even in Maine itself, of the original books and documents read for this project. Without providing some original text quotations here, many mineralogical questions would undoubtedly remain unanswered. The authors agonized over the philosophy of including long quotations. In the end, the reason for using the quotes rested not only with the difficulty of obtaining the source material, which an inquiring reader would want to read, but also with the desire to validate the chronology of events and assure the reader that the facts presented here were not the figment of an active imagination. The great number of historical summaries available are riddled with inexactitudes, sketchy accounts, folklore, misinterpretations, and poor writing. Without presenting the full, first-hand source, the reader might not believe some of the accounts given here, especially when the "familiar" literature is contradicted by recently discovered information. A summary would have provided a shorter account to read, but the result would have been too much like all of the other written accounts available. Moreover, the stamina of even the most ardent mineral historian

might fail in the attempt to read the complete accounts that are so widely scattered. The indulgence of the reader is requested wherever the citations contain information that appears in other parts of these volumes.

The study of Maine minerals has been based on the cumulative experience of the authors' visiting the locations described. Mineralogy is an enjoyable branch of natural history which has taken us to a great many of Maine's remote, and not so remote, towns. Each of us has a delight in the surface landscape of Maine as well as its underground mineral resources. Field trips started in the Oxford Hills before autumn's mists have cleared from the valleys below are memorable. Physical exercise in hiking in the woods, frequently over and past familiar hiking trails, using map and compass or dead reckoning, utilized skills that sharpen both body and mind. The hours in the laboratory, at home or at an institution, challenged the intellect. The solitude of the library has been its own reward. The excitement of conversation and fellowship with our comrades have compensated us greatly for our labor. Each of us has brought different skills and interests to a study which never ends. Mineralogy, as with most sciences, can be enjoyed at a variety of levels.

The authors conducted much of the study of Maine's minerals at locations far removed from its borders. The United States Geological Survey at Denver, Colorado, contains essential information not to be had anywhere else. The major libraries at Cornell University, University of Rochester, Columbia University, Yale University, Gemological Society of America, and elsewhere contributed their unique secrets. Visits to major museums with mineralogical collections from Los Angeles to Boston, as well as Toronto and Ottawa in Canada and Paris, France, proved to be invaluable sources of information. While it might be possible to write a state mineralogy within a state's confines, the size and variety of the world must be acknowledged. The authors regret that they were unable to research known caches of information at the United States Geological Survey in Reston, Virginia; the New York City Public Library; the Library of Congress; the Smithsonian Institution Library (with Parker Cleaveland's ledgers); the University of Stockholm, Sweden; the British Museum of Natural History; and many other known repositories. Further, the existence of unknown societies and institutions with useful information and specimens can only be imagined. The authors are particularly grateful to the many individuals who placed personal libraries and collections at their

disposal. Their cooperation was more than gratifying. Of friends who will come forward in the future, we eagerly anticipate the association. Of those who came before us, we recall and paraphrase Isaac Newton's epithet: "If we saw further, it was because we stood on the shoulders of giants."

The information concerning Maine minerals has not, heretofore, been accumulated into a convenient volume for the enjoyment of the collecting public or as a scientific summary. A glance at the bibliography will convince the reader of the disseminated and fragmentary nature of the information in previously published sources.

Various checklists of Maine minerals have appeared over the years, but they have suffered from a lack of supporting documentation. Many species are so obscure that they are not represented in most collections. In order to provide as many descriptions as possible with firsthand or near firsthand insight, the old literature was systematically read. Each discovery of an original(?) reference to a species' occurrence was a delightful triumph. Many original references could not be traced, however, and the search still continues. Locality reports for already established Maine species have not been given the same priority. Many such reports list only the town where a find was made.

The reader will note locality and species reports, gemstone records, etc., in these volumes which have not been recorded elsewhere. A systematic attempt has been made to acquire unusual specimens directly in the field and by purchase, as well as by recording and photographing specimens in private and institutional collections. We have published notices in various journals concerning the species and locality lists of Maine, prompting a few individuals to come forward with information in their possession. The authors welcome input from people who have new information or old information that should have been included. They should correspond directly with the appropriate chapter author so that the record can be improved.

In particular, species which do not appear in our lists of Maine gems and minerals are sought so that they can be verified and described. Readers should be cautioned that the mineral world is full of "look-alikes," and it is as important to discredit misidentifications as it is to add new discoveries to the list.

Regional mineralogies have been written for areas all over the world. Each has had its own philosophy. The mineralogy of Vermont (Hall, 1824) served as a list of localities with little specimen description. The same was true of the first mineralogy of the United States of America (Robinson, 1825). The mineralogy of New York (Beck, 1842) is still a model for regional mineralogies. Beck wrote about the specimens in detail and he combined specimen description with historical and geological observations.

In recent times, there has been a flowering of regional mineralogies with European authors leading the way. Mineralogies such as *Die Mineralien der Eifelvulkane* by Hentschel (1983) and *Die Mineralien des Binntales* by Stalder et al. (1978) demonstrate the wonderful detail that a mineralogy can possess. The formats of regional works take a very individual approach.

The variety extends from outline works such as *Minerals of Washington* (Cannon, 1975), *Monteregian Treasures* (Mandarino and Anderson, 1989), *Minerals of Mexico* (Panczner, 1985), and *Les Mineraux Secondaires D'Uranium du Zaire* (Deliens et al., 1981, 1984) through the encyclopedic tomes of *The Mineralogy of Greenland* (Bøggild, 1953), *The Mineralogy of Pennsylvania 1966-1975* (Smith, 1978), and the world champion *The Lovozero Alkali Massif* (Vlasov et al., 1966).

The philosophy for the *Mineralogy of Maine* has been to produce a useful work for Maine mineral collectors and naturalists. Many collector's guidebooks have been written, of which Morrill et al. (1958) and Morrill and Hinckley (1959) are still very important. The current *A Collector's Guide to Maine Mineral Localities* by Thompson et al. (1991) contains detailed maps only to *selected* localities.

How Good Are Maine Minerals and Deposits?

Many reports on Maine have emphasized the unusual wealth of Maine pegmatites. One book went so far as to claim that a greater variety of minerals are found in Oxford County, alone, than anywhere else on Earth of comparable size. In reality, there is probably a greater variety of minerals in a single mine in Franklin, New Jersey, or Mont Saint-Hilaire, Quebec, than in the entire state of Maine. The minerals of Langban, Sweden, are more numerous than Maine's, as well. An area smaller than Oxford County in Murmansk Oblast, Kola Peninsula, Russia, has perhaps as many as 15-20% of all of the known minerals on Earth. Other examples exist.

There are relatively few gem-producing areas in the United States, admittedly. Connecticut has produced a few tourmalines, aquamarines, heliodors, and morganite crystals, including one very pale pink beryl crystal, which though essentially of non-gem quality, is probably the largest of its kind found in the United States. North Carolina is a source of true emeralds and outstanding quartz crystals. New Hampshire has also yielded a few aquamarines, heliodors, and clear to slightly blue topazes. However, San Diego County, California, is arguably the most important gem-pegmatite district in North America. Its wealth of tourmalines, morganites, topazes, spessartines, etc., is wondrous. This short review is not intended to diminish the reputation of Maine's minerals or to belittle the magnitude of their importance: America's largest flawless aquamarine *is* from Stoneham and the best American green *and* red gem tourmalines are from Paris, Poland, and Newry. These gems might qualify as world's best and superior to any from Madagascar, Afghanistan, Russia, or Brazil. Certainly, only the best Maine gemstones are in the "world's best" category, and the lesser grades are matched by dozens of worldwide locations. Maine aquamarines are pale by Brazilian or Nigerian standards.

Too often claims are made by individuals who have no experience outside of their home area. The first specimen that they see is by definition the best they've ever seen. It is not possible to judge Maine specimens without being familiar with

the variety that the world has to offer. Are the pink elbaite fans of the Stewart mine in Pala, California better than those from Black Mountain in Rumford, Maine? Are the cassiterite crystals of Resplendor, Minas Gerais, Brazil, better than those from the Harvard quarry in Greenwood? Are the morganites of Cerro de Urucum, Galileia, Minas Gerais, Brazil or from the Pala Chief mine, Pala, California, better than those of the Bennett quarry in Buckfield? The answer to most of these questions is "yes" because the competing worldwide locations mentioned above are extraordinary producers. Our pride in Maine minerals lies in the fact that very good specimens do come from our state, and some of them rival the rest of the world's specimens. In the nineteenth century, Maine had fewer mineralogical rivals.

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The Value and Care of Collector-Quality Mineral Specimens

Before a general explanation on mineral values is attempted, there are several guiding principles that should be expressed for the benefit of beginning collectors.

1. A mineral specimen is worth more in its matrix than extracted from it. This rule is usually more appropriate for crystals and gem crystals than for massive minerals.

2. A mineral specimen is usually more costly the closer one gets to its source. The corollary to this rule is that a mineral from Maine will usually sell for more money in Maine than in California, given an informed seller and an informed buyer.

3. The only form of conservation of mineral specimens is collection. Few minerals are produced under the Earth's surface conditions. The action of the various weathering agents is usually destructive to minerals found in rocks originally formed many kilometers below the Earth's surface.

Mineral specimens often have scientific, historical, and monetary values, which can be determined in several ways.

1. Mineral specimens have historical interest. They represent the tangible results of scientific study, mining, and collecting ventures. While reading the history of mining can be fascinating, actual specimens from both well-known and little-known locations add to the interest of the written account. There are many great mines or finds which have no surviving specimens to represent all of the activity involved in their discovery and exploitation. The same can be said of artifacts such as mine equipment, mining notes and newspapers, and collector correspondence. The understanding of a mineral deposit and the believability of reports depends on the preservation of authenticated specimens of each mineral occurrence. Most species are abundant enough that they will be represented in mineral collections for many years. The believability of claims of the discovery of certain silver minerals in Maine mines is reduced due to the almost non-existence of specimens of the rare species reported. Mineral specimens frequently have characteristics and associated species related to their individual occurrences, and unique scientific information may be derived from individual finds. Collecting is the necessary first step in conservation of these minerals.

2. The cash value of mineral specimens is determined by the collector market. Montebasite was a very rare mineral on a worldwide basis in the nineteenth century and a piece of it might have sold for \$5 in the late nineteenth century. The same specimen might still sell for \$5 a hundred years later, because more specimens have been found. The value might have dropped from a week's wages for a common laborer of the 1800's to one hour's wages of a common laborer today. Some gem crystals or gems

themselves may have increased in value even above the rate of inflation, but not have increased at the same rate as a financial investment would have yielded. However, some items have increased handsomely.

An interesting feature about the value of minerals is the axiom that a mineral is usually more expensive closer to its source. This rule is usually true only for special items from a region. The common minerals are not usually thus affected. Part of the sometimes inflated price attached to a specimen is local pride and perhaps the lack of awareness that the specimen is not really that special. The reason why some specimens sell for a premium is that visitors to a region seldom arrive when the supply of minerals is being produced.

3. The most important consideration for the commercial value of specimens is their preservation within the rock or matrix in which they were originally found. **Removal of crystals from their host rock invariably results in a loss of value.** This statement is especially true for higher quality and gem specimens. Many specimens have been permanently ruined in the attempt to obtain a single crystal from matrix. The interest in matrix rock lies in the information collectors and scientists get from such specimens. At the least, the associated minerals demonstrate to the collector and researcher characteristics which point to the location of origin, conditions of formation, etc. Aesthetically, crystals and minerals in matrix are visually more appealing than single crystals. Removal of crystals from their host rock can result in breakage or the revealing of ugly scars where the crystal was interrupted during its formation by other minerals.

Chemical treatment of specimens is sometimes disastrous as well. While rose quartz crystals frequently occur on a stained matrix and look better without the staining, the rare minerals which can be found with the rose quartz are sometimes more valuable, but are destroyed by acid baths or other cleaning treatments. Some specimens can even be stained by the acids as frugal collectors leave the specimens too long in the cleaning solution. Frequently, an uncleaned specimen is more valuable than a chemically-stained specimen. Minor nicks and chips are as detrimental to mineral specimens as similar nicks and hair-line cracks are on antique china and glassware. Even barely discernible damage is significant to museums and collectors. Specimens should always be handled carefully, even if they are considered to be "rocks." Display shelves shouldn't be crowded to the point that specimens touch each other and potentially knock each other when moved. Specimens should be carefully wrapped when moved some distance, but each specimen should

be inspected *before wrapping* to make sure that delicate crystals won't be damaged by wrapping them.

4. Labels enhance the value of mineral specimens and should never be separated from the specimens. Unlabeled specimens might be recognizable to a mineralogical savant and a locality might be able to be attributed, but original information generates 90% of the value of a good specimen and 100% of a poor one. The most important piece of information from an economic and scientific perspective is a specimen's location of origin. There are many specimens which could appear to have come from any of several localities, or whose source may not be recognizable at all. It is a common practice to use glue to paste a label directly onto the back side of a specimen so that the information will not be lost. Alternatively, a small rectangle of enamel paint on the specimen can be written on with permanent ink to preserve the information. Numerical cataloging is less desirable as there are so many missing catalogs in the world. The only specimens which can be traced to some old collections such as those of Jackson, Webster, and others are known because of the permanent label on the specimen. The mine name is an essential part of any label. The worst cases in Maine of poor labeling concern specimens from Mount Apatite. There are many quarries on this hill but most collectors, unaware of this fact, simply put "Mt. Apatite" on the label when it is much more significant to include the mine name. Similarly, many collectors only put the town name on their specimens because they themselves remember which mines they have visited. If there were a never-ending supply of specimens, this practice wouldn't be so unfortunate. The *location* of a specimen is usually more difficult to determine than the *name* of the species.

The chief prerequisite for conservation of minerals is collecting, unlike many other natural history objects which reproduce themselves. Preservation of mineral collecting sites without collecting being allowed merely results in weathering destroying what was formerly there. The animal and vegetable kingdoms require preservation of sites along with restrictions on collecting so that those species can survive and reproduce. Some states forbid building construction within 50 meters, and sometimes more, of a known mine. Underground mines frequently have near-surface horizontal excavations which can pose a ground stability hazard greater than the danger from shafts. Many states maintain collecting sites for their historical and recreational value.

What Do You Do With Mineral Collections?

The collection of mineral specimens is a very important activity. Virtually 85% of new mineral species are found by active, scientifically aware collectors. The presence of the large number of amateur scientific journals which accept descriptive mineralogical articles greatly increases the base of information as most "scientific" journals are devoid of useful systematic and occurrence data. The amateur mineralogist provides an important function. The essence of a collector's importance to the

science of mineralogy is tied to his reference collection, which after some time acquires significance as articles are written about it and the percentage of its "described" specimens increases. The ultimate significance of a mineral collection is not only its financial legacy, but also its source of future study when re-verification is essential. Collections which have scientific and economic value have to be provided for and carefully curated.

The options that are open to concerned collectors are manifold, but only two are practical: sale or donation. A lifetime of fun invested in mineral collecting is frequently translatable into money. When a collector is no longer collecting, the sale of a collection makes financial sense. Generally, the value of a collection is directly related to how much money has been invested in the specimens. A collector who has been a miner or one who has purchased many specimens can have a collection worth several years, or more, of his wages. A recreational collector who has self-collected most of his specimens may have a similar treasure trove depending on his luck and knowledge level.

A collection which has commercial value should be sold while the collector is still alive because he knows its value and what outlets are available. The sale of a collection which is part of an estate needs guidance or the heirs might miss out on much of the possible value of the specimens. A will should always be written to prevent government agencies dictating activity which might be in conflict with a collector's wishes. A knowledgeable sub-executor, usually a collecting friend, whose only responsibility is the maximizing of a collection's return, is a good idea. A collection has to be suitably gathered so that it can be offered to several dealers, museums, or collectors for bid and purchase. Most collections have something interesting in them and that value can be recovered. (A collection which has an estimated retail value will generally sell for about 20-30% of that value to a dealer. A collector might only be interested in the "good" specimens while a dealer would at least see that the majority of a collection was recycled. Virtually all collections have some percentage of low-value items that have only personal rather than economic value.) Directions should always be entrusted to relatives who can realize value which can be of benefit to the heirs. A false high value will prove a detriment to otherwise knowledgeable heirs. An appraiser can generally be obtained who can indicate what value can be recovered. Bids, usually two or more, can be received from known dealers who advertise and sell minerals. A few auctioneers specialize in selling only mineral collections, and a knowledgeable executor might be able to contact one of these specialists. Consignment to a general auction would be much less productive.

Estates which are not cash-poor might consider donation of the collection, as a memorial. The choice of beneficiary depends on the calibre of the collection. A high-quality display collection, or the scientifically important portions of them, should be donated to an institutional collection *which has a curator*. Collections might be donated to general museums or schools if the general value is low or after a few valuable

specimens are transferred to "secure" collections. The receipt of study specimens is usually a welcome addition to schools who teach geology, as funds are always scarce for the replenishing of study specimens. The donation of study specimens should be with the understanding of their eventual consumption by the educational process. Poor choices for donation include libraries, museums without natural history collections, secondary schools, and any institutions which cannot use the collections. Many museums, colleges, etc., have histories of throwing away parts

of or entire collections. Donation to a curated collection usually prevents this waste.

Many collections are kept within families after a collector is dead. The sentimental value of a lifetime's association cannot be denied. Eventually, some decision should be reached which recycles the collection, perhaps with economic benefit for the family. A lifetime of collecting and financial investment should not become part of a landfill.

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INSTITUTIONAL AND PRIVATE LIBRARIES

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Donald Cooke library, Spencerport, New York

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Geomological Institute of America Library,
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Dona and Wayne Leicht library, Laguna Beach, California

Maine Geological Survey library, Augusta, Maine

Maine State Library, Augusta, Maine

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Museum of Science Library, Boston, Massachusetts

New York Historical Society, New York, New York

Newport Historical Society, Newport, Rhode Island

Northeastern University, Department of Geological Sciences
Library, Boston, Massachusetts

Norway Historical Society, Norway, Maine

Herbert Obodda library, Short Hills, New Jersey

Philadelphia Academy of Natural Sciences Library,
Philadelphia, Pennsylvania

Rush Rhees Library, University of Rochester,
Rochester, New York

Benjamin M. Shaub library, Northampton, Massachusetts

Sullivan Historical Society, Sullivan, Maine

United States Geological Survey Library, Denver, Colorado

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Knowledgeable reviewers are always scarce and as so many authors have participated in this book, the number of reviewers required meant that virtually all of the most important specialists with expertise concerning Maine minerals have been called on. The careful reading of long manuscripts is very difficult. The time invested by reviewers is not trivial and the following reviewers have been very generous with their time and knowledge. While the reviewers cannot be held responsible for errors made by the authors, they have sifted many errors from the pages, have helped clarify the text, and have provided useful information.

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Abbreviations

The following abbreviations are used in the text of Volume 1:

Analysis techniques

EDAX . . . energy dispersive analytical X-rays

XRD X-ray diffraction

Libraries

AMNHL . . American Museum of Natural History Library

RPHL . . . Richard P. Hauck library

References

MMJ Maine Mining Journal

USGS . . . U.S. Geological Survey

Specimen Collections

AMNH . . . American Museum of Natural History

BC Bowdoin College

BM Bryn Mawr College

BMS Museum of Science, Boston

CC Colby College

HH Herbert Haven Collection

HU Harvard University

NMNH . . . National Museum of Natural History, Smithsonian Institution

NMC . . . Canadian Museum of Nature, Ottawa

NE Northeastern University

UMO University of Maine, Orono

PM Philip Morrill collection, Colby College

YU Yale University

Descriptive Mineralogy of Maine Minerals

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The following sections describe the more important Maine mineral specimens and their localities. It is not intended to be a guidebook, though many descriptions are sufficient to lead one to localities. Index maps to mineral localities are provided in a chapter by Thompson, Wintringham, and King in volume two of this work. *A Collector's Guide to Maine Mineral Localities* by Thompson et al. (1991), *Maine Mines and Minerals: Volume 1 - Western Maine* by Morrill et al. (1958), and *Maine Mines and Minerals: Volume 2 - Eastern Maine* by Morrill and Hinckley (1959) are also recommended to help locate the various mineral deposits.

The reader is assumed to know something about mineralogy and, therefore, this chapter on descriptive mineralogy is not an introductory textbook. It will assume that there are many points which require clarification, but the text will be useful to the interested naturalist, the beginning to advanced collector, and the professional geologist. No one level of language will be used. Indeed, some passages will contain the jargon-like use of words peculiar to geologists: e.g. anastomosing beds, debouching streams, etc. Occurrences which are *located* have been mapped in the cited references with enough precision so that the reader should be able to "re-locate" an occurrence if they so desire. Many geologists/mineralogists use crystal to signify a single mineral grain, without restriction. When crystal is used in this chapter, outside of a quote, it will always signify a recognizable shape characteristic of a particular mineral species. When the word crystal is found within a quote, the context may or may not reveal the intended distinction. No glossary is provided here and the reader is directed to the various dictionaries of geology which are available, such as *A Dictionary of Geology* by Whitten and Brooks (1972) or, the exhaustive *Glossary of Geology* by the American Geological Institute (Bates and Jackson, 1987).

Topics which require specific and technical treatment will be cited as they were written. Minerals which are familiar to

virtually all readers will be described according to their specific occurrences, frequently with sufficient detail to note the peculiarities of a locality. Crystallographic descriptions will attempt to be precise and the illustrations will usually demonstrate the morphologies discussed. Occurrences which have not been personally viewed will rely on the often insufficient description or mere listing of the mineral by a particular author.

The brief descriptions of the various minerals will be based on specimens in-hand, unless otherwise obvious. Reports of species without a specimen available will be incomplete and will alert the reader to the scarcity of preserved samples or the uninteresting nature of the majority of samples from a particular location. Original descriptions are cited whenever possible. New information, as well as missed information, is always desired. Individuals with information useful to these listings are invited to correspond with the authors of this book. Checklists were published in the various professional and amateur journals soliciting information (King, 1981b,c; 1982; 1984; 1987a), but only one response was received.

Philosophy of these Descriptive Listings

The coverage for species in this section is intended to be comprehensive for rare minerals and to be selective for common ones. Descriptions will be restricted to "interesting" specimens, while less significant specimens will be noted only for their localities. In many cases, the minerals of interest were not represented by even one sample known to the authors, but the species should be recognizable from descriptions of the mineral from locations for which specimens are available. Questionable entries are indicated. It is impractical to list and describe everything and the observant collector should find numerous common minerals in places which received no mention, but on the whole the specimens will be undistinguished except for some new finds.

The professional geological literature is selectively abstracted to obtain enough specimen descriptions to substantiate a locality's listing. Most geological papers do not adequately describe the specimens listed as the intent and focus of these papers generally have little need for that kind of detail.

Euhedral crystals which have crystallized surrounded by other minerals are said to be *frozen*, or embedded, in matrix. Free-standing crystals in vugs or loose from matrix as in pocket crystals will not be particularly described as such when *crystals* are mentioned.

Most mineral names and varieties are arranged alphabetically. Some minerals are listed by group (e.g. biotite, plagioclase) while some minerals are listed by variety (e.g. damourite, titanogite). Synonyms and questionable entries are also alphabetized. Well-documented species names are listed in capital letters. Unverified species names, varietal names, and synonyms are placed in lower case letters in the "headers." An asterisk in front of the mineral name indicates that the species was first found in Maine. For the purposes of this listing, a mineral is taken to be a naturally-occurring material with a definable chemical composition and which possesses, or originally possessed, a regular internal structure. Naturally-occurring suggests that the mineral was formed solely through the action of geological processes and was not aided by unnatural exposure of a mineral to weathering, the addition of man-made chemicals to the environment, or the direct chemical treatment of a mineral, man-made application of heating, pressure, etc. which would otherwise change the *starting* material.

The removal of specimens from a locality does not ordinarily change the mineral present. But, in a few cases, the new habitat of a mineral results in its unnatural exposure producing new substances. For example, pyrite and marcasite can decompose to form a variety of oxides, sulfates, etc. especially when cleaned in various solutions or just stored in high humidity conditions where sulfide-metabolizing bacteria can infest the specimen and accelerate their decomposition. Zeolites, some phosphates, etc. spontaneously lose water by dehydration in drier conditions than those in which they formed. While it is interesting to understand the processes of change, the resulting alteration product will not receive separate attention here. For the purposes of counting Maine species, autunite and meta-autunite I (a dehydration product of autunite), etc. will be counted as one species as there is no certainty that naturally-occurring meta-autunite was originally present.

Originally, a further restriction, "not biologically produced," was attached to the definition of a mineral, but there became too many exceptions to reasonably keep it. For example, fossiliferous carbonate rocks frequently contain beautiful crystals whose constituents were derived from the fossiliferous components of the host rocks. The geological alteration of biological materials is well known and the calcite crystals from Rockland and Thomaston are derived by the metamorphism and recrystallization of fossil remains, although their "biological origin" seems far removed from today's vantage point. Similarly, graph-

ite in many Maine slates, phyllites, etc. is assuredly organic in origin though it no longer resembles the original material.

Today, the only restriction on "biologically derived elements" is that geological processes have resulted in the recombination of the starting material. Fossils completely replaced by calcite, pyrite, etc. are abundant in many parts of the world. Mummified remains of animals and humans have been found at various worldwide localities replaced by a variety of minerals including calcite, vivianite, etc. Stilpnomelane has been found coating molds of brachiopod shells in Somerset County. The restriction formerly placed on a mineral's definition, "not organically derived," was chosen to suggest that quartz crystals in human ears or magnetite in bird's brains are not minerals. The "minerals" of the Skipton Caves of Australia are perhaps distressingly too close to their starting materials. Though the Skipton guano deposits have transformed into crystalline material after their deposition, there has been no intervention of geological processes in the Skipton Cave material except for dehydration and resulting concentration of elements leading to crystallization. Aragonite nodules formed on twigs in standing water in Thomaston marble quarries do not qualify as minerals under this definition. Residual soils such as those in Limerick and Aurora have existed in their current position and have had extensive erosional introduction and removal of components. The difference between the changes in the Skipton deposits and the residual soil deposits seems to be a matter of degree, though the resultant residual soil material is not "organic." Diatomite from Blue Hill or Phillips, however, still consists of the original skeletal material of diatoms and is, therefore, a fossil and not a mineral. (The main requirement seems to be that a fossil's "gross structure" is not preserved in a "mineral," but even that distinction can be trivialized.)

An automobile, buried in a mudslide and allowed to alter to lepidocrocite, goethite, or limonite would still be no different than a chemical spill into the environment. The future dissolution of an automobile into the water table and its transport into a mud flat where sulfide-fixing bacteria live, might generate iron sulfides which could later recrystallize into pyrite. Much of the phosphate pollution in Lake Sebasticook probably left the water column by being precipitated as mitridatite, strengite, etc. which settled as a diffuse layer on the lake bottom. One wonders if the runoff of arsenic-bearing waters, contaminated by old pesticides, from the blueberry barrens in Washington County will result in the formation of scorodite, symplectite, and other compounds in some clam flat? Most of these scenarios will not result in enough material concentrating in one spot to produce visible "minerals." Maine, fortunately, does not possess many marginal-to-the-definition mineral localities.

Mine dumps, excavation walls, road cuts, etc. can be covered with a variety of efflorescences, which are visibly identifiable materials, but are outside of the concern of these listings. Chemical treatment of minerals can produce obvious changes which are of more interest to a corrosion scientist than to a mineralogist. Though they may use the same terms, those altera-

tions will not be listed among Maine's minerals. The copperas alteration of pyrite ore standing in its new contact with the wet atmosphere is inherently no different than the intentional conversion of that same rock to copperas by a local factory.

Locality Names and Abbreviations

Specific locality names are set in italics after the bold generic names. The usual order will be town (generic) followed by locality (specific). Some geological names will be used in a generic sense with town names as the more specific entry. References which have maps in them will usually be cited to indicate where more information can be obtained. The product of the mine is usually omitted. Instead of Consolidated Feldspar quarry, Heal Granite quarry, or Sullivan Silver mine, etc., the corresponding entries would read: *Consolidated Q, Heal Q, Sullivan M*. Abbreviations are used for quarry **Q**, mine **M**, prospect **P**, locality **L**, and area **A**.

Example: **Newry** - *Bell Pit, Crooker Q, Dunton Q, Nevel Q, Perham P, Rose Quartz Crystal L, Scotty Q*

The abbreviations chosen are natural ones, and although they require getting used to, they save an extraordinary amount of space. Commas are found only within the specific locality entries while semicolons are used to separate town and geological formation names. The resulting text is condensed, particularly for well represented species, but careful reading will show that the listings are unambiguous.

A few localities are unspecified as not enough information is available and the locality might actually represent a duplicate entry for a synonymous place name unrecognized by us. A locality (**L**) is distinguished from an area (**A**), by being a specific, "known" spot to obtain a mineral, while an area implies greater informality and wider distribution of the mineral of interest. Area is also used to signify a collecting site which is known by few people and is, therefore, not generally pinpointed. Geologic names are included whenever appropriate and will serve to signify occurrences that are not restricted to excavations, but to general bedrock formations. The reports of some species refer to glacially transported rocks or sand particles. Some reports of metamorphic indicator minerals, in particular, outside of their bedrock occurrences, are common and should not be construed, *a priori*, as anomalous. Many geologic maps do not show town boundaries and the particular towns have been inferred for the purpose of listings here. Interpolation errors can occur especially where contacts, sample locations, etc. are near town boundaries. The original reports should always be consulted to assure certainty.

Inconsistency has been a problem to overcome. Many collectors refer to the Dunton mine and an equally large number of collectors refer to the Dunton quarry. While it should be insignificant whether the locality is a quarry or a mine, it would

be difficult to evaluate each locality as to its mining methods and its mineral product in order to satisfy one of the many working definitions available as to which term would be appropriate. For the sake of simplicity, in this section, open pits are called quarries if more than half of their workings are above ground. Mines are restricted to those workings which are similarly more than half underground. There is basically little difference between a vertical mine shaft and a deep quarry with a small surface exposure. Ambiguous sites are called quarries if they are pegmatites and mines if they were metal ore producers. Caldwell and Austin, (1957) map both the Given Quarry and the Given Mine in Topsham: both are small open pits in pegmatite. Morrill et al. (1958) relieves the problem by calling them Given #1 quarry and Given #2 quarry. Sites with consistent designations, such as pit, etc., are kept with the familiar name. There is inherently no difference in the words quarry, prospect, or locality and the major difference seems to be the degree of industrial interest and production. The oldest mine or quarry name has been chosen for almost every report. Sometimes a new name has superseded an old name such as the Keith quarry for Towne quarry. Some new names never "caught on" such as Yankee Skipper quarry for Berry-Havey quarry or Plumbago quarry for Dunton quarry. Some places which have no known formal name are given geographical names such as East Standpipe Hill quarry, Lower Tryon Mountain quarry, and Upper Colton Hill prospect. Many localities have multiple, closely spaced, openings such as Mount Mica quarry, Paris; Black Mountain quarry and Red Hill quarry, Rumford; Mount Rubellite quarry, Hebron; etc. It has not always been possible to attribute the occurrence of particular minerals at such actively mined localities and most specimens can only be ascribed to the group of openings. The inability to pinpoint some occurrences is usually inconsequential as the pits in question frequently intersect different portions of the same rock unit.

A significant number of the entries represent locality names which are unknown to the authors and, probably, to virtually every active field collector in Maine. For the most part, the names used here are from the literature, but part of the entries come from specimen labels. It is not currently possible to visit many of these sites, because no one knows where they are. Collectors are asked to follow standard labeling procedures when they collect at **unnamed** sites. Locality data should be referred to nearby **geographic** features: East Standpipe Hill quarry, Southern Whittemore Hill prospect, Morse Brook locality, etc. Arbitrary or "spur of the moment" names should not be invented. It serves no purpose to call a quarry by the name Mosquito Ledge Locality just because there were a lot of mosquitoes at the site. Virtually every site in the State could be given that name! Similarly one should not give names based on one's personal experience such as: Hot mine, Beryl quarry, Paperbag prospect; Late Afternoon quarry, Bobs quarry, etc. [Note: apostrophes are generally eliminated from locality names.] A number of bizarre, if not creative, names which have been seen on labels have been translated into their proper equivalents, when known. Geographical names serve both the collector's memory and posterity. Renaming a

locality has been generally rare in Maine and most collectors are thankful for that. The Dunton quarry at Newry has been called: Newry mine, Abbott quarry, Nevel quarry, Neville quarry, West Paris Company quarry, Halls Ridge quarry, Pollucite quarry, Tourmaline quarry, Plumbago quarry, etc. It should be obvious that the proliferation of names is undesirable and only serves to confuse people who are trying to locate a particular locality.

A ? is used whenever the identification and/or reported occurrence seem to be in error. Question marks are not placed after locations which are cited in the literature by town name only. Towns without specific entries beg the question: "Where in the town is there a locality of the mineral *worth* reporting?" The authors, in many cases, were not able to supply the answer.

The # always refers to a specimen number of the collection indicated. The collection name will be associated with the number by the use of an abbreviation: AMNH (American Museum of Natural History); BC (Bowdoin College); BM (Bryn Mawr College); BMS (Museum of Science, Boston); CC (Colby College); HH (Herbert Haven Collection); HU (Harvard University); NMNH (National Museum of Natural History, Smithsonian Institution); NMC (Canadian Museums of Nature, Ottawa); NE (Northeastern University); UMO (University of Maine, Orono); PM (Philip Morrill collection, Colby College); YU (Yale University). Some museum specimens will be referred to without catalog number, but with only the institutional initials. References to specimens in private collections have been few partly to preserve the privacy and security of the owner and partly due to the general inaccessibility of such specimens.

A mineral report which does not include its specific location is suspicious in addition to lacking verifiability. There are few unnamed spots in Maine. When a specific locality within a town is questioned, the identification of the mineral or locality is doubted. For a fictitious example,

Mineral A - Hannibals Crossing - Brobdingnagian Q,
Musculus P?, *Scipio A?*

indicates that the identification of mineral A from the *Musculus* prospect as well as the *Scipio* area is probably in error though it is mentioned in the literature or though some specimens with that label are known, or the species claimed on the label has been shown to be incorrect. While the question mark is used to question a variety of things, the fundamental reason for its use is concern. The inclusion of questionable material for completeness is better than the exclusion of information which may prove correct. Individuals with verified specimens are invited to contact the authors so that questionable entries can be validated. The removal of a ? after an entry must depend on the discovery of a verified specimen, rather than relying on folklore, old memories, or the reasonableness that a particular mineral "should be there." The listings are alphabetical by town as most of Maine is "settled." County names uncommonly appear on Maine mineral labels, though Oxford County has been the largest specimen producer. Many of the unspecified reports listed by Morrill et al.

(1958) and Morrill and Hinckley (1959) are from old literature citations. They put the entry in their "General" category for each town as specific sites were not indicated in the original source. Such lack of detail has to be questioned even for the most common and easy to identify species, because one can never ultimately know what locality was intended. As much as possible, however, the localities listed in both volumes of *Maine Mines and Minerals* are included here. Many people wishing to know the origin of the "general" listings for each town in *Maine Mines and Minerals* are directed to checklists by Burr (various dates), Hanley (1936), Perkins (1922a,b,c; 1924a,b), Schrader et al. (1917), E. Dana (1892), W. Smith (1882), True (1869), J. Dana and Brush (1868), Hitchcock (1862b), Houghton (1861), J. Dana (1850, 1854a), Jackson (1837a, 1838a, 1839), S. Robinson (1825), and Cleaveland (1816, 1822). Anecdotal accounts frequently were quoted by Morrill and Hinckley, but not cited, from the *Maine Mining Journal*.

Many of the species and localities reported here have never been reported in Maine previously and represent the direct findings of the authors as well as extensive co-operation of the many field collectors listed in the acknowledgements.

Warning: Do not assume a specimen that you own is from a particular mine unless you were provided with that information. Just because a town has only one listed occurrence, it does not necessarily mean that an incompletely labeled specimen is from that locality. Collectors and museum curators are advised that the quarry or mine name is probably more important to record than a town's name. General names such as *Mount Apatite*, *Standpipe Hill*, etc. should be avoided if the individual quarry name is known. If a specimen comes from a mine with the same name as the town, it should not be left off the label: Blue Hill mine, Blue Hill, Maine; Marshfield quarry, Marshfield, Maine; etc. If a specimen is from Standpipe Hill, but not from the Standpipe Hill quarry, it should be labeled with the appropriate locality name. If specimens are not labeled with their proper locality names, the uncertainty concerning Maine mineral localities will only increase.

The town name information listed here attempts to conform to *The Length and Breadth of Maine* by Attwood (1974) and *The Maine Atlas and Gazetteer* by the DeLorme Mapping Company (1988). A review of these works will reveal that even unorganized townships have names or alphanumeric designations. The smaller towns and unorganized townships in Maine are frequently named according to local topographic features such as Jim Pond, Alder Stream, and Little Squaw. Old references may be confusing. For example, Rumford Falls could signify the Great Falls of the Androscoggin River or indicate the village area around them. When geographical features similar to names of municipal areas are referred to in older reports, care should be exercised in labeling specimens or searching for localities with these designations. A mineral locality on Blue Hill (the hill) might be confused with one reported from Blue Hill (the town).

While the *Guinness Book of World Records* in various of its editions has suggested that there are few towns with names so short as one letter, three townships in Maine have single letter names: C, D, and E and some only have number designations such as Township 21. (When township surveying was complete, in the C, D, and E Townships area (abbreviated TC, TD, and TE respectively), a gore was found that was subsequently named C Surplus. The same status is true for Andover North Surplus, Andover West Surplus, Misery Gore, etc.) Many unorganized townships have township and range designations such as T3R5. However, Attwood (1974) explains: "To say that a township is T1 R2 or, as frequently written, 1R2, would not serve to fix its location. It might be any one of nine different townships, as follows: 1R2 TS (Dyer), 1R2 WELS (Bancroft), 1R2 NWP (Hermon), 1R2 NPC WKR (Embden), 1R2 NPC EKR (Solon), 1R2 BKP WKR (Pleasant Ridge), 1R2 BKP EKR (Moscow), 1R2 WBKP (Redington), 1R2 NBKP (Tomhegan)." A number of names are used more than once for towns in Maine. There are two towns named Bald Mountain in Somerset County, for example. Attwood (1974) provided additional examples. The capital letters which follow the township and range name signify a designation arising from various bureaucratic necessities.

The abbreviations used are as follows:

AP - Abbotts Purchase
BKP - Bingham's Kennebec Purchase
BPP - Bingham's Penobscot Purchase
ED - East Division
EKR - East of the Kennebec River
EPR - East of the Penobscot River
EUR - East of the Union River
IP - Indian Purchase
LS - Livermore Survey
MD - Middle Division
NBKP - North of Bingham's Kennebec Purchase
NBPP - North of Bingham's Penobscot Purchase
ND - North Division
NPC - North of the Plymouth Claim
NWP - North of the Waldo Patent
OIP - Old Indian Purchase
PS - Putnam Survey
SD - South Division
TS - Titcomb Survey
WELS - West of the Easterly Line of the State
WBKP - West of Bingham's Kennebec Purchase
WKR - West of the Kennebec River

Attwood (1974) complained of lack of consistency when referring to towns. At this writing, the boundary signpost of D is marked "Township D" at the northern boundary of the town on Route #17 and labeled "Letter D" at its southern boundary.

The locality listings will be arranged alphabetically by town and named unorganized township, plantation, etc. followed by numerical designations for unorganized townships. The prefix

T for township will not be alphabetized. Numerical township names will be arranged after alphabetical listings.

The descriptive listings which follow are admittedly incomplete. There are undoubtedly many omissions which, if included here, would provide a much different picture of a species or give a different reputation to the production of particular localities. It is to be regretted that "secret" localities still exist when the particular finder has no further interest in collecting there. The authors recognize that secrecy is sometimes necessary, but there are a few Maine collectors who are so secretive that the only way they could be more extreme would be to deny altogether that they collected minerals. The authors have cooperated with two field collectors who were finding exceptional specimens when this text was being written and have allowed several non-traditional references. (The "Wicked-Good Beryl Locality" is one such reference, but the collector has indicated that the traditional name for the locality will be revealed to all by the end of the next field season.) The information here is offered in the spirit of openness that natural history should be about. One Maine collegiate mineral collection has an insignificant triphylite specimen obviously from the Red Hill Central Pegmatite #1 quarry, Rumford which is simply labeled "from a secret locality!" (Note: "Red Hill quarry" is a general term which can indicate any of the five closely spaced openings, as most specimen labels fail to indicate the actual pit where the discovery was made.)

Crystal Drawings

Crystal drawings are frequently entertaining as well as diagnostic and add to knowledge of a specimen, often showing nuances that would be difficult to illustrate otherwise, or in lieu of suitable specimens. Two classes of crystal drawings are included as illustrations in this volume. First, there are historical drawings from the literature. The reader is cautioned that these drawings frequently display crystals in non-standard orientations, at least by modern standards. Additionally, the Miller indices indicated may be incorrect as the original data were based on axial ratios rather than unit cell dimensions. Drawings taken directly from the literature are designated "from" a particular publication. Some drawings have been prepared from data in the literature and those illustrations are so captioned. Numerous additional original drawings constitute a second category. These original drawings were "drawn from life" and are designed to illustrate the habit of the mineral from the locality indicated. Note that some localities have a variety of crystal habits, and though a specific locality is noted, other localities might also possess crystals of the same shape. The symbols used for original crystal drawings are entirely of decorative value and do not necessarily imply particular Miller indices, although the more common symbols used for pinacoids and pedions, common prisms, and common pyramids are generally adhered to. The computer program used to generate the new drawings was *Shape 2.0* by Eric

Dougherty as modified for the Macintosh computer by Peter Richards.

Nomenclature, Citation Choice, and Style

Nomenclature has been carefully reviewed to conform with current usage. Changes in modern nomenclature that supersede historically "correct" usage, which have been approved by the Committee on New Minerals and New Mineral Names and other committees of the International Mineralogical Association, have been incorporated into the systematic listing. For example, the changes in amphibole nomenclature reported by Leake (1978) reflect new standards which replaced historically "correct" usage, in order to introduce consistency in that aspect of systematic study. Nomenclature considered to be "unapproved" or in "abusive" usage has been avoided, and numerous nomenclature problems have been extensively reviewed. Some names not directly addressed in modern works are discussed. The primary source of nomenclature information has been the *Mineral Reference Manual* by Nickel and Nichols (1991). Additional sources include Deer et al. (1966), original research articles, etc. The abbreviation q.v. (quod vide = which see) has been placed throughout the manuscript to direct the reader's attention to another section which could provide additional understanding of a particular mineral. Note that q.v. always follows the particular name of interest.

Hyphenated mineral names have been dehyphenated by some authors. Hyphens were kept, by Nickel and Nichols (1991), when confusing or hard to read constructions arose, as per the guidelines of Nickel and Mandarino (1987). Autunite and meta-autunite are names attached to Maine specimens. The repetition of a's in the name meta-autunite is best separated by a hyphen. In order to facilitate reading mineral pair names with hyphens, they are here separated by the virgule / to indicate a coupled relationship and to avoid names such as autunite - meta - autunite, hydroxyl - herderite - herderite, etc.: e.g. autunite/meta-autunite and hydroxyl-herderite/herderite.

The references regarding each mineral are usually the earliest or original sources except where later sources provide significant additional information. Secondary sources have been used when the primary source was not available, was too expensive to procure, or too inconvenient to consult. In many cases, theses and dissertations were original sources, but they were not read. More easily acquired secondary summaries were read in their place. A significant number of minerals new to the state of Maine, or new to a specific locality in Maine, are listed here without a supporting reference. Many of these finds have been first recorded by us and many have been found by the enthusiastic cadre of Maine mineral collectors who have pointed them out to us. Some of the recorded specimens have appeared on the commercial market. The individuals responsible for calling attention to new finds and/or who have provided valuable assistance in the search for specimens and information are acknowledged at the

beginning of this volume. The authors regret not having acknowledged collectors who anonymously provided specimens to the commercial market, where specimens were observed. Collectors are advised that anonymity can be avoided by writing formal articles concerning mineral finds.

The several bibliographies available have been helpful. *Bibliography of Maine Geology 1672-1972* by Hussey (1974) has been very useful. Additional bibliographies contain significant information, almost seemingly on a proprietary basis, as many entries have not been cross-listed. *Geologic Literature of North America 1785-1918* by Nickles (1923), *Catalogue and Index of Contributions to North American Geology 1732-1891* by Darton (1896), *Gemstones of North America, volume II* by Sinkankas (1976), and *Publications of the Geological Survey*, in its various editions, have all helped in locating information. Indexes of mineralogical journals, shorter bibliographies and citation lists in various books and articles, etc. have also been helpful. By far, the majority of references cited herein were "discovered" due to the selective coverage of all bibliographies. Many works in the aforementioned index sources were not read in anticipation that the entry would offer so little that the effort would have been fruitless.

Quotations are *verbatim*. No editing to correct nomenclature, grammar, spelling, punctuation, etc. can be made on quotations. Annotations for clarity are sparingly made and are placed in square brackets []. Archaic spellings are **not** usually pointed out by the Latin *sic*, except to assure the reader that the quotation is *as written*. (Direct quotations are not only *verbatim*, but also strive to preserve font changes, spacing peculiarities, bracket style, hyphen and dash counts, superscript and subscript usage, etc. whenever practicable.)

The two guidebooks, *Maine Mines and Minerals* by Philip Morrill and William Hinckley were researched by those authors to the point where a mineralogy for Maine could have been written at that time. Collectors will be eternally grateful, however, for the guidebooks which they wrote. A descriptive mineralogy could be written at any time, but locality information is difficult to acquire and verify. Morrill and his co-authors have been vilified where their directions led one astray, but little praise has come for the majority of the times they were right. Additionally, real descriptive information appears in their works. Their final result is still a monument of love for their hobby! Morrill et al. (1958) and Morrill and Hinckley (1959) provided much of the locality information contained herein, at least when the authors were novices, for collector-specimen occurrences. When the reports in the Morrill/Hinckley guidebooks appear unsubstantiated, question marks (?) and criticisms are attached by us to the guidebooks' citations. This method of citation is unavoidable and should not be taken to condemn their work by pointing out only errors or questions and taking advantage of the correct information that they presented. When no citation is given, the information for a locality has been generated or selected by us, even in cases where the mineral in question has been known to the general collecting public. Much new information is included

in this volume, but every effort has been made to acknowledge earlier valuable information. The extensive use of citations is intended to provide mineral historians and researchers with a guide to the labyrinthine literature and to avoid "mystery" paraphrasing of worthwhile literature. While some mineralogical folklore is included here with personal communications as the

citations, whenever this information has been generally reported to us by several sources, no citation is used.

Even to the deadline for submission of this manuscript, new citations and new species for Maine were being discovered. The absence of deadlines, however, dooms a work from ever appearing. New data will have to wait for a future edition.

Descriptive Mineralogy of Maine

A

acanthite?

Acton? - Boston-Acton M; **Appleton?** - Appleton Mining and Smelting M; **Crawford?**; **Deer Isle?** - Deer Isle M; **Franklin?** - Franklin M; **Gouldsboro?** - Gouldsboro M; **Hampden?** - Hampden M; **Hancock?** - Cline M, Pomeroy Farm M; **Hersey?**; **Lubec?** - Lubec Lead M; **Milbridge?** - Cherryfield M; **Newfield?** - Bergendahl M; **Rockport?** - Riverside M; **Sedgwick?** - Edgemoggin (sic) M; **Sullivan?** - Sullivan M, Waukeag M; **West Paris?** - Ben Davis M; **T5R5 WBKP?**

The acanthite of Maine has not been identified with any precision. No samples are preserved in major mineral collections to substantiate the discoveries. Reports of "free-milling" silver, black silver sulphurets, etc. have been made, but it is not certain how carefully these reports were made or if they were merely intended as a report for consumption by stock investors and speculators. Black copper sulfides and sulfosalts could have been the original material as well as genuine "argentite", etc., but there are essentially no black copper sulfides, etc. with which to be confused in Maine. Bartlett (1879-1880) and Kempton (1879) appear to be the only observers to announce the species. As Bartlett and Kempton were active in silver mine promotions, their reports may not be unbiased though they appear to be relatively qualified observers. Kempton (1879) did not describe any of the individual minerals of the ore, but reported:

"The ore is essentially silver, sulphides and native, in quartz and slaty gangues, with slight amounts of iron, zinc, etc., as sulphides, and also galena.

Of the silver minerals, stromeyerite is most plentiful, stephanite next, argentite (silver glance) common, native silver in flakes very plenty, threads frequent, lumps occasional.

Ruby silver is exceedingly rare; antimonial silver has been found. The occasional yellow copper sulphide met with has a peculiar lustre and runs very rich in silver."

The above description of the ore is almost fantastic. Stromeyerite is still known in very few localities in the world and nowhere is it an important constituent of the ore, or at least as suggested by Kempton (1879). It is possible that a single hand specimen had the characteristics described, but the entire lack of any description, especially given the primitive conditions that must have existed in a Maine assayer's office at such an early date, present the possibility that the minerals were either misidentified or were misrepresented. The methods of identification, data observed, or names of the actual analysts are not recorded. No specimens are known of "argentite" from the Sullivan mine, or any Maine "argentite." Harvey (1888) listed an argentite specimen from Sullivan in the University of Maine collection, but the specimen is now missing. The above localities are listed by Morrill et al. (1958) and Morrill and Hinckley (1959), but most of the entries are translations of black silver sulphurets (= "argentite"). Many references to black silver sulphurets can be found in the *Maine Mining Journal* from 1880 to 1882.

Li (1942) made a major mineragraphic study of the sulfide mines of Hancock and Washington Counties. He reported a number of species not observed by earlier writers, but no silver minerals were reported. Specifically, Li (1942) said of the Sullivan Mine, Sullivan: "None of the specimens examined by the writer yielded any silver-bearing minerals." Emmons (1910) observed no silver minerals in Maine. Young (1962, 1963) did not report any silver minerals observed during his Hancock and Washington County studies. To this writing, no Maine acanthite or argentite is verified.

Most of the other early reports do not mention a species name, but it is clear that argentite is the usage intended. The above reported occurrences are generally cited for the first time in the *Maine Mining Journal*. Due to the instability of argentite at surface conditions, all of the argentite specimens from anywhere on the surface of the Earth are actually the species acanthite. Argentite spontaneously converts to acanthite at low temperatures. In the absence of specimens, it can be said that the

Abbreviations used in this report: A = area L = locality M = mine P = prospect Q = quarry

* Mineral first found in Maine.

acanthite could have occurred as relatively small masses (up to 1-2 cm?) enclosed in quartz and may or may not have been intergrown with galena and other sulfides. Acanthite from other world locations is a dull, wrought-iron black, metallic mineral.

Morrill et al. (1958) reported argentite in **Parmachenee** (T5R5 WBKP) from a "Stream 3 days trip above Parmachenee Lake," but one wonders what privations would keep a so determined traveler within the United States of America, much less within the township, during such a long trip. No specimens known.

References and quotations concerning "black silver sulphurets" from **Sullivan** are found in entries for chlorargyrite, proustite, silver, stephanite, and stromeyerite. No specimens known.

Of **West Paris** (MMJ, May 20, 1881) it was reported: "Immediate operations are to be commenced on what is known as the Ben Davis mine, the Sim Curtis or Fickett mine near West Paris, and a mine in Si Gotch [sic]. ... The Ben Davis mine.[sic] at the depth of twelve feet, has come upon a sulphuret of silver, assaying \$500 to the ton." No specimens known.

achroite = colorless tourmaline, usually elbaite (q.v.)

acmite - see aegirine

ACTINOLITE (Amphibole Group)



Berwick - *Berwick Formation*; **Bethel**; **Blue Hill** - *Douglass M, Stewart M*; **Boothbay** - *Ocean Point A*; **Brunswick**; **Codyville** - *unnamed mafic volcanic rocks*; **Deer Isle** - *Deer Isle M, Little Deer Isle A*; **Freeport**; **Hermon** - *Hermon Granite Q*; **Jay**; **Lewiston** - *City Q*; **Minot** - *Pitts-Tenney Q*; **Monhegan** - *olivine norite*; **Monmouth**; **Newry** - *Nevel Q, Dunton Q, Meadow Brook gabbro*; **North Haven**; **Oxford** - *Oxford Granite Q*; **Portland**; **Pownal**; **Raymond**; **Rockland**; **Rumford**; **Sanford** - *200 m L*; **Unity**; *unnamed limestone conglomerate* - **Bancroft**, **Weston**; **Winthrop** - *Horseshoe Island A*; **York** - *Berwick Formation*

Actinolite is defined as an amphibole (q.v.) species intermediate in composition between tremolite and ferro-actinolite when iron and magnesium ratios are considered, and between that series and magnesio-hornblende and ferro-hornblende when aluminum and silicon are considered (Leake, 1978). While actinolite is reported from a wide variety of mafic schists, its usage has generally designated any fibrous green amphibole, rather than truly suggestive of a particular chemical series. The few localities listed do not usually have substantiating chemical data and are representative localities of the usage for visible fibrous green amphibole. Many "actinolites" are likely members of the magnesio-hornblende series (Arthur Hussey, personal communication, 1992).

The **Berwick Formation**, **Berwick**, etc. has several members of which Hussey (1962) has specified: "(1) Fine-grained mottled green and purplish gray quartzite with abundant dark green actinolite porphyroblasts; (2) dense, conchoidal fracturing greenish gray quartzite with abundant actinolite; (3) mottled light green and purplish gray quartzofeldspathic actinolite-biotite granulite with a slight tendency toward gneissic structure, and containing abundant thin actinolite-feldspar veins ..."

Ludman (1990b) reported actinolite from an unnamed mafic volcanic rock in **Codyville** that was mapped from southern Little Tomah Lake to Barter Brook and in an unnamed limestone conglomerate exposed in **Bancroft** and **Weston**.

Fine, collector-grade specimens of actinolite are unknown in Maine. The best examples consist of nearly radial aggregates lining fracture veins (to 1 cm thick) at the traprock / serpentine quarry on Little Deer Isle, **Deer Isle**.

Actinolite is generally a component of mafic schists. The pegmatites of the Nevel and Dunton quarries, **Newry** are emplaced in a metagabbro and locally the exo-contact action of the pegmatites has produced an actinolite-clinocllore-dravite schist. The green actinolite needles show some radial arrangement and are tightly intergrown. The individual actinolite fibers reach several centimeters in length. Henry and Dutrow (1990) reported that the actinolite "from the Newry mines" grades into magnesio-hornblende with values - $\text{Mg}/(\text{Mg} + \text{Fe}) = 0.77$ to 0.87 and $^{IV}\text{Al} = 0.238$ to 0.909 .

Milton (1961) wrote of an altered gabbro outcrop in Meadow Brook, **Newry**: "The actinolite crystals are up to 2 cm across, but are all anhedral, in contrast to the fine prisms well known from the alteration zone on the other side of the gabbro body on Newry Hill [= Halls Ridge]."

Lord (1900) mapped and described in detail the rocks on Monhegan Island, **Monhegan**. He described an olivine norite which composed most of the island and described the alteration of olivine (forsterite)(q.v.) which included the development of actinolite.

The "200 meter prospect" associated with the Webster prospect on the Goodall farm area, **Sanford** has produced dark green acicular to slightly bladed actinolite crystals (to 2 x 0.2 cm) embedded in calcite associated with diopside crystals (to 3 mm), white meionite crystals (to 1.5 x 0.4 cm), and massive quartz.

adularia (Feldspar Group) - see also microcline and orthoclase

Brunswick?; **C Surplus** - *Upton - Andover road*; **Farmington** - *U.S. Route #2 road cut*; **Livermore** - *Route #4 road cut*; **Parsons-field?** - *Dr. Swett's fields*; **Sanford** - *Webster P*; **Thomaston** - *Dragon Cement Q*; **Woolwich** - *U.S. Route #1 road cut*

Adularia is a particular blocky form of microcline or orthoclase (Smith, 1974) comprised of equant crystals with rhombic faces. Adularia has been reported from calc-silicate occurrences,

but virtually all of these specimens are plagioclase and are, therefore, not adularia.

Typical tan adularia crystals (to 2 mm) have been found on a rock fracture surface in a road cut in the Upton/Andover road, **C Surplus**. In some aspects, adularia resembles the pericline variety of albite, but the adularia crystals are blocky to elongated, while pericline tends to have a platy rhombic habit.

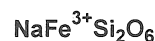
Small clear adularia crystals (to 1 mm) are found on a fracture surface from a Route #4 road cut, **Livermore**.

Jackson (1838a) noted finding adularia "in the fields near Dr. Swett's house," **Parsonsfield** along with "egeran, and beautiful crystals of yellow garnet, pargasite, ... and scapolite." No specimens known.

Clear crystals (to 2 mm) of typical adularia have been found lining fracture surfaces in dolomite along with pale purple, color-zoned, octahedral fluorite crystals (to 2 mm) at the Dragon Cement quarry, **Thomaston**.

aegirinaugite, aegyrine-augite = variant spellings of aegirine-augite (note essential hyphen)

AEGIRINE (Pyroxene Group)



Cashes Ledge - in the Gulf of Maine (42° 54' N, 68° 56' W); *Mount Agamenticus alkaline syenite* - **South Berwick, York; Phippsburg?**; **York** - *paisanite dike, tinguaita dike*

Aegirine is an alkali pyroxene which is generally found in needle shaped dark green crystals frozen in rock.

Cashes Ledge (42° 54' N, 68° 56' W) has aegirine found in a single grab sample from this submarine outcrop. Toulmin (1957) reported on a thin section: "Aegirite, or aegirite-rich pyroxene, forms 0.1 mm. irregular grains associated with hornblende, riebeckite, and aenigmatite(?)."

Acmite (aegirine) was listed by Morrill et al. (1958) from an unspecified location in **Phippsburg**, but no specimens are known.

Hussey (1962) listed aegirine without description from the alkaline syenite of the Agamenticus Complex, **South Berwick** and **York**. Associated minerals noted include arfvedsonite, riebeckite, aegirine-augite, fayalite, titanite, biotite, perthitic microcline and antiperthitic plagioclase. Wandke (1922a) had called the rock alkaline granite and the mineral: "aegirite and aegirite-augite are the usual pyroxenes." Woodard (1957) included aenigmatite among the alkaline syenite associations.

Wandke (1922a) wrote concerning a paisanite dike, **York**: "A single example of this type of dike was found near the crest of a hill just north of 'Scotland,' York, Maine. The minerals present are quartz, albite, microcline, microperthite, aegirite, riebeckite, arfvedsonite, zoisite, and an undetermined titaniferous mineral, brown in color and platy in habit." Concerning a tinguaita dike Wandke wrote, "The aegirite needles which domi-

nate the groundmass give the rock its characteristic color [deep blue to a light gray]."

AEGIRINE-AUGITE (Pyroxene Group)



Casco Bay? - **Cape Elizabeth, Freeport, Harpswell, Portland, South Portland; Litchfield** - *Dennis Hill A; Mount Agamenticus alkaline syenite* - **South Berwick, York; Newfield** - *Symmes Pond stock; Parsonsfield* - *Randall Mountain stock; Shapleigh-Abbott Mountain stock; Tunk Lake pluton* - **Cherryfield, Franklin, Gouldsboro, Sullivan, T7SD, T10SD; York** - *riebeckite granite*

Aegirine-augite was formerly regarded as a varietal name for a pyroxene (q.v.) intermediate between aegirine and diopside/hedenbergite in composition. Morimoto (1989) reported that aegirine-augite is re-accepted as a species and the defined chemical range varies from $\text{Ae}_{80}\text{Di}_{20}$ to $\text{Ae}_{20}\text{Di}_{80}$.

Aegirine-augite was noted, without description, by Barker (1965) from the Dennis Hill area, **Litchfield**, while the same mineral was reported by Gilman (1978) from the Abbott Mountain stock (syenite) east of North Shapleigh, **Shapleigh**, the Symmes Pond stock (syenite), **Newfield**, and the Randall Mountain stock (syenite), **Parsonsfield**.

Lord (1898) wrote of olivine diabase porphyry dikes in the Casco Bay area, **Cape Elizabeth, Freeport, Harpswell, Portland, and South Portland**: "These [augite] crystals are rarely homogeneous; they have usually the well-known hour-glass structure in which the lighter colored inner part of the crystal, with the optical properties of diopside, is surrounded by a purplish rim of titaniferous augite resembling optically the aegyrine-augite of Rosenbusch."

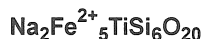
Karner (1974) said of the hornblende aegirine-augite granite exposed on the margins of the Tunk Lake pluton, **Cherryfield, Franklin, Gouldsboro, Sullivan, T7SD and T10SD**: "Calcic hornblende, probably containing significant sodium and ferric iron, occurs as subhedral to euhedral grains from 2 to 3 mm long with cores of aegirine augite. Perthite occurs as subhedral grains from 1 to 2 cm long, and quartz, as anhedral grains from 1/4 to 1/2 cm in diameter. Riebeckite and a reddish-colored biotite (probably astrophyllite) are common in small amounts."

Haff (1939) noted of a riebeckite granite in **York**: "The primary minerals in the granite are microcline, soda microcline, cryptoperthite, albite, oligoclase, orthoclase, quartz, riebeckite, and aegirinaugite. Accessory magnetite, zircon, apatite, sphene, rutile, and cassiterite occur together with an unusual amount of fluorite. ... Riebeckite is the most abundant ferromagnesian constituent in what is here considered the normal rock, and it is always associated with some aegirinaugite, with which it is often intergrown. In some places the riebeckite replaces the aegirinaugite along the (110) cleavages. ... Elongate crystals of riebeckite are interspersed with smaller anhedral grains of riebeckite and aegirinaugite. The latter is almost always subordinate to the

riebeckite." Woodard (1957) noted of the Mount Agamenticus alkaline syenite that aegirine-augite is associated with antiperthite, K-feldspar, aegirine, arfvedsonite, riebeckite, fayalite, quartz, biotite, magnetite, [fluor]apatite, fluorite, and aenigmatite.

aegirite = aegirine

AENIGMATITE



Cashes Ledge in the Gulf of Maine (42° 54' N, 68° 56' W); **Agamenticus Complex - South Berwick, Wells, York**

Toulmin (1957) tentatively identified a mineral from a thin section of a grab sample from the submarine **Cashes Ledge** (42° 54' N, 68° 56' W): "A strongly absorbing, pleochroic mineral, referred to in this note as *aenigmatite*(?), occurs as a few remnants of euhedral crystals one to five mm. long; the mineral is highly fractured, and much of it was lost in preparation of the thin section. The color varies from dark chestnut brown (X') through dark red-brown to black (Z'). The mineral is very similar to that which Washington (1898, pp. 792-793) described as allanite from Gloucester, Massachusetts, but the pleochroism and extinction angle of the material in the Cashes Ledge specimen are more nearly those of aenigmatite. Unfortunately, sufficient pure material for x-ray determination has not been obtained. Small red-brown granules, probably of the same mineral, are associated with the clusters of riebeckite needles."

Wandke's (1922a) Mount Agamenticus "undetermined titaniferous mineral" could have been aenigmatite. Woodard (1957) noted without description, of the Agamenticus alkaline syenite, **South Berwick and York**: "The primary rock is composed of micro- to cryptoantiperthitic 'orthoclase-microcline,' ... Aegirite, aegirinaugite, arfvedsonite, riebeckite, fayalite, and quartz, with accessory minerals of biotite, magnetite, [fluor]apatite, fluorite, and, occasionally, enigmatite." Woodard (1957) also noted aenigmatite from the alkaline granite. (See discussion of Agamenticus Complex riebeckite.)

agalmatolite (see talc)

Rockland

ALBITE (Feldspar Group) - see plagioclase series

ALLANITE-(Ce) (Epidote Group)



Auburn; Biddeford - unspecified granite; **Brunswick** - Bagley Ledge Q, Road Metal Q; **Buckfield**; **Calais quadrangle** - Baring granite, Charlotte granite, gabbro-granite intrusive complex,

Meddybemps granite; Denmark - Pleasant Mountain A; **Harrington** - unspecified granite; **Hebron**; **Hog Island Granodiorite** - **Attean, Jackman**; **Litchfield** - Dennis Hill A; **Lovell?** - Orman McAllister P; **Mooselookmeguntic pluton** - Adamstown, Andover, Andover North Surplus, Byron, TC, TD, Lincoln Plantation, Magalloway, Rangeley Plantation, Richardson, Roxbury; **Newry** - Plumbago Mountain pluton; **Norway**; **Paris**; **Phillips batholith** - Avon, Carthage, Dixfield, Mexico, Phillips, Weld, T6 North of Weld; **Rumford pluton** - Rumford, Rutland?; **Somerville**; **Songo pluton** - Albany, Bethel, Greenwood, Mason, Woodstock; **Stoneham**; **Topsham** - Russell Brothers Q, Spragues Q, Standpipe Hill Q, Swamp #1 Q, Yedlin location; **Umbagog pluton** - TC, C Surplus, Magalloway, Upton; **Vinalhaven** - "Fox Island", Hurricane Island Q; **Wayne** - unspecified granite; **Webhannet pluton** - South Berwick, Wells; **West Gardiner** - Pond Road L; **Whitney Cove pluton** - T5ND BPP, T5R1 NBPP, T6ND BPP, T6R1 NBPP; **York** - Agamenticus Complex; **T30MD BPP** - Saint Regis Road A

Allanite is frequently an accessory mineral in granites. The black to brownish-black crystals are usually very elongated. Dimensions of 5x1 mm are not unknown for the species in pegmatites in Maine. The mineral is one of the species which can contain significant quantities of rare-earth elements. There are innumerable reports of allanite as an accessory in Maine rocks without description or supporting identification data and these specimens are ordinarily microscopic. The above formula, based on crystal structure analysis, is that used by Deer et al. (1966). Allanite has essential ferrous iron and the valence difference is coupled with trivalent rare earth element (REE) substitution $\{\text{Ca}^+\text{Fe}^{3+} \leftrightarrow \text{REE}^+\text{Fe}^{2+}\}$ and the series varies from allanite $(\text{REE}, \text{Ca})_2(\text{Fe}^{2+}, \text{Fe}^{3+})\text{Al}_2[\text{Si}_2\text{O}_7][\text{SiO}_4](\text{OH})(\text{O})$ to rare earth element-bearing epidote $(\text{Ca}, \text{REE})_2(\text{Fe}^{3+}, \text{Fe}^{2+})\text{Al}_2[\text{Si}_2\text{O}_7][\text{SiO}_4](\text{OH})(\text{O})$. Some systematists assign the unique oxygen to the sorosilicate group and give a resulting formula which looks as though the mineral is a nesosilicate, but the epidote group does contain mixed silicate radicals.

Ludman and Hill (1990) listed allanite-(Ce) from unplotted sample locations of Baring granite, Charlotte granite, Meddybemps granite and a gabbro-diorite (gabbro-granite) intrusive complex located in the **Calais quadrangle**. Bulk rare earth element analyses of some of these rocks, which also had allanite, indicated Ce:La:Nd ≈ 2:1:1 and one would expect these ratios were representative of those in the allanite.

Iddings and Cross (1885) were among the first to note the "widespread occurrence of allanite as an accessory constituent of many world-wide rocks." They described the general appearance of the allanite: "Crystals which are large enough to be seen without the aid of a lens are easily recognized in the hand specimen by their brilliant black color, uneven fracture and oily luster. They vary greatly in form and size in the different rocks examined, in some cases being long, slender prisms, reaching a maximum length of 1 cm., though usually appearing in short, stout prisms, or in quite irregular grains of microscopic dimen-

sions." Undoubtedly, most allanite crystals are 1 mm or less. Iddings and Cross (1885) listed allanite in granite from **Vinalhaven, Biddeford, Wayne**, Fox Island, and **Harrington**. Hanley (1936) listed allanite without specifics from **Auburn, Buckfield, Hebron, Norway, Paris, Somerville, and Stoneham**.

Moench and Pankiwskyj (1988) map (as Dqg) a biotite- or hornblende-biotite quartz gabbro to granodiorite cutting the Songo (**Albany, Bethel, Greenwood, Mason, and Woodstock**), Mooselookmeguntic (**Adamstown, Andover, Andover North Surplus, Byron, TC, TD, Lincoln Plantation, Magalloway, Rangeley Plantation, Richardson, Roxbury**), and Rumford plutons (**Rumford**) and the Phillips batholith (**Avon, Carthage, Dixfield, Mexico, Phillips, Weld, T6 North of Weld**) in western Maine and indicate that allanite is among the "conspicuous accessory minerals." They further indicate that allanite is locally an accessory mineral in the Umbagog pluton (**TC, C Surplus, Magalloway, and Upton**). Clearly the identification of allanite deserves chemical attention.

Albee and Boudette (1972) wrote of the Hog Island Granodiorite, **Attean and Jackman**: "Allanite is found in markedly zoned and twinned subhedral crystals as much as 1 mm long, and sphene and magnetite are found as rather large subhedral crystals."

Seaman (1975a) noted allanite from the "lost" Bayley [Bagley] Ledge quarry, **Brunswick**. No specimens known.

Allanite is described briefly by Jenks (1934): "Rarely, allanite is found, occurring in small, nearly isotropic, red grains generally imbedded in the hornblende." The host rock is an analcime syenite which is found on the northwestern foot of Pleasant Mountain, **Denmark**.

Barker (1965) listed allanite as an accessory mineral in an albitite pegmatite from the Dennis Hill area, **Litchfield**.

At the Orman McAllister prospect, **Lovell** dark gray brown zircon rods (to 3 x 0.3 mm) frozen in tan to pink microcline have been erroneously called allanite. They are associated with sharp, "normal," bipyramidal brown zircon crystals (to 3 mm).

Allanite was listed by Houghton (1861) from **Rutland**, but no such town, village, or settlement name is used or has ever been used, in Maine.

Allanite is found in the Webhannet pluton, **South Berwick and Wells** (Arthur Hussey, personal communication, 1992).

Allanite is found along with samarskite-(Y) and elongated zircon crystals at the Russell Brothers quarries and the Standpipe Hill quarry on Standpipe Hill in **Topsham**. The crystals form thin black rods (35 x 4 mm) frozen in reddish-gray albite. The rods of allanite from the various Standpipe Hill occurrences usually have a thin red-brown resinous coating.

Robinson (1884) identified and chemically analyzed allanite-(Ce) from Sprague's quarry, Topsham: "It occurs in the above locality in considerable abundance and in the form of brownish crystals partially decomposed, and looking like rusty nails driven into the granite. Occasionally fair crystals are found. Up to the time of its discovery no cerium mineral was known to occur here, but recently we have found in small quantities another cerium

mineral which is now under examination. This latter does not occur in the same locality as the allanite, but is associated with columbite and gahnite. The analysis of the allanite was made under my supervision by J. Torrey, Jr. ... Different samples seemed to vary somewhat in composition..." Clarke (1884a) also reported a chemical analysis of Topsham allanite, without separation of rare earth elements: "The crystals are usually much rusted upon the surface..." Though the two analyses are considerably different, the total rare earth values are similar. Robinson's (1884) analysis is provocative as LaO + DiO was greater than CeO, even though nineteenth century rare earth separations could only be described as "primitive" even at the best existing laboratories. No specimens known and the identity of "Sprague's quarry" is unknown.

Newberg (1984) reported allanite from a "hornblende quartz diorite" along a cottage access road about 300 m south of Pond Road, 900 m southwest of Pond Road's overpass of I-95, **West Gardiner**: "Twinned and growth-zoned euhedral allanite crystals are occasionally present surrounded by fine-grained epidote."

Katz (1917) and Hussey (1962) do not mention allanite from **York**, but Wandke (1922a) reported of the alkaline granite of the Agamenticus Complex: "... orthite is seen in almost every section."

Ayuso (1984) described and partially analyzed (not for rare earths) allanite from the Whitney Cove pluton, **T5ND BPP, T5R1 NBPP, T6ND BPP, T6R1 NBPP**: "Allanite is common as large (up to 1.5 mm), euhedral, and optically and compositionally zoned grains intergrown with biotite and oxide minerals. Higher contents of titanium, iron, and in some cases fluorine and calcium are characteristic in the cores of allanite compared to lower phosphorus in the rims ..."

Loiselle and Wones (1983) wrote of a locality near the Saint Regis Road, **T30MD BPP**: "Pavements of Cranberry Lake granite exposed in the stream. A coarse grained, massive, biotite-bearing granite. ... Accessory allanite is prominent in many samples."

allophane

Brooksville - Cape Rosier M; Woolwich - U.S. Route #1 road cut

Allophane is not a mineral species in current nomenclature, but is a name assigned to presumed amorphous, pitchy to resinous, aluminosilicate material of variable chemical composition. In Maine, the allophane physically resembles hyalite opal, but it is not fluorescent.

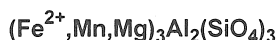
Clear to pale blue translucent botryoidal allophane coats fracture surfaces (in 7 mm patches) in brown talc matrix from the Cape Rosier mine (later superseded by the Callahan mine), **Brooksville**.

Pale blue transparent "allophane" is found in botryoidal patches (to 7 mm) on fracture surfaces in granitic matrix from a

U.S. Route #1 road cut in **Woolwich**, but that material could be non-fluorescent hyalite.

alluaudite - group name (see Unknown mineral #5)

ALMANDINE (Garnet Group)



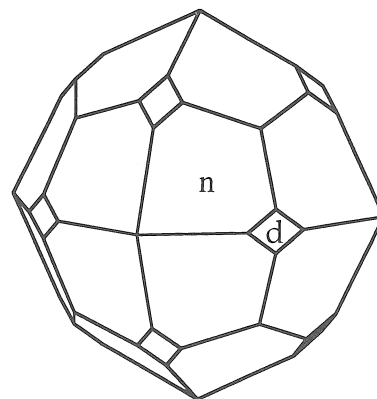
Albany - Bumpus Q, Donahue P, Johnson Q, Pingree Ledge Q, Scribner Q, Stearns P, Wardwell Q, Wiley-Pechnik P; **Auburn** - Danville Corner, Edward Little High School excavation, Greenlaw Q, Groves Q, Maine Feldspar Q, Pulsifer Q; **Boothbay Harbor**; **Bowdoin** - Coombs Q; **Bowdoinham** - West Booker Q; **Brunswick** - LaChance Q; **Buckfield** - Bennett Q, Bessey Q, General Electric Q, Westinghouse Q; **Buckfield quadrangle** - Noyes Mountain Formation; **Byron** - Swift River A, "Transition Zone"; **Canton**; **Carrabassett Valley?** - garnet diorite; **TD** - "Transition Zone"; **Digdeguash Formation** - Calais quadrangle; **Edgecomb**; **Freeport**; **Friendship**; **Fryeburg** - Eagle Gray Q; **Georgetown** - Consolidated Q; **Gilead** - Peaked Hill Q, Wheeler Q; **Gorham** - Dundee Falls A; **Greenwood** - Emmons Q, Harvard Q, Heikkinen Q, Nubble Q, Tamminen Q, Tiger Bill Q, Waisanen Q, West Hayes Ledge Q, Witt Hill L; **Hallowell**; **Harpeswell** - Orrs island; **Hartford** - Ragged Jack Mountain L; **Hebron** - Hibbs Q, Mount Rubellite Q, No. 4 Hill Q; **Lewiston**; **Livermore** - International Paper Mill excavation; **Mexico** - Gogan P; **Naples**; **Newry** - Bell Q, Dunton Q, Nevel Q, Scotty Q, Rose Quartz Crystal L; **Norway** - BB #7 Q; **Paris** - Hoopers Ledge P, Hoopers Ledge Q, Mount Marie Q, Mount Mica Q, Ryerson Hill A?, Slattery Q, Twitchell Q, Whispering Pines Q; **Peru** - Hedgehog Hill Q, Lobikis Q; **Phippsburg** - Thomas Q; **Poland** - Berry-Havey Q; **Pownal** - Lower Tryon Mountain Q, Hinkley P, Upper Tryon Mountain Q; **Raymond**; **Rumford** - Black Mountain Q, Goddard Ledge Q, Red Hill Q; **Stoneham** - Butters Mountain-Great Brook A, Cole Q, Durgin Mountain A, Lord Hill Q, Melrose Q; **Stow** - Deer Hill Q; **Topsham** - Cobbs Q, Consolidated #1 Q, Fisher Q, Noyes Q, Ponziani Q, Porcupine Hill Q, Railroad Q, Russell Brothers Q, Spragues Q, Square Pit, Standpipe Hill Q, Swamp #1 Q, Trenton Q, Twin Pits, William Willes #1 Q, Yedlin L; **Warren** - Starrett Q; **West Paris** - Perham Q, Stearns Hill A; **Windham** - Cook Road L

Many fine almandine localities are known in Maine. Almandine is the iron(II)-aluminum-dominant garnet and is usually found in mica schists and in granite and in granite pegmatites. Almandine does not occur in the various calc-silicate localities. The calc-silicates have calcium-aluminum to calcium-iron(III) dominant garnets instead: grossular/andradite. Spessartine (q.v.) can look like almandine, but it is uncommon by comparison. Only a few spessartine locations (e.g. Keith quarry, Auburn; Bennett quarry, Buckfield; and Bemis Stream quarry, TD) are known from Maine pegmatites. All other *studied* Maine pegmatite garnets are almandine. Almandine of intermediate, but still iron-dominant composition (~55% almandine/45% spessartine),

were found from Dunton quarry, Newry and Mount Mica quarry, Paris (this study). Garnets from schists display a wide variation in composition and can grade into spessartine. The usage by many geologists, however, has been imprecise. Some reports indicating "spessartine" actually have been made on manganoean almandine.

Garnets can be so substituted that no one chemical component is dominant. End-members can be chosen for the richest particular component. For example, a particular garnet, when analyzed, might give Fe:Mn:Ca:Mg of 39:35:20:6. The mineral is almandine-rich, but not almandine-dominant. While it is not permissible to name *new* minerals which are a certain component-rich, and not that component-dominant, it is permissible to use *established* names to cover species which are highly substituted variants. The species represented by the example is, therefore, almandine. (Garnets are well-known concentrators of manganese, above the average ratio of the manganese to other suitable chemical components in the whole rock.)

Auburn has a large number of quarries and prospects, most of which have produced good small almandine crystals. The Maine Feldspar quarry, Auburn has produced numerous dark red-brown almandine crystals, to 7 cm, frozen in microcline and pale smoky quartz. The crystals are frequently interrupted in their development and are ordinarily partial crystals. The higher manganese content of the minerals of the quarry is usually blamed for the black stain frequently found on the almandine of the area. Fisher and Bernard (1934) reported an almandine apparently from the Maine Feldspar quarry, which had a weight of sixteen pounds (7.8 kg), but the quality of the specimen was not described. The Maine Feldspar quarry has also produced almandine in *graphic* intergrowth with quartz in 10-30 cm chunks. Similar graphic quartz/garnet intergrowths are found at the BB #7 quarry, **Norway**. Gemmy, nearly flawless red trapezohedral manganoean almandine (chemical analysis, this study) crystals (to 1+ cm) occur in blocky white albite sometimes associated with gahnite at the Groves quarry ("Hole in the Ground"), Auburn.



Almandine, Groves Q, Auburn

Enormous trapezohedral almandine crystals (to 15 x 15 x 15 cm) occur in albite-schorl-quartz pegmatite at the West Booker quarry, **Bowdoinham**. Although the large crystals are usually murky red-brown, several deep red gemstones have been cut from this quarry's almandine.

Bayley (1892b) described a striated garnet from an unspecified locality in **Buckfield**: "The crystal to which reference is made is an icositetrahedron (211) about two inches in diameter, modified by small faces of the dodecahedron (110). All the planes are deeply striated parallel to the combination edge, 211:110, and these striations are so deep in the icositetrahedral faces that the reflections of the dodecahedron may easily be obtained from them. In consequence of this oscillation between the two planes mentioned, the crystal appears to be made up of a lot of lozenge-shaped plates piled one upon another, with the smallest forming the dodecahedral bounding plane of the crystals, and the edges of the pile the deeply striated icositetrahedral faces." The specimen is preserved at Colby College and is labeled "Hill #4," but that locality is significantly across the Buckfield town line into Paris (the original No. 4 Hill has been subsequently renamed Mount Marie while another hill has been named No. 4 Hill and has a currently active prospect on it.). Bayley (1892b) must have misremembered the actual locality.

Warner (1967) noted of the Noyes Mountain Formation, **Buckfield quadrangle**: "One bed, more than 13 feet thick in a single exposure and traced for almost 1000 feet consists of 50 percent almandine garnet ... with biotite, quartz, and some sulfide. Guidotti [1965a] found similar beds (however, only centimeters thick) in the Bryant Pond Quadrangle." Bastin (1911) wrote of the Ryerson Hill area?, **Paris**: "Certain relations observed on the next large hill north of Crocker Hill... Garnets are very abundant in this gneiss and some are 1½ inches in diameter. There are also some knots or lenticles made up entirely of quartz in irregular association. Most of these are under 1 foot in greatest dimension, but one observed was 8 feet long and 1½ feet in greatest width. A band 2 to 3 feet in width in the gneiss and traceable for about 25 feet is fully three-quarters garnets up to 1½ inches in diameter, the interstices being occupied by quartz and some feldspar. In all probability this profusion of garnets is a contact-metamorphic effect of the pegmatite intrusion."

Abundant euhedral almandine crystals (to several millimeters, but generally about 1 mm or less) are consistently found as the precursor heavy mineral before gold-bearing magnetite sand is reached in gold panning along the various branches of the Swift River, **Byron**. The crystals are generally red, but pink and almost orange crystals are found. The dominant forms present are the rhombic dodecahedron with minor trapezohedron. Guidotti (1974) analyzed almandines from the transition zone between the lower sillimanite zone to the upper staurolite zone, **TD** and **Byron**.

Ludman (1990a) reported of the Digdeguash Formation, **Calais quadrangle**: "Garnet is not common and seems to be restricted to a few sulfide-rich layers. It is largely made up of the almandine component (76.8%) with lesser amounts of pyrope

(6.8%), spessartine (14.2%), grossularite (2.2%), and shows weak zoning with cores slightly enriched in spessartine (Bromble, 1983; Ludman et al., 1989)."

Griscom (1960) noted a garnet diorite near a public camping site between Carrabassett and Bigelow, **Carrabassett Valley**: "The norite then grades rapidly into a biotite diorite which locally contains up to seventy percent garnet. Occasional cordierite inclusions occur." No specimens available for study.

Perkins (1928) wrote: "At Freeport for example, there is an igneous gneiss rich in dark garnets."

Excellent sharp trapezohedra (to 4 cm) of almandine have been found frozen in pegmatite at the Eagle Gray quarry, **Fryeburg**.

Particularly bright ruby red almandine crystals (to 3-5 mm) have been found with chrysoberyl crystals on Witt Hill, **Greenwood** and they have been called ruby corundum by some collectors.

Large gemmy masses of dark red almandine were found in pegmatite at the excavation for the International Paper Company paper mill, **Livermore** in the 1960's. One gemstone over 12 carats was cut from a fractured crystal section.

Hedgehog Hill quarry in **Peru** is a prolific producer of almandine crystals to 8 cm. The almandine occurs in a fine-grained (to several millimeters) muscovite and quartz-rich portion of the pegmatite and the crystals are frequently incomplete. Quartz has been successfully removed from specimens without damaging the almandine by the use of dental picks and blowpipe with candle flame. A black manganese staining is frequently seen on the garnets of the location. The color of the almandine is dark red. The luster of Hedgehog Hill quarry garnets is brilliant when the garnet formed in association with quartz and dull when in association with muscovite.

In **Raymond** there is a lost location for dodecahedral almandine. The Chadbourn collection at Northeastern University and the Lamb collection at the Museum of Science, both in Boston, Massachusetts as well as the Vaux collection at Bryn Mawr College, in Bryn Mawr, Pennsylvania have pinkish-red almandine crystals, to 4 cm, frozen in fine to medium-grained granular gray quartz. The time period of collecting these specimens is about 1900.

Topsham has produced some of the largest almandine crystals in Maine. Large garnets (to 25 cm) are reported by Morrill et al. (1958) near the dam on the Androscoggin river. Particular mention can be made of incomplete giant crystals (to 15 cm) of almandine from the Trenton quarry (= G. D. Willes quarry). Peculiar flattened almandine crystals (1-2 cm) are found sandwiched between biotite and microcline at the Yedlin locality and the Swamp #1 quarry, Topsham. Almandine from the Swamp #1 quarry can have numerous well-crystallized inclusions including columbite, zircon, monazite, uraninite, etc. Columbite crystals (to 3 cm) have been found as inclusions in almandine from the Fisher quarry, Topsham. An exceptional Standpipe Hill, Topsham almandine specimen is 18 cm across and is composed of the dodecahedron and trapezohedron (HU #128427). Addi-

tional important localities include the Fisher quarry and Mallet quarry, though many of the Topsham pegmatite localities have collectible garnet specimens. The rule is that the best specimens are found during mining and little can be found on the dumps, but the small amount of collecting that has been done at Topsham suggests dump collecting should occasionally be rewarding. Specimens from Topsham are so seldom labeled as to their quarry of origin that the anonymity of such fine specimens as have been produced is a disgrace to mineral collecting. Glassy elongated almandine crystals have been found at the Russell Brothers quarry, Topsham. Trapezohedral almandine crystals (to 4 cm) are abundant in white microcline and light smoky quartz at the Square Pit, Topsham. Unfortunately, almandine is a very brittle mineral and intergrown clusters, in particular, are difficult to keep intact during collecting. To avoid breakage, large specimens should be cut with a saw if it is necessary to reduce specimen size. (Many Topsham almandines have a slight black surface staining, but the staining should not be used to identify the garnet as being particularly manganese-rich.)

Wheeler and Wheeler (1878) wrote of Topsham: "Small but fine crystals are found in Cobb's quarry. A fine, perfect specimen, nearly as large as a man's fist, in the Museum of Bowdoin College, was found in Sprague's quarry. At Fisher's quarry are fine, large specimens. Large quantities of crystals, of medium color and large size, have been taken from a quarry near the road, beyond the Old Feldspar quarry [Trenton Q?]. The most ordinary form is the ikositetrahedron modified by the octahedron and dodecahedron." The statement about the crystal shape should be regarded with leniency considering the progress of crystallography of the time. The location of Cobbs quarry is unknown.

almandite = obsolete spelling of almandine

alpha quartz - the form of quartz stable at Earth surface conditions; see quartz

alum? - apparent misidentification or post-mine growth

Brooksville? - *Harborside A?*; **Buckfield?** - *Basin Falls A*; **Gilead?**; **Lebanon?**; **Portland?** - *Jewells Island A*; **Prospect?** - *Fort Point A*; **Wales?**

Given the wet climate of Maine, it is highly unlikely that a water soluble mineral could form, and remain in place, through unaided natural processes. The various reports are unsupported identifications. Jackson (1839) noted alum along with copperas made from "pyritiferous slate," Jewells Island, **Portland**, but the report suggests factory production. A specimen was listed for Gilead in the Cleaveland Cabinet, Bowdoin College, but the specimen was not located.

Jackson (1838a) wrote of the Fort Point area, **Prospect**: "The pyrites mixed with the slate causes it to decompose, and

sulphate of alumina and sulphate of iron are formed." Jackson (1838a) also wrote of additional occurrences: "The only rocks in place, at Lebanon, are alum and mica slate, the former being the result of decomposition of pyrites" and in the Basin Falls area, **Buckfield**: "The gneiss is charged with pyrites, and by the action of the spray from the falls, its surface is kept moist, and a rapid decomposition takes place. The sulphur of the pyrite oxidizes, and becomes converted into sulphuric acid, and this acid attacks the feldspar of the gneiss, appropriates to itself its alumina and potash, forming sulphate of alumina and potash or common alum. This substance encrusts the rocks in considerable quantities, above the falls, where they overlay the cascade."

Brooksville alum was reported by Morrill and Hinckley (1959), but the report was probably based on Jackson (1838a): "In Brooksville, opposite Castine, there is a very rich deposit of pyritiferous slate, which *may* [emphasis added] be profitably wrought for copperas and alum."

alumina?

Gilead?

Alumina was reported by Houghton (1861) from Gilead. It is uncertain what material was meant by this entry. It may have attempted to signify corundum or perhaps any of a variety of aluminum-bearing minerals, including alum (q.v.) or even sillimanite. No specimens are known.

alunogen? - apparent misidentification or post-mine growth

Houlton?, Newry?, Rumford?

Given the wet climate of Maine, it is very unlikely that a water soluble mineral could form through unaided natural processes. **Newry** and **Rumford** alunogen was reported by Burr (1930) and Bailey (1930), but no specimens are known. A single specimen from **Houlton** is known (not tested), but it too appears to be a product of construction activity.

amazonite (Feldspar Group) - see microcline

AMBLYGONITE (Amblygonite Group)

(Li,Na)Al(PO₄)(F,OH)

Hebron - *Mount Rubellite Q*; **Rumford** - *Black Mountain Q*; **Stoneham** - *Lord Hill Q*

Amblygonite has been reported from many locations in Maine for over one hundred years, however, modern identification methods have revealed that only Hebron and Rumford have true amblygonite and that the other Maine localities probably

have a close chemical relative: montebrasite (q.v.). (The uncertainty of fluorine analyses over one hundred years ago has been raised (Leavens et al., 1978). The low consistent determinations of Na₂O in several Hebron samples (0.34 and 0.66 weight %) by Penfield (1879) are less reasonable to allot to error as soda was easy to determine with precision, at that time.) Černá et al. (1973) said that montebrasite from the Tanco pegmatite, Bernic Lake, Manitoba, Canada has a wide variation of fluorine composition (1.40 - 6.30 weight %), but the Tanco pegmatite is perhaps 100 times the size of any Mount Rubellite pegmatite. The Mount Rubellite quarry complex consists of several openings which leads to the obvious ambiguity of which spot yielded the particular studied samples. Crystal pocket specimens of this group at the Mount Rubellite quarry are nearly pure montebrasite (q.v.). The complete understanding of Mount Rubellite quarry amblygonite/montebrasite is yet to come. The large attention paid to this material has been mainly mineralogical, without consideration of geological factors. Groat et al. (1990) re-analyzed, by electron microprobe, the samples of Černá et al. (1973), except for the Hebron sample, which had been analyzed by bulk, wet chemical methods. Groat et al. (1990) frequently found lower fluorine values by selective electronic methods than from the same specimens analyzed by bulk, wet chemical methods. (Of course, all of the nineteenth century Maine amblygonite analyses vary from each other enormously.)

Landes (1925) reported amblygonite and montebrasite from the Bennett quarry, **Buckfield**, but the data given indicate that both samples were montebrasite - one intermediate in composition and one nearer end-member montebrasite. Similarly, Fraser (1930) wrote of Newry without providing data: "*Amblygonite and Montebrasite*. These two minerals are developed rather locally, although they may occur in very large masses. Commonly they show good crystal form. They often enclose cleavelandite and other earlier minerals and sharp crystals of amblygonite are found in massive lepidolite. The distinction between amblygonite and montebrasite is based chiefly on the difference in their optical properties." Given the lack of data, previous identifications in the same laboratory by Landes (1925), and the recent findings of montebrasite, but no amblygonite (Vandall King, unpublished data, 1978); the amblygonite identification has not been believed. (Černá et al., 1973) show that the data of Backlund (1918) and Winchell (1926) were biased toward higher suggestive fluorine compositions and identifications made using Backlund's (1918) and Winchell's (1926) optical data could give inaccurate results. Greiner and Bloss (1987) provided new data on the optical properties of the series including an analysis of intermediate fluorine composition amblygonite from Hebron.) Reports of amblygonite from Auburn, Greenwood, Paris, etc. were never accompanied by data. See montebrasite.

Material of this series in crystal pockets is usually fluorine-poor and therefore the species montebrasite, and masses frozen in matrix at other Maine locations have been shown to be montebrasite. An extensive review of the history of the nomen-

clature of this series appears with montebrasite (q.v.). The two members of the series are visually identical. Small transparent tabular crystals lining vugs, at Hebron and other Maine localities, are also montebrasite (q.v.), as far as have been tested. Additionally, the fine-grained member of the series from Mount Rubellite is montebrasite.

Amblygonite from the small Mount Rubellite quarries, **Hebron** is snow-white and massive. The masses (to 10 cm) have two cleavages about 106° apart. One of the cleavages is perfect with a vitreous luster, but interrupted while the other cleavage is less perfect and difficult to locate, it is so interrupted in its development. The amblygonite masses generally consist of one grain (to 8 cm) showing a continuous cleavage. The mineral is usually associated with cleavelandite and lepidolite.

Černá et al. (1973) provided data on members of the amblygonite-montebrasite series and found that one amblygonite from the Mount Rubellite quarry contained 10.17 weight % fluorine and was therefore one of the few true worldwide amblygonites in their study.

In 1862, Brush discovered a mineral whose properties matched amblygonite:

"A few weeks since Mr. John M. Blake, Ph.B.[sic], late assistant in this Laboratory, called my attention to a peculiar feldspathic looking mineral associated with the *lepidolite* from Hebron, Maine. Mr. Blake found on blowpipe examination that the mineral was extremely fusible, and that it gave a strong reaction for lithia, coloring the flame beautifully crimson. A further examination has shown it to be a phosphate of alumina and lithia, with a considerable amount of fluorine and some water. This composition, together with its physical properties, have led me to refer it to the rare species *amblygonite*.

Lepidolite occurs at Hebron in large masses in a coarse granite, and the *amblygonite* is found imbedded in this lepidolite, associated with albite, quartz, red, green and black tourmaline, and more rarely with cassiterite, and a peculiar compact variety of apatite containing minute prismatic crystals of a hair-brown mineral, which I have not yet been able to obtain in sufficient quantity to determine fully its characters [Later described as childrenite (Brush, 1863a,b)]. ... As soon as I can obtain enough of the mineral [amblygonite] for the purpose, I hope to examine the alkalies more minutely, with especial reference to rubidium and caesium. These two new alkaline metals have been found in comparative abundance in the Hebron Lepidolite by Messrs. O. D. Allen and J. M. Blake."

The water-bearing and, by extension, hydroxyl-bearing nature of the Hebron material was recognized early. See montebrasite for a more extensive discussion of the F/OH substitution. Brush (1862) said of the snow-white masses of "amblygonite" from Hebron: "It is an exceedingly interesting circumstance that the Hebron mineral should occur associated with other minerals in a manner so perfectly analogous to the Saxon amblygonite, the latter being also found in a coarse granite and frequently imbedded in lepidolite containing quartz and tourmaline. The Hebron amblygonite occurs in irregular masses which in some specimens

appear to be rough prisms of from half an inch to an inch in diameter." Dana and Brush (1868) and Dana (1892) figured Hebron amblygonite/montebasite with original drawings.

Penfield (1879) showed that a low-sodium member of the series from Hebron was relatively low in fluorine (i.e. montebasite). Černá et al. (1973) published data on high-sodium Hebron amblygonite (2.55 weight % Na₂O) which indicate a high fluorine content (10.17 weight % F) for Hebron samples. Fransolet (1989) determined that the fluorine- and sodium-bearing mineral lacroixite was intergrown with and/or replacing amblygonite from Hebron. Fransolet (1989) did not suggest that the lacroixite contributed to the high sodium content of the older Hebron amblygonite/montebasite analyses.

One specimen of amblygonite from the Black Mountain quarry, **Rumford** has been tested by the method of Černá et al. (1973) and consists of a blue-gray mass of amblygonite (to several cm) embedded in cleavelandite (Michael Wise, personal communication, 1993) (reported but not described in Francis et al., 1993).

Amblygonite from the Lord Hill quarry, **Stoneham** is very rare and no specimens are known. Hidden (1886) noted that it had a "lavender-blue" thermoluminescence. This material may have been fluorine-rich given the former quantity of topaz at the locality.

amethyst - see description under quartz

amianthoide? - fibrous or asbestiform amphibole; usually tremolite or actinolite

Topsham

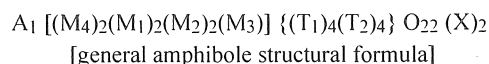
Cleaveland (1822) reported amianthoide from Topsham: "... it occurs in an aggregate of quartz and hornblende with epidote."

amphibole - a group of minerals; see also actinolite, amianthoide, anthophyllite, arfvedsonite, barkevikite, barroisite, basaltic hornblende, cummingtonite, edenite, ferroactinolite, ferroedenite, ferrohastingsite, ferrohornblende, ferropargasite, ferrowinchite, gedrite, glaucophane, grunerite, hastingsite, holmquistite, hornblende, kaersutite, magnesio-hornblende, osannite, pargasite, pargasitic hornblende, riebeckite, tirodite, tremolite, uraltite. No analyzed amphiboles from Maine were listed by Leake (1968).

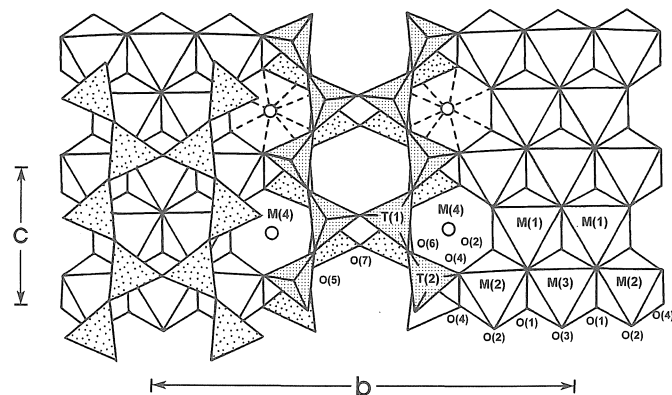
The new nomenclature of amphiboles (Leake, 1978) has been a source of confusion for most non-specialist geologists, petrologists, and mineralogists and has been a mystical tablet of commandments for collectors and other non-professionals. The following discussion is written specifically for geologists who

have chemical analyses of Maine amphiboles. Many professionals have avoided using the new nomenclature because of the perceived, as well as real, complexity of amphiboles. The summary offered here is intended to call attention to these guidelines. The reader will note that there is no longer a species simply called hornblende. In the 1960's, William Gary Ernst once said something to the effect that if the problem of amphibole nomenclature were solved, mineralogists would have surmounted a problem as large as solving the problem of the Vietnam War. The amphibole names which have been applied to Maine specimens are tabulated above. Many of these names have not been substantiated by chemical analysis and some of the names are now disused. ("Prefixes [e.g., 'magnesio', 'ferro', etc.] are separated from the root name by a dash: thus ferro-actinolite, magnesio-hornblende. Besides making very long names [e.g., ferro-fluor-pargasite] easier to comprehend at a glance, it also aids indexing [i.e. ferro-fluor-pargasite can be indexed under pargasite if desired, but ferrofluorpargasite can only be indexed under 'f' for ferro...]." [Frank Hawthorne, personal communication, 1992])

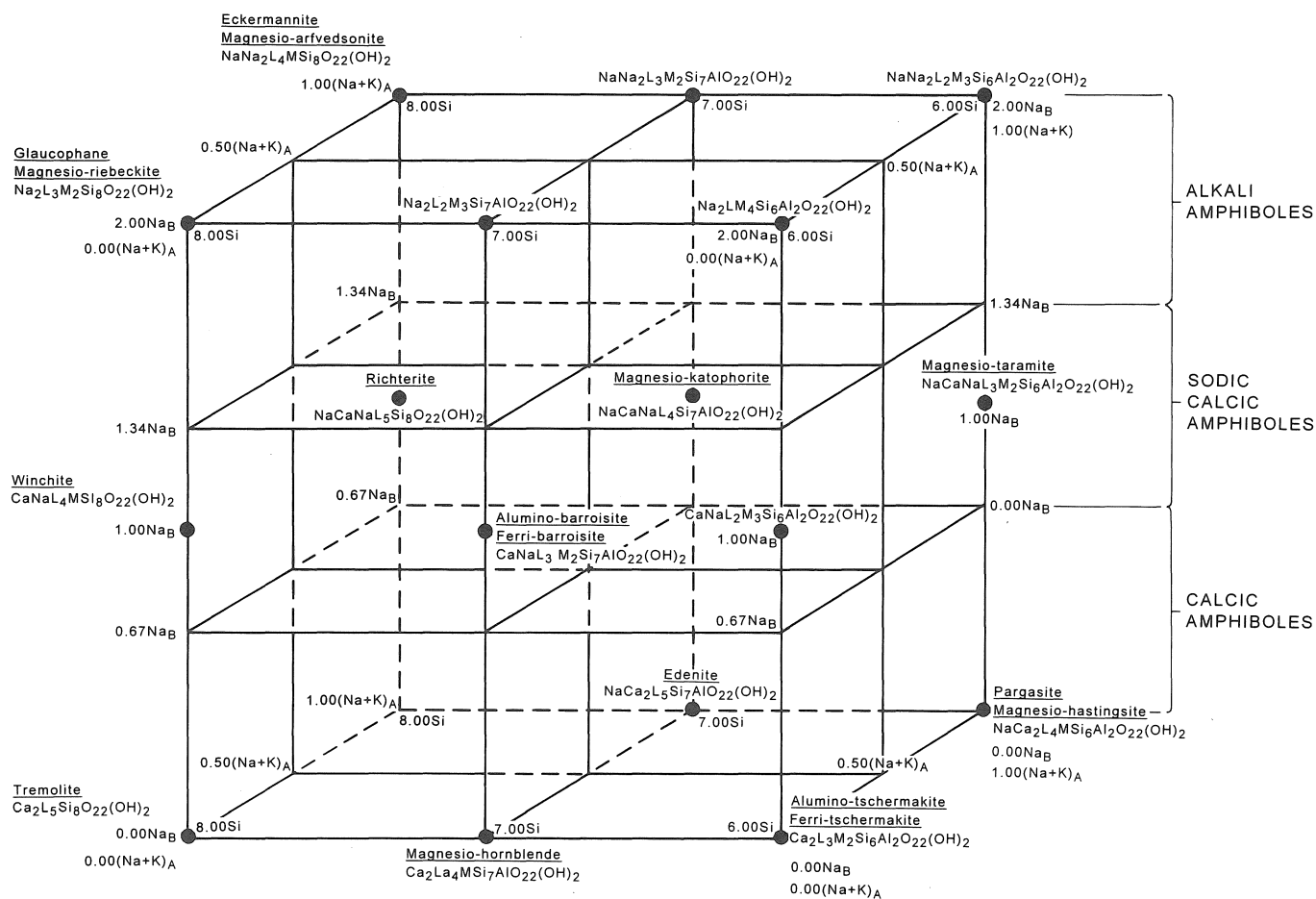
The amphiboles have a complex crystal structure. Hawthorne (1981) has provided an excellent summary which is abstracted here. There are as many as nine different sites in the amphibole structure, each which can be subject to chemical variation, but there are exceptions (see Hawthorne, 1981). Understanding the mineral depends upon understanding the mineral's general structural and chemical formulas. The structural formula (for space group C2/m, the most common structure, both by number of species and volumetrically) contains (see amphibole crystal structure diagram):



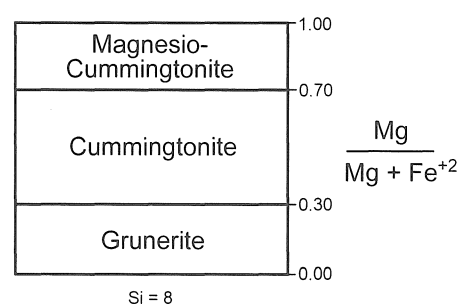
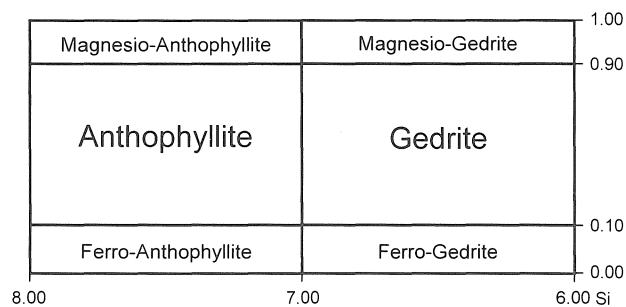
The *A* site is a large site which is surrounded by a ring of silicate tetrahedral groups and the number of coordinating oxygens is usually counted as 12. The *M* sites are each slightly differently shaped and constitute a central "slab" within the



The C2/m amphibole structure projected onto (100); the space group symmetry elements are shown (courtesy F. C. Hawthorne).

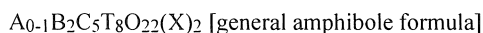


Amphibole classification for $(\text{Ca} + \text{Na})_B \geq 1.34$; excluding Fe-Mg-Mn Amphiboles



structure. The M_4 site, which is at the edge of the slab has 8 coordinating oxygens (6 in $P2_1/m$ and orthorhombic structures). The corners of the M_{1-3} sites are occupied by six oxygens and the space within the cluster is where the metal sites occur. (There are six oxygens in each cluster, the polyhedron formed by connecting the oxygen centers with imaginary lines from oxygen center to center along the outside of the cluster forms an octahedron, and so the sites within the cluster are called octahedral sites - also M sites) The positions of the M sites, from the edge to the center of the slab, are as indicated in the crystal structure diagram. The silicate tetrahedra form double braided chains which extend along the top and bottom of the slab of M sites. The X site is almost always occupied by hydroxyl (OH), but fluorine or chlorine substitution can occur here. In amphiboles with higher valence substitutions, i.e. "oxy-amphiboles", the X site is occupied by oxygen instead of hydroxyl.

The generalized chemical formula is less complex than the structural formula. The M_4 site is so different from the octahedral M_{1-3} sites that the elements occupying it are usually different from the elements in M_{1-3} . For this reason, a unique part of the formula, B , is recognized. For most amphiboles, the occupancy of the octahedral M sites is similar (Mg, Fe^{2+} , Al, Fe^{3+}), but cation ordering can be important. The C position of the formula consists of the contents of the M_{1-3} sites.



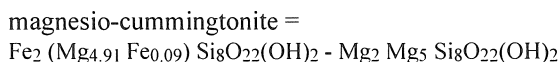
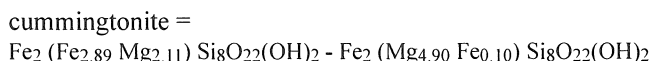
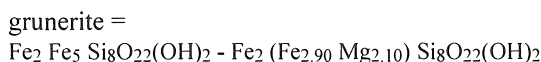
The A position is usually occupied by Na and K, if any of these atoms are present. The B position can accommodate Na, Li, Ca, Mn, Fe^{2+} , Mg. The C site accommodates Mg, Fe^{2+} , Mn, Al, Fe^{3+} , Ti. The T sites may be wholly occupied by silicon or partly occupied by aluminum, along with silicon. The X position is generally occupied by hydroxyl (OH), but fluorine and chlorine might be dominant. The formula provides for 15-16 cations per formula unit.

The A position might be vacant, partly filled, or completely filled; that is, have between 0 and 1 occupants, statistically. In a mineral like eckermannite $Na_3Mg_4AlSi_8O_{22}(OH)_2$, one Na is at the A site and the other two Na are at the B sites. A better formula is actually $NaNa_2[Mg_4Al]Si_8O_{22}(OH)_2$; the Na cations are separated into their A and M_4 sites and the octahedral cations are grouped [], but the suggestion is that Al is ordered into the single M_3 site and the Mg occupies the four sites remaining (2 M_2 and 2 M_1).

The majority of the confusion undoubtedly comes from not having read about the nomenclature and the non-specialist petrologists, geologists, and mineralogists have perceived the nomenclature as "an act of faith," but a careful reading of Leake's (1978) text, not just his diagrams which contain errors (F. Hawthorne, personal communication, 1992), should relieve any confusion or anxiety. Leake (1978) also has an optical section which the mineralogist and petrologist will find useful as well as consistent with the new nomenclature. The effort of assigning amphibole nomenclature has been likened to "dividing n-space

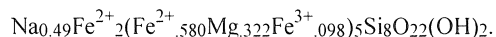
into an array of paper bags, into which data can be dumped" (Steve Chamberlain, personal communication, 1991), but the amphiboles are the origin of the complexity and not the nomenclature itself (Frank Hawthorne, personal communication, 1992). The inconsistent placement of cations in a formula, by some authors, as well as the inconsistent representation of which elements are dominant in a site (e.g. [Fe, Mg] instead of [Mg, Fe] or [Al, Fe^{3+}] instead of [Fe^{3+} , Al], etc.), have made the non-specialist perceive near chaotic representation of the formula of amphiboles. The new guidelines provide a logical basis for amphibole nomenclature.

The cummingtonite series might offer a good first example of the defined limits of amphibole species. The cummingtonite series, assuming only divalent cation substitution, is divided into grunerite $\{^{Fe}/_{(Fe+Mg)}\} = 1.0 - 0.7$, cummingtonite $\{^{Fe}/_{(Fe+Mg)}\} = 0.699^+ - 0.30$, and magnesio-cummingtonite $\{^{Fe}/_{(Fe+Mg)}\} = 0.299^+ - 0$. This translates into:



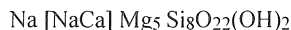
The simplified discussion of the grunerite/magnesio-cummingtonite series, above, assumed that the A position was less than half occupied (i.e. essentially "empty") and that aluminum, or other trivalent cations, were not significantly present. It also assumes that Fe^{2+} is very ordered at the B site to the exclusion of Mg, which, of course, is not completely accurate. ("... if you don't know how much Mg is in the B group and in the C group..., you cannot draw consistent boundaries given only the chemical analysis. ... I must emphasize that site occupancies (as distinct from A -, B - or C -group cation type) are not used in classification, and that the amphibole compositions used are 'traditional' compositions, defined chemically long before any crystal structure work was done on them [Frank Hawthorne, personal communication, 1992].) It is apparent, however, that the magnesio-cummingtonite end of the series would have been split into two species before the new guidelines.

The few amphiboles with Li^+ , at least half occupying M_4 , are usually aluminous (e.g. holmquistite series) and are usually orthorhombic in symmetry. The monoclinic Na^+ dominant species do have end-members without aluminum or trivalent cations, but they too usually have some aluminum substitution. (Perfectly good grunerite could be:



The real variability of amphiboles is far greater than here indicated.)

The richterite/ferro-richterite series, when cast into the general formula yields:



The *A* site is filled by Na^+ and the M_4 sites are filled by one each of Na^+ and Ca^{2+} : note there is no comma separating these two symbols in the above formula. With the M_4 sites occupied by $[\text{NaCa}]$, the nomenclatural change from richterite to ferro-richterite occurs at $\text{Fe}/(\text{Fe}+\text{Mg}) = 0.5 \pm$ or at the boundary $\text{Na}[\text{NaCa}](\text{Mg}_{2.5}\text{Fe}_{2.5})\text{Si}_8\text{O}_{22}(\text{OH})_2$. (The M_4 sites usually have divalent cations and the presence of an *A* cation requires that one of the M_4 sites be univalent statistically. Other coupled substitutions are possible.)

Cation Ordering

Elements are not randomly clustered together in minerals, but are distributed within a crystal's structure according to the positions available. The relatively large number of similar sites in the amphibole structure needs some discussion as the *M* sites, for example, do not "fill" with equal probability, but show significant ordering. For example, Fe^{2+} is preferentially ordered in the M_4 structural site or the *B* formula-position: "... Mg seems to be virtually excluded from the *M*(4) site" (Hawthorne, 1981). For M_{1-4} , the ordering preference of Fe^{2+} seems to be $M_4 \gg M_3 \geq M_1 > M_2$. Without detailed knowledge of the coefficients of ordering, before its detailed crystal structure was known, grunerite was thought to be $(\text{Fe}_1[\text{Fe}_{0.5}\text{Mg}_{0.5}])_7\text{Si}_8\text{O}_{22}(\text{OH})_2$ or $\text{Fe}/(\text{Fe}+\text{Mg}) = 1.0 - 0.5$. Subsequently, grunerite's species boundary with cummingtonite would have been regarded to be $\text{Fe}_2(\text{Fe}_{0.5}\text{Mg}_{0.5})_5\text{Si}_8\text{O}_{22}(\text{OH})_2$. The former grunerite range was $\text{Fe}/(\text{Fe}+\text{Mg}) = 1.0 - 0.643$. The current definition has $\text{Fe}/(\text{Fe}+\text{Mg}) = 1.0 - 0.7$. While the ratio seems less complicated with one significant figure, the consequent subscripts are more complex. Magnesio-cummingtonite was formerly placed at $(\text{Fe}_{0.5}\text{Mg}_{0.5})_2\text{Mg}_5\text{Si}_8\text{O}_{22}(\text{OH})_2$ to completely Mg-rich compositions. Magnesio-cummingtonite now varies by definition in the M_4 site from essentially completely occupied by Fe^{2+} to completely occupied by Mg excepting actual compositions which rarely reach this value.

Additional rules that have been derived include the strong ordering of trivalent and quadrivalent cations, (Fe^{3+} , Al, Ti^{+4}), at the M_2 site. (The assignment of Ti^{+4} to an ordering scheme, such as M_2 site preference, is not yet well-established. Monoclinic (C2/m) amphiboles have Al in $T_1 \gg T_2$. Orthorhombic amphiboles show Al preference in tetrahedral sites $T_{1B} \geq T_{1A} \geq T_{2B} > T_{2A}$. Manganese (Mn^{2+}) is very strongly ordered in M_4 , even when Fe^{2+} is present. When manganese preferentially orders in M_4 , as in tirodite and dannemorite, Fe^{2+} preferentially orders in M_2 . In calcic amphiboles, where Ca^{2+} very preferentially occupies M_4 , Fe^{2+} orders according to $M_1 \geq M_3 > M_2$. Further ordering schemes are enumerated by Hawthorne (1981).

The recognition of order in the various amphibole crystal structure sites has partly determined the defined limits of the various amphibole species. For example, the ordering of aluminum at one site, M_2 , rather than being distributed evenly over four metal sites (M_{1-3} and M_4), allows the recognition of such species as eckermannite $\text{NaNa}_2\text{Mg}_4\text{AlSi}_8\text{O}_{22}(\text{OH})_2$. (The M_2 site would range from fully occupied by Al_2 through (Al_1Mg_1) . Compositions with $(\text{Mg},\text{Al})_2$ to Mg_2 would be a different species depending on the elements substituting in the rest of the mineral to balance the charge difference.)

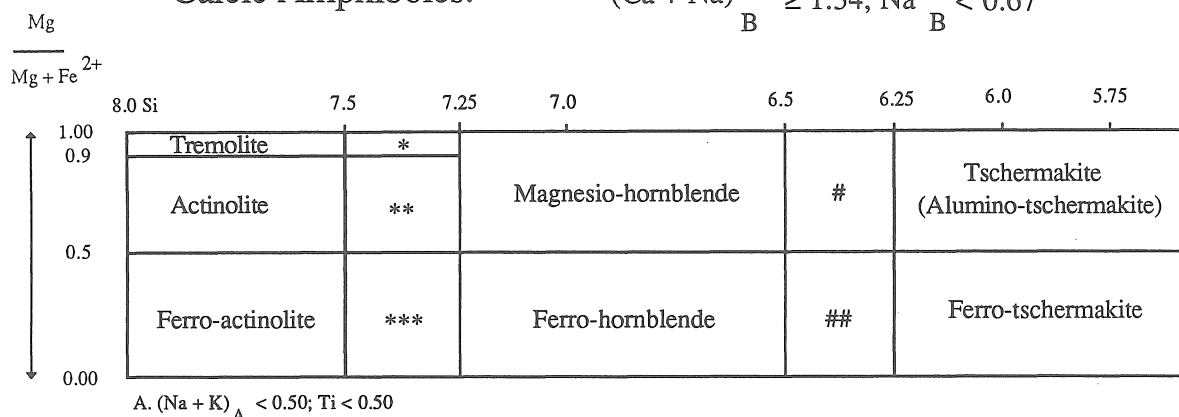
The wealth of amphibole variety depends on trivalent or quadrivalent substitution: Al^{3+} , Fe^{3+} , and Ti^{+4} , and with more extensive substitutions the subtleties of the structure change and, with it, the space group. There are only a few Ti^{+4} dominant amphiboles: kaersutite/ferro-kaersutite. The topologies of the overall structure of the various amphibole structure types are not significantly different, even with stacking variations, unit cell dimension variability, etc. Some sites increase in size due to substitution of large cations, and the space group changes as the tetrahedral angles, bond lengths, and positions change, or become "unique" or more specialized due to ordering and the fit between the basic structural units shifts for favorable energetic stability.

The ferric iron-bearing amphiboles include: hastingsite / magnesio-hastingsite; ferri-winchite / ferro-ferri-winchite; ferri-barroisite / ferro-ferri-barroisite; ferri-katophorite / ferro-ferri-katophorite; ferri-taramite / magnesio-ferri-taramite; riebeckite / magnesio-riebeckite; arfvedsonite / magnesio-arfvedsonite; and kozulite. The arfvedsonites and the riebeckites are fairly widespread, while the remaining ferric amphiboles are less so. (The barroisites are becoming better represented as analyses are interpreted in light of the relatively new name.) The arfvedsonites grade into the riebeckites quite commonly.

The arfvedsonites grade from end-member $[\text{NaNa}_2(\text{Fe}^{2+})_4\text{Fe}^{3+}\text{Si}_8\text{O}_{22}(\text{OH})_{22}]$ to "near riebeckite" $[\text{Na}_{\approx 0.5}\text{Na}_2[(\text{Fe}^{2+})_{\approx 3.5}(\text{Fe}^{3+})_{\approx 0.5}]\text{Fe}^{3+}\text{Si}_8\text{O}_{22}(\text{OH})_2]$ when only the oxidation state of iron is considered. The arfvedsonite formula makes more sense when the ferrous iron atoms are separated so that the series varies from end-member $[\text{NaNa}[\text{Fe}^{2+}_3\text{Fe}^{2+}]\text{Fe}^{3+}\text{Si}_8\text{O}_{22}(\text{OH})_2]$ to "near riebeckite" $[\text{Na}_{\approx 0.5}\text{Na}_2[\text{Fe}^{2+}_3(\text{Fe}^{2+},\text{Fe}^{3+})]\text{Fe}^{3+}\text{Si}_8\text{O}_{22}(\text{OH})_2]$. (The ≥ 0.5 subscript of Na indicates that the Fe^{2+} in the second iron position in the formula has implied $\text{Fe}^{2+} \geq 0.5$. The occupancy of the *A* position is coupled with the ferric iron and aluminum contents of the mineral.) The string of Fe symbols, when separated, yield more enlightenment than monotony. There is a basic requirement that three and a half ferrous iron atoms per formula unit are required for arfvedsonite or more specifically a total of three and a half ($\text{Fe}^{2+} + \text{Mg}$). Where $\text{Fe}^{2+} < \text{Mg}$, the mineral becomes magnesio-arfvedsonite. The horrible complexity of amphiboles is evident when some aluminum substitutes in a mineral intermediate between arfvedsonite and riebeckite. The need for a fully codified method of naming amphibole species, as exemplified by Leake (1978), becomes more evident.

Calcic Amphiboles:

$$(Ca + Na)_B \geq 1.34; Na_B < 0.67$$



* = Tremolitic Hornblende

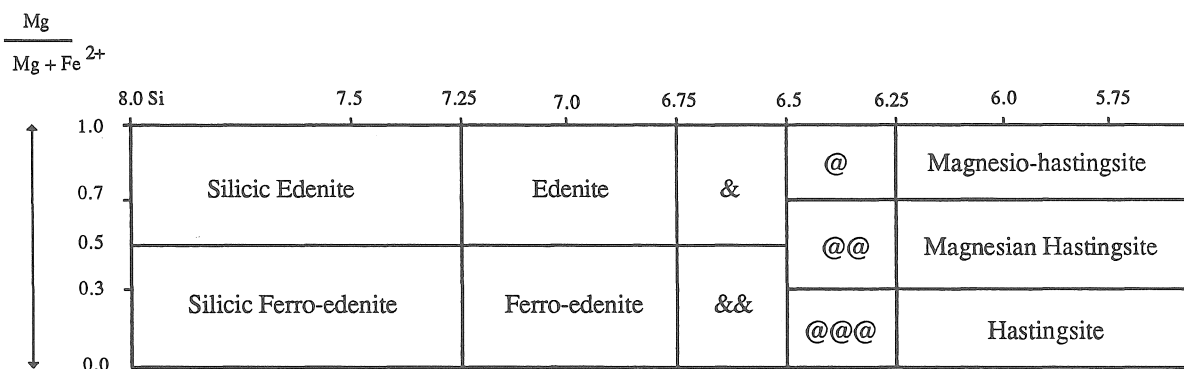
** = Actinolitic Hornblende

*** = Ferro-actinolitic Hornblende

= Tschermakitic Hornblende

= Ferro-tschermakitic Hornblende

(Diagram redrawn from Leake (1978))

C. $(Na + K)_A \geq 0.50; Ti < 0.50; Fe^{3+} > Al^{VI}$

@ = Magnesian hornblende

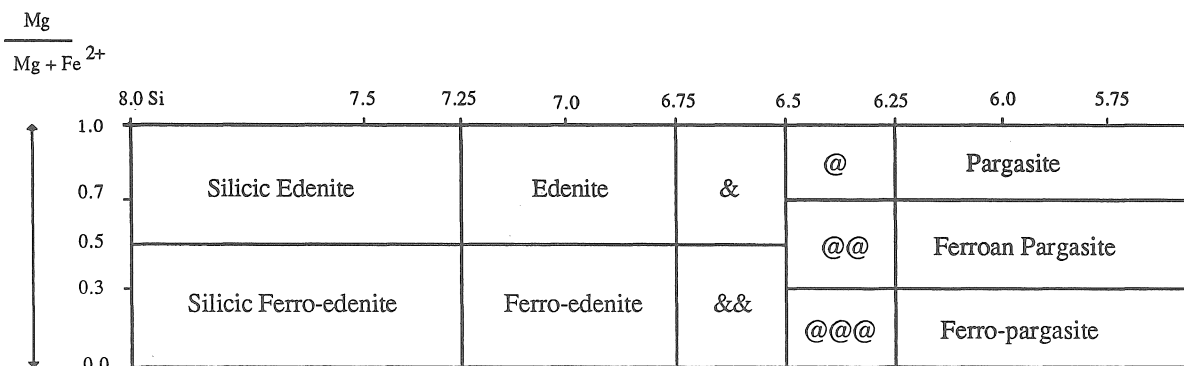
& = Edenitic Hornblende

@@ = Magnesian Hastingsite

&& = Ferro-edenitic Hornblende

@@@ = Hastingsite

(Diagram corrected from Leake (1978); F. C. Hawthorne, personal communication)

B. $(Na + K)_A \geq 0.50; Ti < 0.50; Fe^{3+} \leq Al^{VI}$

@ = Pargasite

& = Edenitic Hornblende

@@ = Ferroan Pargasite

&& = Ferro-edenitic Hornblende

@@@ = Ferro-pargasite

(Diagram corrected from Leake (1978); F. C. Hawthorne, personal communication)

The aluminous amphiboles now comprise about 40 end-members. The variation includes octahedral substitution of one or two aluminum atoms and similarly one or two tetrahedral aluminums [Si_8 to Si_7Al or Si_6Al_2]. Amphiboles with no aluminum are common in the Earth's crust as tremolite or cummingtonite groups. Amphiboles with two or more sites dominated by aluminum are also common: magnesio-hornblende $\text{Ca}_2(\text{Mg}, \text{Fe}^{2+})_4\text{Al}[\text{Si}_7\text{Al}]\text{O}_{22}(\text{OH})_2$, pargasite $\text{NaCa}_2(\text{Mg}, \text{Fe})_4\text{Al}[\text{Si}_6\text{Al}_2]\text{O}_{22}(\text{OH})_2$, etc. The intermediate compositions such as edenite $\text{NaCa}_2(\text{Mg}, \text{Fe})_3[\text{Si}_7\text{Al}]\text{O}_{22}(\text{OH})_2$, aluminowinchite $\text{CaNa}(\text{Mg}, \text{Fe})_4\text{AlSi}_8\text{O}_{22}(\text{OH})_2$, ferro-eckermannite $\text{NaNa}_2(\text{Fe}^{2+}, \text{Mg})_4\text{AlSi}_8\text{O}_{22}(\text{OH})_2$, etc. are generally scarce.

The definitions of the various amphiboles are best shown by diagrams (**Important notice:** two of Leake's (1978) calcic amphibole diagrams have a misplaced boundary line (Frank Hawthorne, personal communication, 1992). The diagrams on the previous page have correctly placed boundary lines.

ANALCIME (Zeolite Group)

$\text{NaAlSi}_2\text{O}_6 \cdot \text{H}_2\text{O}$

Brooklin - Flye Point A; **Castle Hill** - southwest Castle Hill A; **Denmark** - Pleasant Mountain A; **TDR2 WELS** - west Hedgehog Mountain A = Squapan Mountain A; **Greenwood?** - Harvard Q; **Lower Enchanted**; **Mapleton** - unnamed hill; **Perry** - Loring Cove A; **Rockland** - Jameson Point A; **South Berwick** - Spence and Coombs Q; **Upton** - camptonite dike; Winterville Formation - Westmanland, **T14R5 WELS**, **T14R8 WELS**, **T15R6 WELS**

While zeolites such as analcime tend to be conspicuous vug-filling minerals, zeolites can be found as minute alterations of minerals and might only be visible in thin sections of the rock.

Smith et al. (1907) tentatively identified analcime from a vertical basalt dike (30 cm wide) on the east shore of Flye Point, **Brooklin**: "The rock is probably an olivine-free analcime basalt (fourcheite). The only other rock which at all resembles it occurs as a dike 2 feet wide cutting the sedimentary schists of the northern shore of Rockland Harbor. The principal mineral here is basaltic augite, as in the Frye [sic] Point rock, but olivine is also present. Hornblende and biotite are not developed and the amount of isotropic base is much smaller than in the older rock. It seems to be a true analcime basalt (monchiquite)."

Analcime is found in a small area on the northwestern foot of Pleasant Mountain, **Denmark**. Jenks (1934) said of it: "The *analcite syenite* is a medium to coarse-grained light gray rock spotted abundantly with black amphibole. ... Analcime is always present to the extent of six to eight percent and occurs in small rounded grains imbedded in the feldspar or interstitial to it."

At one time Palache and Landes (1925) believed that the quartz pseudomorphs at the Harvard quarry, **Greenwood** were replacing analcime, but a footnote to the article retracted the identification in favor of pollucite. The identity of the original

material must be considered still unknown. (See quartz pseudomorphs.)

Gregory (1900) described the analcime problem from an unspecified hill in southwest **Mapleton**, and possibly from southwest base of Castle Hill, **Castle Hill**:

"The most common alteration [of andesine] is a clouding by means of myriads of minute specks of pure white analcime, which is distributed without order along cracks or in the center, or as a zone surrounding the crystal. ...

A whitish isotropic mineral, with low refraction and birefringence abundantly present in the rock, suggested leucite, sodalite, and analcime. In order to determine which of these minerals was present, a portion of the rock powder was treated with dilute nitric acid and then filtered, and the filtrate yielded gelatinous silica so easily and abundantly that the mineral could not be leucite. A test of a portion of the original filtrate showed no chlorine, which the presence of sodalite would demand. Moreover, the rock yields water abundantly below red heat in the closed tube. Analcime is the only rock-making mineral which corresponds in composition and optical behavior to the one under discussion.

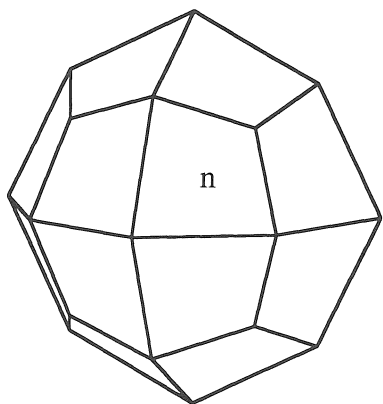
The analcime of the teschenite is either pure white or clouded by dust particles, and the slight birefringence is accordingly variable. It occurs abundantly in the typical slides, filling the polygonal areas between the interlacing feldspars, or filling cavities partly bounded by crystal faces, or as the secondary product described above."

Clarke (1900c) also reported the mineral and chemical analyses of the Mapleton teschenite. Gottfried et al. (1984) concluded that the analcime was formed as the result of prograde metamorphism rather than being a primary mineral. Toppan (1932) described the Mapleton material: "In the hand specimen the teschenite appears as a rock made up of pink and shiny black grains with an evident segregation of the minerals, so that it consists of light and dark patches. The light portions comprise white and pink feldspars with pure white analcime, while the dark areas are made up of augite and magnetite. Local variations occur with the dark minerals making up most of the rock in some cases, and being absent in others." Pavlides (1978) mapped the teschenite dikes in southwest Mapleton.

Analcime was reported as a secondary mineral from **TDR2 WELS** from a thin section of andesite from the west Hedgehog Mountain area (Boucot et al., 1964).

Excellent milky white analcime crystals (to 5 mm) are found in seams in basalt above and in the intertidal zone north of Loring Cove, **Perry**. The analcime is present as opaque trapezohedral crystals in small patches (to 5 cm) of massive analcime and calcite which fill veinlets within fractures in the basalt.

Bastin (1908b) tentatively identified analcime in a basalt dike on Jameson Point, **Rockland**: "Under the microscope the rock appears perfectly fresh. Its most abundant mineral is basaltic augite in crystals averaging one-fourth millimeter but reaching 1 millimeter in length. Many of these show distinct crystal outlines. Some show concentric and hourglass structures. Among the augite crystals are scattered crystals of perfectly fresh olivine



Analcime, Loring Cove, Perry

up to 3 millimeters in diameter. Small grains of magnetite distributed abundantly through the rock in part show crystal faces but are mostly irregular grains. Between these minerals is a colorless, isotropic substance which can hardly be regarded as a glass in view of the rather coarse crystallization of the other components and which is most probably the isometric mineral analcime. The amygdules are mainly filled with calcite."

Dale (1907) and Smith (1923) reported of **South Berwick**: "The Spence & Coombs quarry ("black granite") is in the town of Berwick, 1½ miles southeast of North Berwick village and station. ... This rock ... is a gabbro of very dark olive-brownish color and medium ophitic texture, consisting, in descending order of abundance, of longitudinal crystals of grayish olive-brownish lime-soda feldspar (labradorite) between which are particles of diallage, black mica (biotite), magnetite, and a little pyrite, together with secondary hornblende, analcime, zoisite, and calcite." The nearby Miniutti quarry was not reported to have analcime. The report was obviously made from microscopical examination of rock thin sections.

Milton (1961) reported on a camptonite dike in **Upton**: "Amygdules are composed of calcite and analcime."

Analcime was reported from five locations in Aroostook County from sample locality numbers. The approximate townships for these samples are **Westmanland** (#104), **T14R5 WELS** (#19), **T14R8 WELS** (#13, #22), and **T15R6 WELS** (#16). The analcime was reported as a microscopic constituent of the volcanic rocks except for analcime completely filling amygdules at sample location #22 (14R8 WELS). Richter and Roy (1976) report: "Analcime, always associated with prehnite, has been observed in thin sections from five localities in the Winterville Formation. Optical identifications were confirmed by x-ray diffraction and electron microprobe. Electron microprobe analysis shows that the analcime from three localities (19, 13, 16...) has an average of 55 percent SiO₂, 22 percent Al₂O₃, 13 percent Na₂O, 0.3 percent CaO, and 0.1 percent K₂O. These data indicate that the mineral is nearly pure Na-analcime. Analcime occurs as amygdule fillings, in veins with irregular and gradational margins..., and as pseudomorphs after plagioclase.

In one sample from locality 13, analcime is sufficiently abundant to yield a prominent pattern in whole - rock x-ray diffraction."

analcite = analcime

ANATASE

TiO₂

Bridgton - Route #117 road cut North Bridgton; **Calais** - Red Beach village U. S. Route #1 road cut; **Denmark** - Pleasant Mountain A; **East Middlesex Canal Grant?** - Lobster Mountain A; **Newry** - Dunton Q; Saco Bay - **Biddeford, Old Orchard Beach, Saco, Scarborough**; **Stow** - Colton Hill Q; **Sullivan?** - Pine Tree M; **Topsham** - Consolidated #2 Q, Consolidated #4 Q [= Square Pit]

Lustrous typical bipyramidal anatase crystals (to 2 mm), sometimes with brookite crystals, were found on a fracture surface lined with drusy quartz in granite in a road cut along Route #117 in North Bridgton, **Bridgton** (Yedlin, 1966).

Anatase in miarolitic cavities in the Red Beach granite in a road cut along U. S. Route #1, **Calais** is pseudocubic and black. The crystals are about 1 mm and associated with quartz and microcline. The microcline in the granite is terra-cotta red.

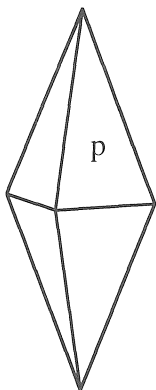
Splendent black pseudocubic anatase crystals (to 1 mm) have been found on red-brown rusty fracture surfaces in quartz found in loose dirt on Pleasant Mountain, **Denmark** (Woodrow Thompson, personal communication, 1990).

A tentative identification was made by Simmons (1987) for a sample at *SP6* on the southwest foot of Lobster Mountain, **East Middlesex Canal Grant**: "anastomosing veinlets of chlorite and very fine Ti-oxides (anatase or brookite?)."

Small 2-4 mm steep, bipyramidal black anatase crystals with deep "horizontal" striations are found at the Dunton quarry, **Newry** (Robert Janules, personal communication, 1990). The crystals are from vugs in microcline lined with white carbonatian hydroxylapatite botryoids. The anatase crystals can be very irregular.

A large number of heavy minerals was reported to occur in nearshore sediments of the Saco Bay area, **Biddeford, Old Orchard Beach, Saco, Scarborough** by Luepke and Grosz (1986): "Pyrite and anatase appear to be of authigenic origin because of unweathered crystal facets, but they may be detrital, considering the rapidity with which periglacial sediments are deposited."

Anatase usually forms steeply pyramidal black crystals in Maine. While anatase is rarely found in the pegmatites of the world, three of the state's occurrences are in these rocks. A small prospect pit on the northern edge of the Consolidated #2 quarry where it meets the William Willes #3 quarry, **Topsham** has produced numerous anatase specimens in etched buff-colored



Anatase, Consolidated #2 Q, Topsham

microcline and etched graphic granite (King, 1992a, 1993a, 1993b). (The other William Willes quarry, to the north of the Cathance River, is called the William Willes #1 quarry.) The small 1-3 mm crystals are typically deeply striated as anatase almost always is. Many of the anatases are multiply terminated; "crooked" with pinching and swelling; and are, many times, completely irregular. The vugs usually have a sericitic muscovite coating. Associated species include occasional brookite and rare rutile. Similar anatase, sometimes with black rutile needles (1-2 mm), has been found in etched cavities of microcline at the Consolidated #4 quarry (Square Pit), Topsham.

ANDALUSITE (Aluminosilicate Group)

Al_2SiO_5

Acton - Acton M; Albee Formation - **Lower Cupsuptic, Parkertown, Upper Cupsuptic**; **Andover** - Dunn Notch A, Lone Mountain A; **Appleton** - Appleton Formation; **Bald Mountain** - Bald Mountain Stock A; **Bangor**; **Belfast**; **Bingham**; **Bucksport**; **Byron** - Byron schist; **TC**; **Camden** - Camden beach, Megunticook Formation; **Cape Elizabeth**; **Caratunk** - Pleasant Pond Mountain A; **Carmel**; **Carrabassett Valley** - Route #27 road cut, Deer Hill A, Poplar Mountain A; **Carrying Place** - Hill 1660 A; **Chatham** - incorrect labeling, actually a New Hampshire town; **Clearwater Pond granodiorite contact** - **Farmington, Industry**; **Dead River** - Little Bigelow Mountain A; **Digdegash Formation** - **Crawford, Wesley, T21**; **Dixville Formation** - **Lower Cupsuptic, Stetson town**; **TE** - Smalls Falls A; **The Forks** - Pleasant Mountain A; **Freeport**; **Georgetown** - Bay Point A; **Gorham** - Warren Mill canal, unspecified road cut; **Harpwell** - Ash's Point A, Bailey island A, Orrs Island A, White's Point A; **Jackson**; **Kellyland Formation** - Indian Lake Stream, Princeton, T21; **Kendall Mountain Formation** - **Alexander, Crawford, Princeton**; **Kennebago Lake quadrangle** - Flagstaff Lake, Redington, and Spider Lake pluton contacts; **Kingfield** - The Bluff, Deer Hill Camps road A, Lexington pluton contact, Route #27 road cut; **Lebanon** - Silver

M; **Lincolnvile** - Penobscot Formation; **Madrid** - Smalls Falls A; **Monmouth**; **Moscow**; **Mount Abram** - Mount Abraham A; **Moxie** pluton contact zone - **Big Squaw, Greenville, Harfords Point, Little Squaw, Squaretown**; **North Berwick** - Bauneg Beg Mountain A; **Onawa pluton contact** - **Elliotsville, Katahdin Iron Works, Willimantic, T7R9 NWP**; **Phillips** - Seboomook(?) Formation on Bear Hill; **Phippsburg** - Hermit Island A, Small Point A; **Rangeley Plantation** - **Quimby Formation**; **Raymond?** - Camp Hinds L; **Readfield?**; **Roxbury** - stream crystal; andalusite grade rocks not mapped in this town by Moench and Hildreth (1976); **Rumford** - Farmers Hill A; **Saint George** - Hart Neck A; **Sandy River** - Sandy river A; **Searsmont** - Cobbs Mills A; **Shirley-Blanchard stock** - **Blanchard, Shirley**; **South Berwick**; **Spaulding**; **Standish** - Mount Wiley A, Whitney Farm cellar; **Surry** - Surry - Blue Hill line woods outcrop; **Topsham**; **Union** - Union Andalusite L; **Warren**; **Washington**; **Whitneyville**; **Windham** - Dundee Falls A; **Winthrop** - Wayne Road A; **Woodland Formation** - **Alexander, Crawford**; **T21** - Huntley Ridge A; **T26ED** - Carloe Brook A

Andalusite is an important component in schists, phyllites, and other rocks in Maine. This mineral has been used to ascertain pressure and temperature conditions of metamorphism. As with other members of the aluminosilicate group, the progressive, or even retrograde, metamorphism of a rock with aluminosilicate mineral(s) might result in incomplete transformation of one into another and the restriction of conditions implied by the species' presence might give an incorrect impression to the observer. Harwood (1966) noted in the Cupsuptic quadrangle: "Andalusite persists in the rocks of the sillimanite zone, but in such occurrences it is rimmed by quartz, quartz and sillimanite, sillimanite, or less commonly muscovite."

Andalusite varies in shape from elongated cylinders of irregular shape which usually taper toward the crystal ends to well-formed rectangular prisms and cruciform twins. When reasonably sharp crystal shape is apparent, the crystals are invariably prismatic with a square cross-section and simple pinacoidal terminations. A thin muscovite coating is frequently present and a few localities have yielded margarite or muscovite pseudomorphs after andalusite. Chiasmolite is a variety of andalusite which shows a white or light-colored right-angle cross in cross-section. The shape of the cross usually changes along the length of the crystal. The chiasmolite can be composed of just the cross or be square with darkened corners. The dark portions of the chiasmolite owe their coloring to minute graphite inclusions. Burr (1939b) listed many town occurrences for andalusite. The above list of localities, while being comprehensive, is certainly not complete.

Harwood (1966) mapped andalusite hornfels in the Albee Formation, Burnt Mountain, **Lower Cupsuptic**, Big Buck Mountain, **Parkertown**, and Cupsuptic Mountain, **Upper Cupsuptic** and in the Dixville Formation, Big Canyon area, **Lower Cupsuptic** and Bald Pate Mountain - Little Kennebago Lake area, **Stetson town**.

Andalusite crystals (to several cm) occur in phyllite at the Acton mine, **Acton** (Ray Woodman, personal communication, 1993). Patry (1962) noted andalusite at an unspecified silver mine, **Lebanon**. Andalusite from Dunn Notch, **Andover** has been misidentified as pink tourmaline by some collectors. Andalusite crystals (to 1.5 x 1.5 x 10 cm) have been found near the summit of Lone Mountain, Andover (George Crooker, personal communication, 1989).

The Appleton Formation, Appleton Ridge, **Appleton** was described having andalusite by Cheney (1967): "The facies is characterized by finger-sized white chialstolite metacrysts that commonly have intermediate pink zones around black cruciform cores. The metacrysts are usually arranged at right angles to each other in the foliation planes of gray fine grained muscovite - biotite quartz schists, with the biotite forming 1 mm long tabular black metacrysts in an otherwise gray ground mass. In thin section only the biotite within the slightly cataclastic chialstolite has escaped partial alteration to chlorite. These chialstolite-bearing units are intercalated with chialstolite-free metasediments 5 to 10 inches thick. ... The bedding that has not been obliterated is thin and foliated in the same style as the beds on the aforementioned hill and the Round Pond facies to the north, but here the prisms are filled with chalky white feldspars and some biotite surrounding a cruciform core of muscovite, pseudomorphic after the chialstolite cores. Some of the pseudomorphs contain tan to nearly transparent needles of sillimanite."

Perkins (1928) wrote of **Caratunk-The Forks**: "Pleasant Pond Mountain, to the east of Caratunk, seems to be a mass of Andalusite schist with a core of granite."

Boone (1973) indicated the resistance to change exhibited by aluminosilicate group minerals in **Carrying Place**: "Andalusite persists, probably as a metastable phase, into the sillimanite zone on hill 1660 north of Pond Stream." Further, concerning andalusite in **Dead River**: "Fresh andalusite occurs as large porphyroblasts in metapelite portions of graded beds of the Seboomook Formation underlying the northeast slope of Little Bigelow Mountain. It accounts for approximately 5-8 percent of the metapelite rock. Most of the andalusite examined in thin section contains numerous inclusions. It is judged to be in uneconomic concentrations as a raw material for refractory ceramics." Additionally, Boone (1973) reported on the large (to 5 x 1 cm) chialstolites on the west flank of Poplar Mountain, **Carrabassett Valley** formed by the contact action of the Lexington pluton. South of this area, well-known collecting sites are across the Carrabassett River from the former ranger station, **Kingfield**. Large pink andalusite crystals (to 15 x 5 x 5 cm), with silvery mica coatings, are found in quartz. Some pale green andalusite crystals (to 2 cm) are also known. Road cuts along Route #27 in Carrabassett Valley and Kingfield contain chialstolite in phyllite and good crystals (to 3 x 1 x 1 cm) can be found along the margins of quartz stringers and veins.

The contact zones of the Moxie pluton, **Big Squaw**, **Harfords Point**, **Little Squaw**, etc.; the Shirley-Blanchard stock, **Shirley** and **Blanchard**; and the Bald Mountain stock, **Bald**

Mountain, **Blanchard**, and **Shirley** were described to contain andalusite by Espenshade and Boudette (1967):

"Andalusite occurs in pelitic rocks in a zone ranging from less than a thousand to several thousand feet wide around the intrusions. Actinolite and tremolite occur in the calcareous rocks of the limy sandstone unit in about the same zone, and the isograd on the geologic map bounding the outer part of this zone is called the andalusite - amphibole isograd ... This isograd is generally farther from the contact of the mafic pluton than from the felsic intrusions, presumably because of the greater heat supplied by the mafic pluton and probably also because of the southerly dip of the south contact of the pluton. The andalusite-amphibole zone around the Shirley-Blanchard stock ranges from about 1,000 to 4,000 feet in width, probably because of subsurface irregularities in the shape of the body. On the other hand, this zone adjacent to the Bald Mountain stock has a rather uniform width of about 1,500 feet which suggests that the edge of this part of the stock dips uniformly.

The andalusite schist and hornfels range in color and texture across the andalusite - amphibole zone from the fine-grained light - gray schist containing andalusite prism as much as 2 cm long in the outer part of the zone to granular or gneissic dark-brownish-gray hornfels in the inner part of the zone containing andalusite crystals only a few millimeters long. In the outer part of the zone, andalusite occurs as well-formed chialstolite crystals that contain fine dusty inclusions in cross-shaped concentrations which have a thin mantle of graphitic material on the crystal boundaries. ... The crystals characteristically are randomly oriented within the cleavage plane. ... In the inner part of the andalusite zone all the essential minerals (quartz, feldspar, biotite, and muscovite) except andalusite are coarser grained than in the outer part. Here the andalusite forms stubby pleochroic crystals a few millimeters long that have irregular shapes and a spongy appearance because of abundant tiny inclusions of quartz, feldspar, and biotite. The andalusite content throughout the zone ranges from a few percent to about 10 percent."

Jackson (1953) observed that andalusite remained as tiny relicts in muscovite pseudomorphs after andalusite in the Byron schist, **Byron**.

The thin chialstolite schist member of the Megunticook Formation (Berry, 1987) winds from just northwest of Sherman Cove to Spring Brook and doubles back on the east and southwest slopes of Mount Megunticook, **Camden**: "Abundant chialstolite megacrysts typically 5 centimeters long, and ranging up to 12 centimeters long, characterize the unit."

The contact aureole of the Onawa pluton, **Elliotsville**, **Katahdin Iron Works**, **Willimantic**, and **T7R9 NWP** was described by Philbrick (1936). The aureole consists of schist and hornfels with tiny (less than 3 mm) andalusite crystals and grains.

Kunz (1883c) reported a rare occurrence in **Gorham**: "At Gorham, Maine, on the shores of Sebago Lake, some excavating was done for a road about one year ago, and in a mass of rock thrown out in blasting, Mr. Hayden, of Raymond, Maine, found the specimens of andalusite now exhibited. These crystals, for

perfection, color and size, are equal to those found at any known locality where this mineral does not occur in gem form. The color is mostly a brownish flesh tint and at times the pink hue fades to a faint grayish pink. The crystals are opaque but translucent in pieces from 3^{mm} to 5^{mm} in thickness. A broken crystal measured 90^{mm} (a), 53^{mm} (b), 48^{mm} (c). Several measured over 80^{mm} in length, and one fragment of a large crystal measured 55^{mm} on one face, and may have measured over 70^{mm} on the prism. Some crystals are very small, being 1^{mm} in diameter. ... They occur in a quartzite vein in a mica schist of a brown color, scattered through which are beautiful small crystals of pyrrhotite. These which I exhibit and a few fragments are all that have been found as yet in the locality. A hasty visit to the place failed to bring to light any more specimens, the rock having been thrown into the excavation and all traces of the mineral thus obliterated." A specimen labeled "Windham" from an "old" collection bears some resemblance to Kunz's (1883c) description. The specimen consists of a repaired and unterminated brownish pink square andalusite prism (2.5 x 2.4 x 7.2 cm) with minor golden brown and black stained milky quartz and muscovite. The muscovite is parallel to the prism and forms a discontinuous coating on the andalusite.

Some very large andalusite prisms (to 7 x 3 cm) are found in muscovite and quartz lenses on the beach "across from the church" on Bailey Island, **Harpwell**. Andalusite from the Ash's Point and White's Point areas can have small irregular blue corundum inclusions (2 - 3 mm) (Arthur Hussey, personal communication, 1991).

Boudette (1991) mapped andalusite-bearing contacts around the Flagstaff Lake, Redington, and Spider Lake plutons, **Kennebago Lake** quadrangle.

Lander (1953) wrote of **Kingfield**: "We first visited what is known as the Bluff four miles north of Kingfield on route 27. Here one will find andalusite crystals which are gray, white, green, and flesh color. There is a variety of andalusite found here which is called chiasolite or cross stone. When these crystals are cut perpendicularly to the length of the prism, you will notice a cross of which no two will be alike, no matter how many times that crystal is cut." Andalusite from Kingfield is actually found in many locations and is found in a variety of aspects. Good specimens are found in boulders in the Carrabassett River. Light green andalusite crystals have been found at an unspecified location on the Deer Farm Camp road, Kingfield. Big pink andalusite crystals (to 10 x 3 x 3 cm) which have a peculiar bright silvery-white undulatory muscovite flake (to 1 cm) coating, all embedded in quartz, have been found at a woods outcrop across the river from the former forest ranger station.

Andalusite is found in large, but generally poor quality crystals in the Penobscot Formation, **Lincolnton**. Bickel (1976) described the generally altered nature of much Maine andalusite in the specific case of the Belfast quadrangle:

"In the andalusite and lower sillimanite zones, most of the rocks of the Penobscot Formation contain or are interbedded with rocks that

contain andalusite or sericite that replaces andalusite. ... Between Duck-trap and Frohock Mountains, but nowhere northwest of the Coleman antiform, andalusite schist without obvious bedding is more abundant than bedded rock. Most of it is black and contains abundant, randomly oriented porphyroblasts of andalusite, partly replaced by sericite. ... Minor graphite and abundant pyrrhotite account for the black color before and rusty color after weathering of this rock.

Most of the andalusite schist is gray on fresh surfaces, but portions of the rock particularly rich in andalusite or sericite pseudomorphous after andalusite are bluish gray or light gray. ...

Prisms of andalusite average about 1 cm and range up to 5 cm in length. Completely fresh andalusite is rare. Generally, the andalusite is partly or completely replaced by patches of sericite with or without coarse, nearly equant, randomly oriented crystals of muscovite. In some of the most strongly schistose rocks, the sericite patches are flattened in the plane of the schistosity. Abundant, coarse, randomly oriented muscovite cuts across a weak schistosity in many of the rocks and probably represents andalusite porphyroblasts for which no other textural evidence remains."

Terminated andalusite crystals (to several centimeters) are found frozen in quartz lenses in the schist at Small Point, **Phippsburg**. Some of the best morphological andalusite crystals (to 2 cm) are found frozen in quartz pods along with sillimanite and probable dumortierite from Hermit Island, Phippsburg. The Hermit Island crystals are somewhat gemmy, bright brownish pink, and have sharply formed terminations and modifications. Hussey (1988) also noted: "Pelitic rocks of the Small Point area, now at andalusite to sillimanite grades of metamorphism, preserve 2 to 4 cm long pseudomorphs of muscovite after chiasolite(?)... The present assemblage includes poikiloblastic fresh andalusite up to 5 cm in diameter, twinned staurolite, biotite porphyroblasts, minor cordierite, and sillimanite in small quantities intergrown with the biotite, in addition to muscovite pseudomorphs."

A relatively sharp, slightly water-worn pinkish brown, andalusite crystal (4 x 1 cm) was found in a stream bed in **Roxbury** and was in the Edmund Bailey collection, University of Maine collection, Orono (specimen no longer available). However, andalusite-grade rocks are not known from the town (Moench and Hildreth, 1976). A similar-appearing crudely terminated square prismatic highly flawed, but sporadically gemmy pink, with occasional green patches, andalusite crystal (2.3 x 1.7 x 1.6 cm) from Andover has particularly bright white mica flakes (to 1 mm) interstitial to a few minute cracks in the crystal.

Guidotti (1979) mapped and discussed the occurrence of andalusite at Hart Neck area, **Saint George**: "All of the metamorphic rocks are now at least somewhat retrograded. This is indicated by the prominent development of muscovite pseudomorphs after andalusite and sillimanite and irregular biotite (and chlorite?) aggregates after some presumably Fe-Mg mineral. The pseudomorphs after andalusite consist of medium-grained muscovite plates and form euhedra up to 4 cm long. They are well displayed on weathered surfaces along portions of Hart Neck."

Jackson (1837a) reported of **Searsmont**: "Near Cobb's mills, in Searsmont, the talcose slate runs E. N. E. and is intersected by numerous beds of quartz, from six to ten inches thick, containing large flesh colored crystals of andalusite."

Jackson (1861b) reported of **South Berwick**: "... andalusite macle, alluded to in the previous meeting as occurring at Boar's Head and the White Mountains, has been found at the intermediate position of South Berwick, Maine."

Kunz (1892a) said of **Standish** andalusite: "Those from Mount Wiley are from $\frac{1}{4}$ to $\frac{3}{8}$ of an inch in diameter, of good flesh-pink color, and would cut into very fair gems." The Mount Wiley in question does not appear on current maps of Standish, although there is a Mount Wiley in nearby Baldwin. No specimens known. Specimens of andalusite from an unspecified Standish occurrence (AMNH #11565, 11566, 11567) seem to fit the description of Gorham specimens (Kunz, 1883c). The rectangular prismatic crystals (to 12.5 x 2.4 x 2.1 cm) can have flat or complex terminations, a gray-pink interior, and a muscovite coating and quartz matrix.

A woods outcrop in **Surry** along the north side of a dirt road several hundred meters from Route #172 on the Surry - Blue Hill town line has produced pink, terminated andalusite crystals (to 5 mm) in quartz and muscovite matrix associated with gahnite, sphalerite, and pyrite.

The **Union** andalusite collecting locality was located by Thompson et al. (1988). The Union andalusite consists of gray and white chiastolite rods (to several cm) which appear as rounded cylinders oriented in subparallel fashion within a gray phyllite.

Forsyth (1955a) reported 3 mm chiastolite crystals from **Wesley** village area (probably an extension of the andalusite zone of the Digdeguash Formation).

Larrabee (1964) noted andalusite and sillimanite in the Kellyland Formation, **T21**, **Indian Lake Stream**, and **Princeton**. Additionally, chiastolitic andalusite crystals (to 16 x 1 cm) were found in the metamorphosed "Dark Argillite" (Charlotte Group) northeast and west of Huntley Ridge, **T21** and north of Carloe Brook west of Hawkins Ridge, **T26ED**. Similarly large andalusite crystals were reported by Ludman (1986) in the andalusite zone of the Digdeguash Formation, **T26ED**, **T21**, and the extreme northwest corner of **Crawford**: "Andalusite occurs in pelites of the Woodland and Kendall Mountain Formations as small rice-shaped gray porphyroblasts, but in the Digdeguash Formation it is nearly always euhedral and occurs as chiastolitic prisms that range from 1.5 to 20 cm long. ... In 1979, the General Refractories Corporation examined pelitic hornfels of the Digdeguash Formation along Seavey Ridge to determine the feasibility of opening a mining operation to recover andalusite for the manufacture of refractory brick. ... Andalusite porphyroblasts from the sites collected amounted to as much as 20% of the rock and generally ranged from 4 - 10 cm in length."

andesine (Feldspar Group) - see plagioclase series

andradite? (Garnet Group)



Arrowsic - *Arrowsic Emery M; Carrabassett Valley?* - garnet diorite; **Deer Isle**; **Georgetown** - *Indian Point A*; **Paris**; **Rangeley** - *Rangeley Garnet Q*; **Woodstock** - *Bryant Pond A*

No sample of Maine andradite was available for description or verification. Morrill et al. (1958) said of **Arrowsic** andradite: "Arrowsic Emery Mine. Andradite garnet reported sold as emery." The garnet from Arrowsic is identical to the garnet from Georgetown and is part of a cotecule member of the Cape Elizabeth Formation and the garnet could be related to spessartine (Arthur Hussey, personal communication, 1990).

The red-brown, fine-grained, jasper-like, banded garnet from Indian Point, **Georgetown** has been called andradite by some collectors, but may be spessartine.

Dark olive green andradite (unanalyzed) dodecahedral crystals (to 2 mm) from **Paris** (AMNH, #5560) occur in layers in granular quartz calcite matrix, which resembles some calcite-rich layers within the Sangerville Formation.

The Rangeley Garnet quarry, **Rangeley** was abortively developed for its potential as an abrasive source in the 1970's. The deposit consists of a contact aureole with a high percentage of garnet. The garnet is probably andradite (Charles Guidotti, personal communication, 1990).

A specimen labeled andradite, **Woodstock** exists (USNM # 44603), but the specimen has not been tested. It consists of red-brown dodecahedral crystals (to 1 cm) frozen in vein quartz (7± cm thick) with garnet selvage (Paul Powat, personal communication, 1993). The original specimen was initially labeled grossular with no indication for the name change.

ANGLESITE (Barite Group)



Brooksville - *Callahan M, Cape Rosier M; Garland - Preble Hill M; Gouldsboro - Gouldsborough M; Lincolnville?*; **Lubec** - *Lubec Lead M; Pembroke - Big Hill M*

Prevailing "wisdom" formerly suggested that the fine-grained gray to gray-white alterations of galena were anglesite. The usual alteration is actually cerussite. Anglesite crystals are rarely twinned and this is a distinction from usually twinned cerussite crystals.

Carpenter and Foster (1960) say of the Cape Rosier mine, **Brooksville** anglesite, "A few snow-white platy crystals of anglesite have been observed in the talc rich wall rocks. The anglesite crystals at the Cape Rosier mine can be recognized by their diamond-shaped outline and close association with small cubes of halite." The frosted rhombic-shaped anglesite (unnum-

bered) is preserved in Carpenter's suite of Cape Rosier specimens at Harvard University.

Transparent anglesite crystals (1-2 mm) are found in milky quartz vugs with sparse galena grains at the Preble Hill mine, **Garland**.

Li (1942) reported of the Gouldsborough mine, **Gouldsboro**: "The secondary mineral anglesite, replaces galena along the cleavage lines."

"Anglesite" from an unspecified locality in **Lincolnville** appears to be cerussite.

Blocky, rhombic anglesite crystals (to 5 mm) in laminated clusters (to 8 mm) are found in slightly limonite-stained vugs in massive galena at the Lubec Lead mine, **Lubec**. The crystals are occasionally striated and are not twinned as cerussite would frequently be. Anglesite crystals (to 2 mm) in orange-stained vugs with milky quartz crystals are transparent and show complex morphology.

"Anglesite crystals" observed from the Big Hill mine, **Pembroke** appear to be cerussite. However, Li (1942) noted of Pembroke: "The galena itself is replaced by secondary anglesite along cleavage traces."

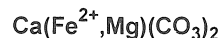
ANHYDRITE



Blue Hill - Black Hawk M

Lilac-colored anhydrite cleavages (2 - 6 mm) were found in compact masses (to 10 cm) with interlocking texture and were found associated with minor green granular diopside (3-4 mm) and pyrite grains (1 mm) at the Black Hawk mine, **Blue Hill**. Masses to several kilograms were recovered during mining.

ANKERITE (Dolomite Group)



Brooks quadrangle - **Dixmont, Thorndike, Troy; Cape Elizabeth - Cape Elizabeth Formation; Carys Mills Formation - Blaine, Easton, Fort Fairfield, Mapleton, Mars Hill, Presque Isle, Washburn, Westfield; Dead River Formation - Eustis, Tim Pond, Stetsontown; Digdeguash Formation - Alexander, Crawford, Princeton, T21, T26ED BPP, T27ED BPP, T37ED BPP; Flume Ridge Formation - Baileyville, Grand Lake Stream, Indian Township, Princeton, Talmadge, Waite, T1R2, T21, T26ED, T27 ED; Hurricane Mountain Formation - Alder Stream, Eustis, Jim Pond, Tim Pond, Stetsontown; Mexico - U. S. Route #2 road cut; Penobscot - Penobscot P; Saco - Cascade Q; Sangerville Formation, Smyrna Mills Formation - Amity, Cary, Forkstown, Haynesville, Orient, T8R3 NBPP; Trescott - Bog Brook Cove - Moose River A; Vassalboro and Waterville Formations? - Benton, Fairfield, Winslow**

Ankerite is a member of the dolomite group and is a far scarcer mineral than has been generally supposed (Robinson and Chamberlain, 1984). Modern chemical analyses have demonstrated that most historical ankerite determinations were incorrect and that the samples have proved to be ferroan dolomite, calcian siderite, etc. The definition of ankerite requires a site in the crystal structure dominated by Ca and a second metal site where $\text{Fe} > \text{Mg}$, Mn, etc. Many geological reports of ankerite are field terms rather than correct identifications. Ferroan calcite and ferroan dolomite are the most frequent correct identifications in Maine rocks and this notation may be applicable to some of the "ankerites" listed here. Frequently, ankerite is identified only based on the fact that a particular carbonate-bearing rock weathers with a rusty surface.

Ferry (1976) informally used the term ankerite when his analyses indicated ferroan dolomite from biotite-bearing zones of the Vassalboro and Waterville Formations, **Benton, Fairfield, and Winslow**. Osberg (1968) noted ankerite in lower metamorphic grades of the Vassalboro Formation.

The Cape Elizabeth Formation, near the Two Lights State Park area, **Cape Elizabeth** was found by Hussey (1982) to contain ankerite: "Quartzite of the Cape Elizabeth Formation, when examined with a microscope, has small amounts of mica, feldspar, and two carbonate minerals (calcite and ankerite); thus it is not a pure quartzite." Hussey (1978) wrote: "Extensive shore-margin exposures here are of thin to thick-bedded, slightly calcareous and ankeritic metasiltstone (weathers with pale buff color due to alteration of ankerite to limonite on the weathered surface), and dark gray phyllite. These rocks are metamorphosed to chlorite grade. This is considered to be the type area for the Cape Elizabeth Formation by F. J. Katz (1917) who first mapped and named the formations."

Ankeritic limestone which "weathers buff to tan" was reported from the Carys Mills Formation, **Blaine, Easton, Fort Fairfield, Mapleton, Mars Hill, Presque Isle, Washburn, and Westfield** by Pavlides (1978).

Occasional ankerite was reported from the chlorite zone of the Digdeguash Formation, **Alexander, Crawford, Princeton, T21, T26ED, T27ED** and **T37 ED** (Ludman, 1986, 1990b) and the Flume Ridge Formation, **Baileyville, Grand Lake Stream, Indian Township, Princeton, Talmadge, Waite, T1R2, T21, T26ED, and T27 ED** (Ludman, 1990a, b).

Ankerite is a component in some metamorphic rocks and has been formed as a result of the induced chemical reactions in the rocks. Bickel (1974) reported chemical analyses of ankerite from the chlorite and biotite zones of the Brooks quadrangle, **Dixmont, Thorndike, and Troy**.

Boudette (1991) noted ankerite in the Early Paleozoic metasedimentary Dead River Formation, **Eustis, Tim Pond, and Stetsontown** and the Hurricane Mountain Formation located in the same towns and **Alder Stream and Jim Pond**.

Large (1 cm) thin to tabular ankerite crystals have been found in a road cut on U.S. Route #2 just east of the village of **Mexico**. Frew (1957) reported on the identification of the min-

eral as crandallite (q.v.), but indicated that ankerite was also a choice. The ankerite is tan to golden brown in color and formed the lining of a 5-10 cm thick quartz crystal-bearing vein in the mica schist. Solid plates of crystals 10 x 10 cm were not uncommon. The crystals are tightly packed with the curved, tabular crystals clustered "on end." The arrangement was called "Wheaties" by the local collectors as the flakes on-end fancifully resembled breakfast cereal flakes. No quantitative chemical data known, but the mineral gives positive wet chemical tests for carbonate, iron and calcium (Vandall King, unpublished data, 1966).

Young (1962) reported ankerite without description from the Penobscot prospect, **Penobscot**.

Hitchcock (1874) reported from **Saco**: "The Cascade Slate Co. have opened a ledge where a cliff of fifty feet altitude gives facilities for cleaving the strata. There is no difficulty in getting slabs ten feet long. Between the clay beds are harder strata with quartz veins carrying the mineral ankerite."

Ankerite was reported from unspecified locations in the Sangerville Formation, which extends from the Dover-Foxcroft quadrangle to the Buckfield quadrangle, by Pankiwskyj et al. (1976): "A wide variety of lithic fragments in the metagraywacke is cemented by a calcareous and (or) argillaceous matrix that often includes a ferroan carbonate (both ankerite and siderite have been observed) in outcrops in the chlorite zone."

Ludman (1982) reported ankerite from the "Central Maine Sandstone Belt" which includes the Smyrna Mills Formation. The localities referred to seem to be near western Stetson Mountain, **T8R3 NBPP** and in an area including **Amity, Cary, Forkstown, Haynesville, and Orient**.

Gates (1961) reported of **Trescott**: "Several of the major shear zones contain veins of calcite, and one intersecting the coast between Bog Brook Cove and Moose River has a mass of ankerite with quartz veins which must weigh at least several tons."

ANNITE (Mica Group) - see extended discussion of annite's interrelationship with other micas under biotite series heading.

ANORTHITE - see plagioclase series

ANORTHOCLASE - see plagioclase series

ANTHOPHYLLITE (Amphibole Group)



Appleton - *Gushee Farm A*; **Blue Hill** - *Black Hawk M*; **Byron** - *West Mountain A*; **Coburn Gore** - *Boil Mountain Complex*; **Georgetown** - *coticule beds*; **Grafton** - *Black Brook A, knob SE of York Pond, Old Speck Mountain A*; **Harpwell** - *Spring Point Forma-*

tion; **Newry** - *Scotty Q*; **Rumford** - *Route #108 outcrop*; **Union** - *Harriman P*; **T6 North of Weld** - *West Mountain A*

The Gushee Member of the Penobscot Formation, **Appleton** was described by Bickel (1976): "About 65 percent of the rocks in the Gushee Member are mafic. Near the type area, the rocks weather rusty and are rich in anthophyllite and cordierite... They range from fine- to coarse-grained; there are conspicuous "sunbursts" of anthophyllite in the coarser varieties." (See also tiroidite.)

Anthophyllite is found in the ore body at the Black Hawk mine, **Blue Hill**. Brown splintery needles (to 3 mm) of anthophyllite are found embedded in pyrite and brownish-black sphalerite. Some of the associated pyrite shows octahedral crystal shape (to 2 mm) with offset intergrown octahedral pyrite crystals producing a sort of "rosette" due to the intergrowth. Yates and Howd (1988) wrote of the Black Hawk mine: "Anthophyllite grains BHE4 are well-formed, euhedral needles which are scattered either as individual grains or as radiating rosettes throughout the biotite-quartz-oligoclase matrix. Although anthophyllite is commonly in contact with the large cordierite poikiloblasts, like biotite, it is rarely included within cordierite..." Lindgren (1925) mentioned, but does not describe, anthophyllite and cordierite (q.v.) from the Ellsworth Schist contact with unspecified ore deposits in Blue Hill.

An unnamed garnet-biotite tonalite near West Mountain, **Byron** and **T6 North of Weld** contains occasional anthophyllite as well as pyrrhotite and pentlandite (q.v.) (Moench and Pankiwskyj, 1988).

Anthophyllite laths from the ultramafic Boil Mountain Complex, **Coburn Gore** have been found altering to flaky white talc (to several mm) (Charles Guidotti, personal communication, 1990).

An interesting occurrence is seen in **Georgetown** where anthophyllite fills plane fracture openings in strongly folded coticule beds (Arthur Hussey, personal communication, 1992).

Milton (1961) noted anthophyllite in Ammonoosuc Volcanics from the Black Brook area and from a knob southeast of York Pond and elsewhere, **Grafton**. Kimball (1981) analyzed anthophyllite coexisting with one or even two other amphiboles from Old Speck Mountain and further north exposures of the Ammonoosuc Volcanics, **Grafton**: "Anthophyllite occurs as colorless patches in gedrite or as exsolution lamellae in gedrite... Occasionally anthophyllite occurs as small individual grains between gedrite crystals or in plagioclase matrix. These grains are also colorless."

Hussey (1988) reported of **Harpwell**: "The Spring Point Formation consists primarily of metamorphosed basic and intermediate volcanic tuffs and flows. These are represented now by chlorite-spessartite phyllite, actinolite gneiss, and hornblende - garnet amphibolite locally with cummingtonite and rarely anthophyllite."

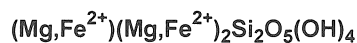
The contact of the Scotty pegmatite, **Newry** with the chloritized Plumbago pluton metagabbro shows albite with a medium

to light green fibrous amphibole which sometimes has been called actinolite. In a few spots, a dull-lustered amphibole is found with needles which reach 4 cm in length and the color is tan to cream-white. The light colored material has been called anthophyllite. Peacor (1960) wrote of Newry anthophyllite: "A single one half inch seam was found in the country rock."

Moench and Hildreth (1976) reported: "The ultramafic rock exposed near Rumford (crops out on Route 108) is massive, tough, and coarsely crystallized; it is composed of tremolite, olivine, magnesian chlorite, sparse anthophyllite and magnetite, and trace amounts of apatite and zircon."

Houston (1956) explained that in the Harriman feldspathic lherzolite peridotite, **Union**: "Hornblende, tremolite-actinolite and anthophyllite occur as secondary products of the original peridotite minerals."

ANTIGORITE (Serpentine Group)



Black Narrows A - East Moxie, The Forks; Boil Mountain Complex serpentinite - Alder Stream, Oxbow, Seven Ponds; Brooksville - Callahan M, Cape Rosier M; Deer Isle - Deer Isle M, Little Deer Isle traprock quarry, North Deer Isle A, Pine Hill A, Verde Antique Q; TDR2 WELS - Porcupine Hill A; Hampden - Hampden Wharf A; Harpswell; Hermon - Hermon Hill Q, Island Falls; Jim Pond; Katahdin Iron Works - Katahdin Iron Works M; Lewiston - City Q; Lincolnville - Heal Q; Lower Enchanted; Mapleton - unnamed diabase; Monhegan - White Head Q; North Haven; Oakfield; Parmachenee; Richardson - Pine Island A; Rockland; Seven Ponds - Beaver Pond - Kennebagaw Divide A; Sidney; Thomaston - Williams Q; Union - Harriman P; Whiting - Cooper M; T3R5 BKP WKR - Little Spencer Stream-Spencer Lake A; T5R6 BKP WKR - Three Slide Mountain A

Antigorite is the common serpentine. It forms compact resinous, oily, to dull masses which are generally dark green. Antigorite does not usually form visible crystals and is frequently produced by the metamorphism of basalts, norites, troctolites, and other basic and ultrabasic rocks. Verde antique is a decorative variety of serpentine which contains light colored veins and variegated patterns. The distribution of some serpentine bodies can be seen on the *Bedrock Geologic Map of Maine* (Osberg et al., 1985), and also in Harwood (1966), and Boone et al. (1970). Antigorite is a frequent alteration of forsterite and other species in basalts, etc. For example, Boucot et al. (1964) wrote of **Mapleton**: "The diabase east of Mapleton and on Haines Hill is olivine-bearing, and some of the olivine has been replaced by plates of antigorite and veinlets of chrysotile."

Deer Isle contains numerous outcrops of serpentine and the Little Deer Isle quarry and the Verde Antique quarry yield fine specimens of dark green opaque antigorite. Kunz (1892a) mentioned the locality. Smith et al. (1907) wrote of the Verde Antique

quarry: "A considerable amount of serpentine has been obtained in the past from a quarry on the northeastern shore of Deer Isle, but for almost twenty years this quarry has remained unworked. The rock here is fine-grained, massive, and dark green to almost black in color; in places it is cut by a multitude of minute veins of calcite. ... The serpentine was sawed into slabs for window-sills, doorposts, doorsills, etc., but the work was soon abandoned because of the liability of these blocks to split along joint planes while in the shops or even after they were placed in position in a building. The color is too somber for ornamental uses, but the rock seems durable and well adapted for certain general building purposes in which large pieces are not required (Merrill, G. P., [1903] *Stones for Building and Decoration*, p. 60)." Merrill (1888) noted serpentine alteration of augite from peridotite, Little Deer Isle, Deer Isle.

Gem quality serpentine, retinalite (q.v.) variety of antigorite, has been found at **Alder Stream**, **Eustis**, and **Jim Pond** and other towns in northern Franklin County. Boudette (1970) located exposures of antigorite in Alder Stream west of Blanchard Pond.

Houston (1956) said of the host rocks at the Katahdin Iron Works mine, **Katahdin Iron Works**, the Black Narrows area, **The Forks** and **East Moxie**, and the Harriman prospect, **Union**: "Except in the highly altered phases of the rocks, serpentine is confined to the mafic types rich in olivine. Single olivine crystals are partly or completely replaced by serpentine and magnetite. In these cases the serpentine is essentially antigorite. It may locally replace other minerals where they touch the olivine but the antigorite does not extend far from the olivine crystals."

Bastin (1908a) described the formation of antigorite at the Harriman pyrrhotitic peridotite, **Union**: "The serpentization begins in the normal manner at the borders of the olivine grains and proceeds inwards along irregular cracks. The degree of serpentization varies greatly in different portions of the rock, some olivine grains showing only a narrow border of serpentine not exceeding 0.015 mm in width along their contact with pyrrhotite and chalcopyrite, while in other cases the olivine grains have been almost entirely serpentized."

Burr (undated a) listed additional localities for serpentine in **Brooksville**, **Hampden**, **Harpswell**, **Lower Enchanted**, **North Haven**, **Sidney**, **Whiting**, and **T3R5 BKP WKR**, however, at least one of his occurrences (Harpswell) has no known serpentine (Arthur Hussey, personal communication, 1992). Smith (1923) listed black granites which have serpentine alteration of their components including Hermon Hill quarry, **Hermon** and **Heal** quarry, **Lincolnville**. Pavlides et al. (1965) mapped the antigorite body on Porcupine Hill and near the outflow of Ketchum Lake, **TDR2 WELS**.

antimonial silver?

Acton? - *Dirigo M; Gouldsboro?* - *Gouldsboro M; Lakeville?* - *Cushman farm M; Lowell?* - *Shorey M; Sullivan?* - *Sullivan M*

No Maine samples have been preserved. True antimonial silver is dull metallic gray and can be massive to foliated in texture and is brittle. Modern nomenclature would assign the name dyscrasite to antimonial silver, but a mixture of minerals could give this suggested identification when blowpipe analysis was used. Alternatively, the identification may originally have been overenthusiastically or fraudulently intended to make a mine seem richer in silver and thus more attractive to investors.

Antimonial silver was reported from the Cushman farm, **Lakeville** (Morrill et al., 1958) without further citation known.

Actual reports include - Gouldsboro mine, **Gouldsboro**: "The ore is argentiferous galena, sulphurets of copper, copiously intermixed with gray copper and antimonial silver" (MMJ, September 17, 1880; see also MMJ, March 26, 1880) and Shorey mine, **Lowell**: "The ore is antimonial silver..." (MMJ, July 16, 1880). While antimonial silver from Sullivan mine, **Sullivan** is listed by Kempton, 1879; Thomas Cahill, Sullivan mine superintendent is later cited (MMJ, June 24, 1881): "I got the first antimonial silver yesterday from the mine; it contains 65 per cent of silver."

The most competent observer of the mineral, Charles Hitchcock, was imprecise concerning the Dirigo mine, **Acton**: "In general, we may say of the Acton mines, without speaking of several other locations beyond the Dirigo, there are three quartz veins, the one usually mined being 10 feet wide, charged with argentiferous galena, argentiferous mispickel and magnetic pyrites, ordinary pyrites in less amount, besides a little antimonial silver, copper and zinc."

antimony?

Falmouth?, Old Town?, Union?, York?

Antimony has been reported in many reports beginning with W (1809) through Morrill et al. (1958), and others. There is no evidence that *native* antimony was found and the name seems to have been an informal designation for small amounts of antimony in ore, probably as stibnite, etc. The only definitive statement appears to be that of Bartlett (August 6, 1880): "We have now in the native condition, copper, silver, gold, antimony, bismuth, platinum and iridium." No locality was given for the antimony.

apatite - common apatite is fluorapatite, see also hydroxyl-apatite

apophyllite?

Perry? - Loring Cove A?

Jackson (1837a) noted of **Perry**: "In the amygdaloid are found numerous nodules of calcareous spar, coated, on their external surface, with a layer of bright green chlorite [possibly pumpellyite], geodes of agate, containing crystals of amethyste quartz, apophyllite, analcime and various other infiltrated minerals, specimens of which are deposited in the collection made for the State." Apophyllite is listed in subsequent checklists, but all subsequent reports are apparently based on this first report. Morrill and Hinckley (1959) listed "apophyllite (Rare)" from Loring Cove, **Perry**. Thompson et al. (1991) listed fluorapophyllite. No specimens known.

aquamarine - see description under beryl

ARAGONITE (Aragonite Group)

CaCO₃

Brooksville - *Callahan M*; **Franklin?**; **Fryeburg** - *Eagle Gray Q*; **Jim Pond**; **Pembroke** - *Barrett P*; **Rangeley** - *Mingo Loop Q*; **Thomaston?** - *"Buttermilk Street Q"*; **Unity** - *Routes #139 / #220 road cut*; **Winthrop?** - *Horseshoe Island A*

Aragonite is found as 1-2 mm white needle crystals from the Callahan mine, **Brooksville** associated with aurichalcite in tan clayey gossan.

Small "hedgehog" botryoids (to 4 mm) of white aragonite crystals can be intergrown with pale yellow opaque hyalite opal on fracture surfaces on granite pegmatite from the Eagle Gray quarry at the foot of Stark Hill, **Fryeburg**.

An unspecified locality produced clear to white aragonite crystals (to 4 mm) in stellate groupings along fracture surfaces in arnoldite rock from **Jim Pond**.

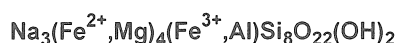
Sprays of clear aragonite crystals are found with malachite and tenorite botryoids (to 2 mm) on chalcopyrite, quartz, and siderite matrix from the Barrett prospect, **Pembroke**.

Translucent gray to snow-white irregular botryoidal aggregates (to 3 mm) of aragonite with "curved spike" crystals (to 1 mm) projecting from the botryoids have been previously identified? as artinite (q.v.) (supposedly by X-ray diffraction) from fractures in quartz boulders from Mingo Loop road metal pit near Oquossoc village, **Rangeley**. The aragonite is post-excavation in formation.

Aragonite, forming recent tan to brown columnar-grained concretions around twigs and sticks, has been found at a small unnamed marble quarry at Buttermilk street and U.S. Route #1, **Thomaston** in the standing water in the quarry (Charles Guidotti, personal communication, 1990).

A road cut along route #139 and #220, **Unity** produced transparent aragonite crystals (to 2 mm) on clear quartz crystals (to 1 cm) on chloritic tan microcline with pyrite and limonite patches associated.

ARFVEDSONITE (Amphibole Group)



Agamenticus Complex - South Berwick, Wells, York; paisanite dike, tinguaitite dike - York

Arfvedsonite is a dark green soda amphibole. Arfvedsonite has distinctive optics, yet no chemical data are available to substantiate Maine finds. A rock found in **Wells** had "arfvedsonite" embedded in a magnetite-bearing (grains to 5 mm) microcline alkali syenite without albite. The arfvedsonite grains are irregular (1-2 cm), are dark green with a splintery aspect, and appear to be infilling volumes between Carlsbad twinned microcline grains (to 2 cm). Brown titanite grains and crystals (to 5 mm), greenish-black fayalite grains with conchoidal fracture, pale pinkish-purple fluorite grains (to 2 mm), brown prismatic zircon crystals (to 2 mm) and 2-5 mm annite-phlogopite grains are also frozen in the syenite.

Arfvedsonite can be found in several of the rocks of the Mount Agamenticus area. A thin section of the alkali syenite from this complex, **York** shows pleochroic grains of light to dark green zoned arfvedsonite which contains blue "streaks" of riebeckite with essentially the same association as the Wells material. The host rocks are widespread. Wandke (1922a) indicated of the alkaline granite of the complex: "Although the usual amphibole is arfvedsonite, riebeckite is common..." but suggested that arfvedsonite was the only amphibole observed in the syenite. Woodard (1957) noted arfvedsonite from this alkaline syenite along with aenigmatite (q.v.) and noted arfvedsonite from the alkaline granite of the Agamenticus Complex.

The association of arfvedsonite in a paisanite dike: "...near the crest of a hill just north of 'Scotland,' York..." was described by Wandke (1922a) and he concluded: "The minerals present are quartz, albite, microcline, microperthite, aegirite, riebeckite, arfvedsonite, zoisite, and an undetermined titaniferous mineral, brown in color and platy in habit."

argentite - see acanthite; argentite is not stable at earth-surface conditions and spontaneously inverts to acanthite (q.v.)

arnoldite - a fuchsite-bearing carbonate rock

Alder Stream; Jim Pond - unnamed hill

The rock name, arnoldite, apparently originated with Boudette (1982). Thompson (1968) earlier described the same rock, provisionally called cabinite by him, from a small unnamed knob almost half way between Little Greenbush Pond and Shallow Pond, **Jim Pond** as well as from near Tea Pond also in Jim Pond Township: "The green mineral is mixed with the groundmass in such small quantities that it is difficult to concentrate and identify it. ... The fuchsite variety of muscovite is the likeliest

possibility. ...The groundmass in this cabinite is a white, fine-grained rock whose principal constituents are dolomite and quartz with lesser magnesite." Small samples of arnoldite have been found in **Alder Stream** (Bob Cary, personal communication, 1990).

Boudette (1991) adopted the name virginite, a local rock name used in Newfoundland, to supersede arnoldite. Mariposite and other names have been used to describe this unusual rock on a worldwide basis.

arseniate of nickel? - arsenate of nickel?

Falmouth - *Falmouth M*

An early report stated of the Falmouth Copper mine, **Falmouth**: "The explorations have reached a depth of 22 feet, showing a vein over six feet in width, carrying copper pyrites, variegated copper and arseniate of nickel. ... These are good results, and would indicate that the property may prove with proper development to be extremely valuable; but the Argus reporter taxes the credulity of his readers a little too heavily when he claims that these 'copper pyrites, variegated copper and arseniate of nickel' ores are 'free-milling'" (MMJ, June 3, 1881). No specimens known. Hussey and Austin (1958) updated the name to arsenate of nickel.

arsenic?

Buckfield?; Greenwood? - *Furlong Mountain A*

One of the most difficult to eradicate species from Maine checklists has been arsenic. It was reported in 1861 by Verrill: "A second specimen he supposed to be native arsenic, though it may contain an admixture of other substances; it occurred in a vein about three inches wide, inclosed by feldspar, of limited extent, and passing through granite. It was found on the eastern flank of Furlong Mountain in Greenwood, Me. In a neighboring locality he also found the same mineral disseminated through the rock in small masses. At other localities on the same mountain are found beryls of large size, black tourmaline, ilmenite, and black garnets." Houghton (1861) and Hitchcock (1861) repeated the listing. Verrill (1863) retracted the identification: "The mineral mentioned in these Proceedings, Vol. VII. p.423, as probably Native Arsenic from Greenwood, Me., has recently been analyzed by Mr. G. H. Emerson, of Cambridge, and found to be a massive variety of Mispickel." Hitchcock (1862b) noticed the retraction, but the name arsenic has been perpetuated through every subsequent checklist of Maine species. While Morrill et al. (1958) listed arsenic from Buckfield as well as from the Harvard quarry [sic!], Greenwood, the additional identification must be considered incorrect until verified samples come to light. True (1869) shed some light on the exact locality: "*Mispickel* . - Greenwood. This mineral is found on the farm of Isaac Wentworth, not far from the Ice Caves in that town; and on the

farm of G. W. Patch; also, near Greenwood city. It occurs in narrow veins, in Granite, and has been mistaken for metallic arsenic, which it very much resembles." (Native arsenic does not particularly resemble arsenopyrite (mispickel), but both test positively for arsenic.)

arsenical iron = arsenical pyrite(s) = arsenopyrite (occasionally löllingite)

Blue Hill - Blue Hill Neck A, Camdage Farm hill A, Long Island A; **Newfield** - Bonds Mountain A, Davis Mountain A; **Paris** - Mount Mica Q; **Skowhegan** - Fifteen Mile Stream A; **Thomaston**

Jackson (1838a) noted arsenical iron from **Thomaston**; Blue Hill Neck, Camdage Farm hill, and Long Island areas, **Blue Hill**; and Bonds and Davis Mountain areas, **Newfield**: "Bond's mountain is also composed of granite, and there are found numerous veins of arsenical iron which has been frequently mistaken for silver ore." Jackson (1838a) noted: "On Davis farm, in Newfield, I observed that the rocks dug out in sinking a well, were filled with an infinity of veins of this mineral, and since it decomposes when exposed to the joint action of air and water, sulphuret of arsenic being formed, it may not be altogether safe to make use of water in contact with it, since this mineral is slightly soluble in water, and is poisonous. It can be easily imagined that a complicated case of medical jurisprudence might grow out of an occurrence of this kind, and I beg leave to call your attention to the subject, on that account. I should certainly feel very reluctant in making use of water constantly flowing from rocks charged with arsenic; and although I do not know of any case of poisoning, from such a cause, it is still possible that they may have occurred, unknown even to the sufferers." Jackson (1838a) stated: "Arsenical iron occurs abundantly in Maine, forming veins in the granite, sienite, and greenstone trap-rocks. This mineral is composed of 46 per cent arsenic and 54 per cent iron, and may be used for the purpose of manufacturing the white oxide of arsenic, which is used in the making of shot." This chemical composition cannot be reconciled with minerals known to early nineteenth century mineralogy.

Arsenical iron was reported by Elijah Hamlin (1826) from Mount Mica quarry, **Paris**. Though the best synonym for arsenical iron is arsenopyrite, the mineral reported was probably löllingite (q.v.), but both species occur there (this study).

arsenite of iron?

Orland

True (1869) contains the enigmatic entry: "*Arsenite of Iron* abounds in Orland, associated with Tierra di Sienna." Neither material can be ascribed a modern counterpart with certainty. The nearest probable materials might be limonite-invested arsenopyrite.

ARSENOPYRITE (Arsenopyrite Group)

FeAsS

Acton - Acton-Consolidated M, Boston-Acton M, Dirigo M; **Auburn** - Maine Feldspar Q, Mine Road P; **Bar Harbor**; **Belfast**; **Bethel**; **Blue Hill** - Bisbee M, Blue Hill Falls A, Candage farm M, Douglass M, Stover Hill M, Trio M, Twin M; **Bowdoin** - Coombs Q; **Brighton** - Moody Corner A; **Brooksville** - Callahan M; **Brunswick** - Dwelly Q; **Buckfield** - Bennett Q, Bessey Q, Dudley Ledge Q, General Electric Q, Westinghouse Q; **Carthage** - Briggs M; **Clinton**; **Concord** - Robinson M; **Corinna**; **Deer Isle**; **Eastport**; **Eden**; **Fairfield**; **Falmouth** - West Falmouth-Beulah farm A; **Farmington** - Titcomb Hill A; **Franklin** - Franklin M, Franklin Extension M; **Garland** - Preble Hill M; **Greenwood** - Emmons Q, Furlong Mountain A, Harvard Q, Waisanen Q; **Hampden** - Argonaught M, Lawrence M; **Hancock**; **Hebron** - Mount Rubellite Q; **Hollis** - Hollis Center road cut; **Knox** - Fort Point A; **Lebanon**; **Levant** - Antimonial Silver M; **Litchfield** - Dennis Hill A; **Lowell** - Harvey Hill M; **Lubec** - West Quoddy Head A; **Minot** - LaFlamme Q, Sturtevant Q; **Mount Desert**; **Newfield** - Bergendahl M, Bonds Mountain A, Davis Farm M; **New Limerick** - Drew Hill sulfide veins; **Newry** - Bell Pit, Dunton Q, Nevel Q; **Owls Head** - Owls Head Silver M; **Paris** - Glover Q, Mount Marie Q, Mount Mica Q, Ryerson Q; **Parsonsfield**; **Pembroke** - Pembroke M = Big Hill M; **Penobscot** - Hercules M; **Poland**; **Rangeley** - Wing M; **Rockland** - Limerock Q; **Rockport** - Riverside M; **Rumford** - Goddard Q, Thurston Brown Q; **Sedgwick** - Eggemoggin M; **Sidney**; **Skowhegan** - Fifteen Mile Stream A; **South Thomaston**; **Stoneham** - Cole Q, Lord Hill Q; **Stow** - Colton Hill Q; **Sullivan** - Sullivan and Waukeag M; **Sumner** - Mount Tom Q; **Surry** - Campbell P; **Thomaston** - Owls Head M; **Topsham**; **Tremont** - McKinley M; **Union** - Harriman P; **Verona** - Empire M; **Washington**; **Wesley** - Rollins M; **West Paris** - Cobble Hill Q; **Winslow** - Winslow Tin M; **T31 MD BPP** - Chain Lakes Stream A

Arsenopyrite has been found in many locations in Maine. The silver and copper mines have yielded silvery metallic masses which vary from barely visible to many centimeters. While arsenopyrite can have a highly reflective metallic and silvery-white luster, it easily loses its high luster on exposure to the elements of nature and frequently becomes silvery-gray. Löllingite is a species also found in the pegmatites of Maine and it is so like arsenopyrite in appearance and chemical composition that it causes considerable confusion among collectors. A very subtle difference between the two species is that arsenopyrite can be fractured with a granular pattern and löllingite can have a barely discernible fibrous texture, but there are exceptions. Specific gravity and chemical tests can distinguish arsenopyrite from löllingite.

Arsenopyrite from the Maine Feldspar quarry (verified this study), **Auburn** can be intergrown with ball muscovite in a slightly rusty intergrowth. The arsenopyrite can exhibit deeply

striated incomplete crystals (to 8 mm) and broken surfaces can show a slightly iridescent tarnish.

Silvery gray massive arsenopyrite has been found at both the Bennett quarry (verified this study) and the General Electric Pollucite quarry (verified this study), **Buckfield** in quartz albite matrix. Landes (1925) wrote of the Bennett quarry, Buckfield: "Only two specimens containing arsenopyrite were found. In one it occurred in parallel bands 1 to 5 millimeters thick. Between the bands were even narrower zones of brown lepidolite. The latter was in plates about 5 millimeters across which were arranged parallel to the banding. The whole is tightly enclosed in massive microcline and quartz." The "brown lepidolite" is probably zinnwaldite (q.v.). Masses of silvery metallic arsenopyrite (to 10 x 10 cm) can have a gun-metal blue to iridescent tarnish.

Li (1942) wrote of the Franklin Extension mine, **Franklin**: "The arsenopyrite is galena-white, distinctly anisotropic, with slight absorption. ... It exhibits beautiful diamond-shaped form. Single grains range from 0.1 mm ... and 0.14 [mm] ... to 0.7 mm ... and 1.2 mm."

Preble Hill mine, **Garland** ore was described: "The ore contained within the walls of this vein is galena, associated with some pyrites of iron, numerous crystals of mispickel, a very little copper, and minute particles of zinc blende, which latter, however, is somewhat rare..." (MMJ, May 27, 1881).

In the Argonaught mine, **Hampden**, the doubly terminated crystals are silvery metallic, occasionally with a slight golden tarnish, and are elongated about 5:1 so the crystals resemble needles. The crystals are embedded in a yellow to brown fine-grained sericitic rock.

Bladed arsenopyrite crystals (to 10 x 1 mm) with a golden tarnish are found with albite, black mica, nepheline, and cancrinite from Dennis Hill, **Litchfield** (this study).

Large masses (to 1 kg) of arsenopyrite have been found at the LaFlamme (pronounced la - flam) quarry, **Minot** (Raymond Woodman, personal communication, 1991). The arsenopyrite can be interlaminated in lightly rust-stained muscovite or quartz.

The arsenopyrite ore from the Bergendahl mine, **Newfield** has been spectrographically analyzed and found to contain a host of minor elements. Morrill et al. (1958) indirectly cited one of these reports (actually by Union Carbide, unpublished) as though they were actual minerals rather than trace elements derived from various minerals in the ore. Trefethen et al. (1955) noted arsenopyrite and scheelite at an "old abandoned 'lead-silver' mine on the Ray Davis farm" in Newfield.

Arsenopyrite crystals occur at the Dunton quarry, **Newry** (this study). The bright silvery metallic crystals (to 2 mm) have a diamond/rhombic cross-section and are found in siderite and drusy quartz vugs in blue tourmaline "eyes" embedded in cleavelandite. Sometimes these crystals have a "beaded" parallel growth.

The Wing mine, **Rangeley** is reported by Moench (1971) to have ore "dominantly" arsenopyrite. He mapped the locality "0.5 mile west of Dodge Pond."

Sharp, symmetrical and doubly terminated arsenopyrite crystals (to 4 mm) are found embedded in calcite at the Limerock quarry, **Rockland**.

Li (1942) reported of the Sullivan mine, **Sullivan**: "Arsenopyrite is frequently found in rectangular forms sometimes triangular or diamond-shaped. The largest ones observed are about 0.02 by 0.05 mm. in size. Hence, when it occurs with pyrite, its presence may be overlooked due to slight difference in color. It is easily noticeable when the small grains are surrounded by dark gray sphalerite." Crystals to 2 mm can be found densely clustered in milky quartz.

Arsenopyrite at the Owls Head mine, **Thomaston**, is fine-grained granular (1 mm) irregularly intergrown with pyrite of the same grain size.

The Winslow Tin mine, **Winslow** has produced some exceptional corrugated and doubly terminated arsenopyrite crystals (to 15 x 5 mm) embedded in fine-grained "margarite" (= muscovite), quartz, and purple fluorite matrix. Crystals (to 5 mm) are also embedded in selvage schist. (Most of the dump material of the mine has been washed down a small stream, but small boulders can still be located.) Graton (1905) noted the occurrence.

Westerman (1978) wrote of the Chain Lakes Stream area, **T31 MD BPP**: "Quartz granule feldspathic metaconglomerate with biotite clots, glassy hornblende bearing beds, and feldspathic metatuffs with and without hornblende are found in this portion of the section. Rocks in the section frequently contain pyrrhotite, and garnetiferous arsenopyrite-bearing pegmatite lenses transect the beds in place."

artinite?

Rangeley - Mingo Loop road metal pit

Translucent gray to snow-white irregular botryoidal aggregates (to 3 mm) of artinite with "curved spike" crystals (to 1 mm) projecting from the botryoids have been identified (supposedly by X-ray diffraction) from fractures in quartz boulders from Mingo Loop road metal pit near Oquossoc village, **Rangeley**. The occurrence is particularly unusual in that the "artinite" is not on or immediately associated with serpentine matrix and that the crystals submitted for this study are curved similar to some aragonite (q.v.) crystals and bear no similarity to worldwide artinite specimens.

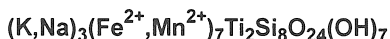
asbestos (asbestos) = varietal name of fibrous minerals; see also clinochrysotile

Jackson (1838a) noted of **Deer Isle**:

"The serpentine occurs on the northern and north-eastern extremity of the island, of which it forms a considerable part. We traced this rock from Torry's Pond to the Reach, about 1 1/2 miles in width.

In some places, we found it beautifully veined with indurated asbestos, which gives a silky lustre to the polished specimens, and augments their beauty."

ASTROPHYLLITE (Astrophyllite Group)



Biddeford? - *Clifford Park A*; **Cashes Ledge** in the Gulf of Maine; **Litchfield** - *Dennis Hill A*; **Tunk Lake pluton?** - **Cherryfield**, **Franklin**, **Gouldsboro**, **Steuben**, **Sullivan**, **T7SD**, **T10SD**

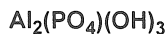
Black to bronzy-brown micaceous patches (1 - 2 cm) (not laths or blades) frozen in medium to dark gray microcline have been found at an old prospect near Clifford Park, **Biddeford** and this material has been called astrophyllite. It has been suggested that most, if not all, of the material called astrophyllite from Biddeford is actually biotite (King, 1977b). Recent X-ray studies, by the authors, suggest that very little if any astrophyllite is present at the locality. All of the studied material appears to be a bronzy altered biotite, which superficially resembles astrophyllite.

Cashes Ledge (42° 54' N, 68° 56' W), far to the south of Brunswick in the Gulf of Maine, has astrophyllite as discovered in a thin section of a grab sample "broken from ledge" (Toulmin III, 1957): "*Astrophyllite* occurs in a 0.2 X 0.5 mm. irregularly shaped grain enclosed in the hornblende of a hornblende-aegirite intergrowth. Many small red-brown to yellow fibrous aggregates associated with aenigmatite (?) and riebeckite may also be astrophyllite."

Bronzy-brown to golden brown irregular micaceous astrophyllite flakes (1-3 mm) from the Dennis Hill area, **Litchfield** have been found intergrown with black lepidomelane with nepheline, albite, and cancrinite.

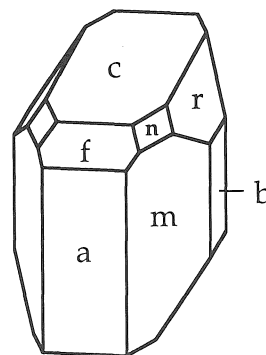
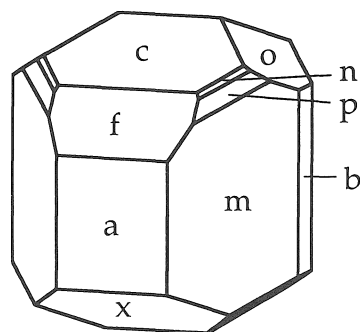
Karner (1974) said of the hornblende/aegirine-augite granite exposed on the margins of the Tunk Lake pluton, **Cherryfield**, **Franklin**, **Gouldsboro**, **Sullivan**, **T7SD**, and **T10SD**: "Calcic hornblende, probably containing significant sodium and ferric iron, occurs as subhedral to euhedral grains from 2 to 3 mm long with cores of aegirine augite. Perthite occurs as subhedral grains from 1 to 2 cm long, and quartz, as anhedral grains from 1/4 to 1/2 cm in diameter. Riebeckite and a reddish-colored biotite (probably astrophyllite) are common in small amounts."

AUGELITE



Newry - *Bell Pit*

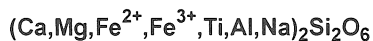
Augelite has long been known from the Bell pit, **Newry**, but its identification has always posed a problem (King, 1989a,b). At this locality augelite is frequently found in a siderite/quartz assemblage. It forms colorless transparent to



Augelite, Bell Pit, Newry

cloudy-white pseudorhomboidal crystals (to 3 mm) which have a great number of faces (King, 1989a,b). The pseudorhomboids are generally clear and have an oily luster. The crystals require magnification to identify and a key identifying feature seen on partially exposed crystals is a set of three faces which resemble a steep rhombohedron, but with only two small modifying faces instead of three. The absence of a third equivalent face lowers the intuitively obvious symmetry from trigonal to monoclinic. The matrix is quartz occasionally with some small quartz crystals (to 3 mm), sometimes siderite, and infrequent orange diadochite staining or coating. The mineral is probably derived from the dissolution of montebrasite.

AUGITE (Pyroxene Group)



Addison - *black granite*; **Alfred** - *Alfred Complex*; **Casco Bay A** - **Cape Elizabeth**, **Freeport**, **Harpswell**, **Portland**, **South Portland**; **Deer Isle** - *Pine Hill A*; **Denmark**; **Monhegan** - *pyroxenite*; **Moxie pluton**; **Newry**; **North Haven** - *Ames Knob A*; **Phippsburg**; **Pocomoonshine gabbro/diorite** - **Alexander**, **Crawford**, **Princeton**, **T21**, **T26 ED**; **Wells/South Berwick** - *tectonic complex*; **York** - *Cape Neddick A*

Augite is found primarily in igneous rocks. Some pyroxenes from calcium-rich metamorphic rocks have been inappropriately called augite and their proper naming requires chemical analysis, not just optical examination. Recently, the

re-classification of pyroxenes (q.v.) by the International Mineralogical Association, as reported by Morimoto (1989), has formalized augite to species status. Augite varies from $\text{En}_{45}\text{-En}_{20}$ along the join between enstatite (En) and wollastonite, as well as $\text{Fs}_{45}\text{-Fs}_{20}$ along the ferrosilite/wollastonite join and within the compositional field these coordinates bound. (See diagram under pyroxene.) The name ferroaugite has been rejected as a species name with chemical variation in augite being indicated by adjectives: magnesian and ferroan. Additional adjectives could indicate extensive replacement, but contrary to the 50% rule (see Nickles, 1992), both ends of the primary chemical variation, magnesium to iron, are considered to be a single species-augite. (The above formula from Morimoto (1989) suggests complete disorder between M_1 and M_2 , but the representation is probably just for convenience. The above formula does not suggest a relationship to wollastonite. In some cases, calcium is not the most abundant element in the set of parentheses.) Augite is a common constituent of basalt, gabbro, and numerous *basic* rocks widespread in Maine. It is a component of some "black granite." Augite from Maine has not been particularly an object of discussion in recent geological literature so relatively old, but seminal, studies are cited here. Collector grade augite is virtually unknown in Maine. (Note: Augite usually appears nearly black in hand specimens. The descriptions of light colored augite are based on thin section observation. Augite is reported from many Maine locations by Espenshade (1972), Espenshade and Boudette (1964, 1967), Hussey (1962, 1985), and Ludman (1986).)

Lord (1898) described some zoned phenocrysts of augite and aegirine-augite from olivine diabase porphyry dikes in the Casco Bay area, **Cape Elizabeth, Freeport, Harpswell, Portland, and South Portland**:

"The *augite* is the most important mineral constituent of these rocks. The crystals are either prismatic in form with octagonal cross-sections, owing to equal development of 110. with 010 and 100. or they are somewhat tabular formed by the pinacoid 010. Twinning after this face is not uncommon. The crystals vary in color from purplish brown to light yellowish green; the former being the most common, and decidedly pleochroic: purplish brown parallel to *a* and *b*, pale yellow parallel to *c*. Absorption is strong: $a > b > c$.

These crystals are rarely homogeneous; they have usually the well-known hour-glass structure in which the lighter colored inner part of the crystal, with the optical properties of diopside, is surrounded by a purplish rim of titaniferous augite resembling optically the aegyrine-augite of Rosenbusch."

Lord (1898) further discussed the partial replacement of the augite, in certain dikes, by chlorite, limonite, and biotite.

Merrill (1888) described "Secondary Enlargement of Augites in a Peridotite from Little Deer Isle", **Deer Isle**:

"The augite, which is the only constituent to which particular attention need here be called, is of the normal type, of a faint yellow or

wine red color in the thin section, and gives maximum extinction angles on clinopinacoidal sections of 40° . The mineral occurs in the form of broad plates with deep, rounded embayments and in long armlike forms reaching out and enfolding the altered olivines, the peculiar habit of the mineral in acting as a binding constituent being here displayed in its best development. On casual inspection by ordinary light the mineral presents no features other than of the ordinary type, the rounded forms of the altered olivine abutting closely against the fresh augite, while the line of separation is perfectly sharp and distinct as I have attempted to show in figs. 1 and 2. Here the portions marked (*a*) and bounded by the heavy wavy line represent in each figure a single augite individual.* [* In fig. 1 the rock has been fractured and re-cemented by serpentine. The portions in the upper left and lower right field forming originally one crystal.] More careful inspection, however, shows that in nearly every instance the augite is surrounded more or less completely by a narrow and extremely irregular colorless border which projects in the form of sharp teeth or tongue-like prolongations for a considerable distance into the serpentine (olivine) granules. ... This irregular border I am inclined to consider as a true secondary growth, formed since the consolidation of the rock..."

Merrill (1889) further disclosed his reasoning concerning the origin of the overgrowths from peridotite on Pine Hill, Little Deer Isle:

"(1) It would seem extremely improbable the the augite first separated from the molten magma in such irregular forms; (2) the original outline of the augite is perfectly sharp and smooth, eminently characteristic of augite outlines in this class of rocks; (3) the new portion is much lighter in color, being, in fact, so nearly colorless as at first to be wholly overlooked when examining the section by ordinary light; (4) It projects in very irregular and jagged forms into the serpentine (olivine: the dotted areas in the sketch). Indeed, its appearance is such as to suggest that not only was its formation subsequent to the consolidation of the rock, but that it is an accompaniment of the alteration, the sharp, tooth-like edges projecting into the olivine along the curvilinear lines of fracture much like the ordinary beginnings of serpentinization. The new growth in all cases possesses the same crystallographic orientation as the original, the entire mass as figured extinguishing simultaneously between crossed nichols"

Lord (1900) described and chemically analyzed a peculiar augite from bytownite-bearing pyroxenite rocks, **Monhegan**:

"The mineralogical interest of these rocks is confined chiefly to the pyroxenite [sic], which is of a dark gray color in contrast to the lighter purplish gray of the feldspar aggregates.

The pyroxene of the one dark vein critically examined is a brownish green augite resembling diopside. It is of crude prismatic habit and well defined cleavage parallel (110). It is furthermore characterized by the unusual position of the optical constants...

A diopside-like pyroxene of almost identical physical properties, has been described by Broegger * [* W. C. Broegger: Min. der sudnorig. Augitsyenite. Zeit. für Kryst., 1890, Vol. 16, p. 656.] from some

of the coarse grained dikes near Frederiksvärn, Norway, but there the mineral appears to grade into aegirine, which is not the case in the Monhegan dike. Microlitic inclusions of opaque ilmenite needles, arranged crystallographically very much like those in the bytownite, are very plentiful in this pyroxene."

Forrest Carpenter (1952) reported augite, without description, in a boulder from a gravel pit, **Newfield**: "... I think it contains the best augite crystals (dark green) for this area that I have ever seen."

Haff (1939) described thin sections of gabbro from Cape Neddick, **York** which contained augite with (poikilitic) inclusions of labradorite, while Smith (1901) noted augite from the Ames Knob area, **North Haven**. Hanley (1936) noted augite from **Denmark**, **Newry**, and **Phippsburg**.

AURICHALCITE



Brooksville - Callahan M, Cape Rosier M, Goose Falls A; **Lubec** - Lubec Lead M; **Pembroke** - Barrett P, Big Hill M

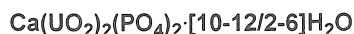
The "large" copper mine in **Brooksville** has been known by several names: Cape Rosier mine, Goose Falls mine, Harbor-side mine, etc. The latest mine, which was operated as an open pit with some underground workings, was called the Callahan mine after the operating company. Aurichalcite is found there as delicate feathery robin's-egg blue crystals (1 mm and less) in clusters (to several millimeters) and coatings impregnating limonitic and kaolinitic gossan. The associated minerals include sphalerite, chalcopyrite, quartz, aragonite, linarite, cerussite, malachite, hemimorphite, etc.

Aurichalcite from the Lubec Lead mine, **Lubec** varies from pale blue to nearly white and is found in feathery botryoids (1-2 mm) in milky quartz cavities, sometimes in contact with galena, and occasionally with drusy colorless hemimorphite crystals (much less than 1 mm). The milky quartz is sparsely impregnated by chalcopyrite grains (to 2 mm) and brown to black sphalerite grains (to 3 mm).

The Big Hill mine, **Pembroke** has aurichalcite which varies in hue from light blue through blue-green. The clusters of crystals (1-2 mm) are found in limonitic quartz with cerussite, chalcopyrite, sphalerite, and tenorite.

The Barrett prospect, **Pembroke**, which was really not much more than an exploration pit, has the nicest aurichalcite in Maine and the mineral makes good micromounts by eastern U.S. standards. The pale blue rectangular bladed crystals (to 2 mm) can be tightly clustered in malachite-lined vugs or almost individually grouped on partially limonite-coated quartz vugs. Associated species include anglesite crystals, azurite crystals, and massive chalcopyrite, tenorite, and sphalerite.

AUTUNITE / META-AUTUNITE (Autunite/Meta-autunite Groups)



Albany - Bumpus Q, Johnson Q, Wardwell Q; **Auburn** - Greenlaw Q, Maine Feldspar Q; **Buckfield** - Bennett Q; **Casco?** - South Casco road cut; **Cornish?** - Berry Ledge L; **Freeport** - Autunite locality; **Georgetown** - Consolidated Q; **Greenwood** - Emmons Q, Harvard Q, Tamminen Q, Tiger Bill Q; **Hebron** - Hibbs Q; **Lovell** - Oak Hill A = McAllister P; **Minot** - LaFlamme Q, Phillips Q; **Newfield?** **Newry** - Bell Pit, Dunton Q, Martin P, Nevel Q, Scotty Q; **Norway** - BB #7 Q; **Paris** - Hoopers Ledge Q, Mount Mica Q, Singepole Mountain Q; **Peru** - Perry P; **Phippsburg** - Thomas Q; **Poland** - Berry-Havey Q; **Raymond** - Route #302 road cut; **Rumford** - Black Mountain Q, Thurston Brown Q; **Stoneham** - Aldrich Q, Cole Q, Lord Hill Q, Melrose Q; **Stow** - lower Colton Hill Q; **Topsham** - Consolidated #1 Q, Consolidated #2 Q, Fisher Q, Havey #2 Q, Square Pit, Swamp #1 Q, Yedlin L; **Warren** - Starrett Q

Autunite is a common secondary uranium mineral in Maine pegmatites. The mineral as it is found in a fresh excavation is probably fully hydrated, but after removal from the moist environment of its original nature, even by being uncovered by mining, autunite is subject to dehydration in low relative humidity conditions. The dehydration occurs in stages. The slight loss of water (from 12 down to 10 molecules per formula), does not alter the mineral's structure and rehydration can occur up to 12 molecules per formula. When conditions for further dehydration continue to occur, even when the specimen is just kept from getting wet, additional water continues to evaporate from the mineral layers and the layers can move closer together and reposition themselves slightly. After the layers are contracted together, it is not possible to re-establish the fully hydrated condition and the new material is structurally different from the original material and many of the physical properties have changed. (The dehydration can occur in just a few days or even hours. Freshly found autunite can have a decidedly green color and be mistaken for torbernite. Upon dehydration, the greenish cast to the mineral can lighten or disappear entirely.) Because of the platy nature of the mineral and its ability to cleave into thin sheets, the group is sometimes called "uranium mica." Very commonly, no crystals or cleavages are apparent, but the mineral looks like a thin earthy to waxy coating. The dehydrated mineral is called meta-autunite. Systematists variously count the species. For the purposes of a conservative count of the state's species, this and other hydrated/dehydrated pairs will be counted as one each. Smith and Maslowski (1937) report autunite from Nevel quarry, **Newry**, but it is uncertain which of Nevel's workings was meant. Similarly, they list autunite from Harndon Hill, **Stoneham** and it is also uncertain if their choice of location name is correct. Currently, no specimens are locatable to verify Smith and Maslowski's (1937) localities, but as the mineral is so widespread it

is to be expected at these sites. Autunite and meta-autunite are equally brightly fluorescent yellow-green in short-wave and long-wave ultraviolet light. Burr (1942) reported autunite along with other Maine uranium minerals.

Robertson (1956) reported autunite on granitic matrix from a road cut not far from the Chute prospect, **Casco**. No specimens known.

Autunite from the Consolidated quarry, **Georgetown** is found as earthy to crystallized yellow coatings on fractures in dark smoky quartz. The autunite forms square to rectangular crystal tablets (to 3 x 3 x 0.5 mm) along schorl crystal faces embedded in albite. The freshly exposed Georgetown autunite is particularly green, but fades to yellow on exposure.

Abundant autunite was found by McAllister (1955) at his prospect on Oak Hill, **Lovell**: "In mucking out after a blast here, we found ore that was unusually rich in Autunite and associated minerals. There were thick crystals of Autunite and almost every rock was coated with yellow uraconite. ... They took about 50 pounds of the ore back with them for testing purposes. ... The nearest processing plant was in Utah, and it would cost almost as much freight as the ore was worth so the dreams of wealth quickly vanished." This passage was written during the 1950's "Uranium Rush," a phenomenon which generally did not affect easterners.

Very fine small (2-3 mm) square, platy autunite crystals have been found at the Dunton quarry, **Newry**. The matrix is cleavelandite and the interstitial voids between the cleavelandite blades serve as the opening into which most of the mineral is crystallized. The cavities are frequently coated by a tan to brown earthy powder. The platelets frequently show square striations on the termination surface of the crystals and the striations are oriented at 45° to the prism faces. Autunite crystals are frequently found in vugs in the blue and green tourmaline "eyes" embedded in cleavelandite at the Dunton quarry as well as in cleavelandite interstices.

Autunite has been found as sulfur-yellow square crystal platelets (to 2 mm) on clay-coated clear quartz crystals (to 7 mm) with bertrandite crystals (to 3 mm) at the BB # 7 quarry, **Norway**.

The most prolific autunite locality in Maine has been the Lord Hill quarry, **Stoneham**. Individual crystals to 8 mm across are known. The mineral was found in the crystal cavities of the quarry and frequently was sprinkled over etched smoky quartz crystals (to 10 cm). It is found in "accidental" association with a number of species, but is frequently seen lining etched fractures in albite along with muscovite crystals (to 2 mm), clear fluorapatite crystals (to 3 mm), doubly terminated quartz crystals (to 3

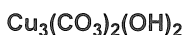
mm), sericite and clay coatings, etc. The crystals of autunite can show small first-order bipyramids in conjunction with small first-order prisms and dominant second-order prisms and "c" pinacoid. The appearance is that of a square yellow plate with the corners slightly clipped. The autunite can be grouped in parallel to sub-parallel clusters or randomly sprinkled over matrix in "jackstraw" fashion. Thin films of autunite can be highly fluorescent in ultraviolet light (both short-wave and long-wave) without telltale signs of the mineral otherwise. Not all of the yellow coatings which fluoresce yellow-green are related to autunite, but it is the most common mineral which does so in Maine. Rare specimens of Lord Hill quarry autunite crystals are rimmed by torbernite (1 mm rim on 2-3 mm crystals). Stan Perham (1966) noted: "Three large 5 foot wide pockets were found near the westerly end of this big pocket and they may have connected into the large one. A great deal of autunite was in one of these pockets. The dirt was green, with small crystals as one would shovel it out."

axinite - see ferroaxinite

Bath - City Q; **Casco?** - Chute P; **Minot?** - Pitts-Tenney Q; **Phippsburg?** - The Basin L; **Sanford?** - Webster P; **Wales?** - loose boulder

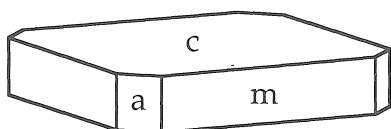
Axinite is a group name. The most common member of the series is ferroaxinite (q.v.) while other members of the series are highly unusual and rare. Most of the axinite specimens reported from Maine are actually clinozoisite, including the Phippsburg material.

AZURITE



Blue Hill - Bay View M, Douglass M, Osgood farm P; **Brooksville** - Callahan M, Cape Rosier M; **Gouldsboro** - Gouldsboro M; **Guilford**; **Hancock** - Emmet M; **Moxie Gore**; **Pembroke** - Big Hill M, Barrett P; **Woolwich** - U.S. Route #1 road cut

Azurite is rarely observed in Maine. Navy-blue azurite crystals (to 2 mm) have been found on fracture surfaces in compact talcose or sericitic matrix at the Cape Rosier mine, **Brooksville** as well as tan clayey gossan and "rusty" pyrite. The light colored clayey matrix has clear allophane botryoidal coatings which have a pale tint of blue. The azurite crystals vary from drusy spots on matrix to lustrous individually placed crystals. As is typical of the species, some crystals show a rounded development of morphology due to vicinally spaced parallel and sub-parallel azurite crystals. Clear to satiny cerussite crystals (to 2 mm) are sometimes associated in addition to virtually white thin films of aurichalcite. Occasional azurite and malachite veinlets are found in rusty talc and sulfide rock. The azurite can form patches



Autunite, Lord Hill Q, Stoneham

nearly 1 cm in maximum dimension with tiny botryoids (1 mm and less) which can vary from a nearly smooth satiny surface to a coarsely crystalline granular texture. Individual crystals to 1 mm are rare. Malachite botryoids (to 2 mm) can be commingled with the azurite, but no crystals or individual fibers are apparent. The sulphides in the matrix vary from shattered brownish black sphalerite grains (to 3 cm) to disseminated pyrite and chalcopyrite grains (to 3 mm). The harsh actions of acidic rain and acidic decomposition of the sulfidic rocks may have resulted in the

virtual disappearance of the secondary carbonate and sulfate minerals on the Callahan/Cape Rosier mine dumps.

Outstanding micromount-sized azurite crystals come from the Barrett prospect explorations, **Pembroke**. The transparent, lustrous navy-blue crystals (to 2 mm) are found on black earthy tenorite-lining quartz vugs impregnated with sparse chalcopyrite. Tufts of malachite are sometimes present. Tiny (1 mm) "dots" of azurite crystals can also be found on pyrite crystals (to 1 cm).

B

BABINGTONITE



Bath - Town Q; **Cornish?** - Berry Ledge L, Day Hill L

Brilliant black babingtonite crystals (to 3 mm) have been found tightly clustered on fracture surfaces of an epidote-bearing granite at the Town quarry, **Bath**. Yedlin (1941) referred to the locality along U.S. Route #1 (actually Court Street), but shopping center construction has undoubtedly covered the area.

A map exists (drawn by Forrest Carpenter?) of the Berry Ledge road cut locality (Route #5), **Cornish** with a short species list including babingtonite. A micromount of "babingtonite" with meionite and diopside from the Day Hill location, Cornish, originally in the Leon/Forrest Carpenter collection, is a peculiar clinozoisite (this study) with pagoda-like steps which were probably caused by interrupted growth against another mineral, now absent.

BARITE (Barite Group)



Bethel? - Chapman Farm A; **Brunswick?**; **Calais?** - U.S. Route #1 road cut; **Caribou** - Green Mountain A; **Castle Hill** - Dudley P; **Deer Isle** - Deer Isle M; **TDR2 WELS** - Maple Mountain P; **Gouldsboro** - West Bay M; **Grafton** - Morse brook L; **Hancock** - McFarland M; **Newry?**; **Pembroke** - Barrett P, Big Hill M; **Sanford?**; **Sullivan** - Sullivan M; **Unity?** - Route #139 & #220 road cut; **Woodstock?**; **T9R3 WELS** - Hovey Mountain P

Many of the Maine barite occurrences have massive mineral only. The barite forms a portion of quartz/metallic ore veins of marginal and sub-economic interest. Samples are scarce from all localities, except Grafton.

Prehnite from U.S. Route #1, **Calais** and aragonite from a road cut on Route #139 and #220, **Unity** have both been misidentified as barite. Hanley (1936), Morrill et al. (1958) and Morrill and Hinckley (1959) listed barite for **Brunswick**, **Sanford**, and **Woodstock** without specific descriptions or locations. Davis (1948) wrote: "The only other occurrence known to me of Barite in Maine was found by the late Dr. True of Bethel, at or near the Fred Chapman farm in Bethel." Dr. N. T. True died

between August 6 and November 1, 1886. Barite from "Mt. Sandford" (AMNH #64536) consists of lightly brown-stained tabular cleavages (to 2 cm) in a pure laminated aggregate.

Boucot et al. (1964) noted of the Perham Formation exposed on Green Mountain, **Caribou**: "Brownish-gray blocky shale crops out in a lens about half a mile long and 400 feet wide on the east side of Green Mountain. ... A bed of red shale, two or three feet thick, is present in this lens, as is a zone containing barite-rich nodules $\frac{1}{2}$ inch to 2 inches in diameter."

Smock (1883) noted barite of **Deer Isle**: "Deer Isle silver mine, Hancock county, in gangue of lead silver vein." This report became entrenched in government files as Stuart (1905) continued: "Barytes occurs sparingly in Hancock county." No specimens known, however.

Crystals of barite have been found in a quartz vein that cuts across Morse Brook, **Grafton** (Davis, 1948; Shaub, 1959). The locality has sometimes been given as Newry. The clear to milky white barite crystals (to 2 x 2 cm) are simple, typically tabular, and are associated with cloudy to clear quartz crystals (to 5 cm) and a brown limonite coating on the crystals and matrix. The barite is sometimes etched or rounded in appearance. Tiny wisps of amethyst are occasionally seen in the quartz crystals. Barite crystals frequently show skeletal development with the edges overgrown with a smooth lip and the central portion of the crystals can be etched and can show vicinal faces. Davis (1948) indicated some pseudomorphs had been found: "On some of these same plates there were - at some time in the past - Barite crystals up to one inch square and an eighth inch thick. A coating of tiny quartz crystals had covered all but one of the sides of these barite crystals. One of the large flat surfaces was left uncovered. Later the Barite crystals dissolved leaving the quartz crystal coverings."

Transparent barite crystals (1 mm) are found on partly crystallized calcite at the Big Hill mine, **Pembroke**. The barite from the Barrett prospect, Pembroke is rhombic in outline and forms transparent crystals (to 3 mm) on poorly formed drusy quartz crystals. Malachite and chalcopyrite are associated. The gray matrix is pyrite-bearing and is limonite stained.

Pavlidis and Milton (1962) reported barite in manganiferous rocks of the Hovey Mountain prospect, **T9R3 WELS** and the Maple Mountain prospect, **TDR2 WELS** "in a few pods." White (1943) noted of the Dudley prospect, **Castle Hill**: "Barite forms the inner part of the rounded bleb of greenish carbonate in a specimen of red shale."

barkevikite = ferrohornblende (Amphibole Group)

Old Speck Mountain quadrangle?; South Portland - camp-tonite dike

Milton (1961) wrote about barkevitic hornblende in the Old Speck quadrangle, but the analyses he gives are for ferroan magnesiohornblende.

Lord (1898) reported barkevikite from a camptonite dike near Portland Head Light, **South Portland**. See ferrohornblende.

barroisite? (Amphibole Group)



Sapling - Gabbro Point A

Barroisite is a relatively new amphibole species which might eventually prove to be one of the common amphiboles. It is both sodium- and calcium-bearing and is very aluminous. Boone (1983) apparently suspected this species when he wrote: "In one block at Round Pond (northeast of Indian Pond) assemblage (a) grades into rock containing the assemblage

actinolite - barroisitic hornblend[e] - chlorite - albite - epidote -
quartz - hematite ± pumpellyite

Na in M_4 is close to 0.75, from calculation of stoichiometry ..." Boone et al. (1989) shows analyses for "barroisitic" amphiboles which variously qualify for ferroedenite, ferrohornblende, or ferropargasite.

basaltic hornblende? (Amphibole Group)

Andover - Lone Mountain A; Deer Isle - Eagle Island A; Newry - Mount Dimmock A, Mount Plumbago

Basaltic hornblende is a name used to suggest a significant variant of hornblende. Leake (1978) suggested: "Basaltic hornblende = an oxyhornblende, often ferri- or ferrian titanian (magnesian hastingsite)."

Moench and Hildreth (1976) noted thin dikes of basalt or basaltic andesite on the "steep slope" of Lone Mountain, South Andover, **Andover** and on Mount Plumbago and Mount Dimmock, **Newry**: "Least altered rock contains about 40 percent augite and basaltic hornblende..."

Pinette and Osberg (1989) report of the intrusive gabbros in eastern Penobscot Bay, **Deer Isle**: "At one locality on Eagle Island... basaltic hornblende appears as an additional phase."

basanite = slate or phyllite

Topsham

Morrill et al. (1958) list basanite as a mineral name, but the original references (Cleaveland, 1816, 1822) appear to use the name exclusively as a rock name.

bastinite = a platy variety of hureaulite (q.v.)

Newry - Dunton Q

bavenite?

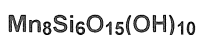
Stoneham - Lord Hill Q

Bavenite is reported to be on specimen USNM # 0120671 of the Smithsonian Institution. The specimen is from the Lord Hill quarry, **Stoneham** and has the Neal Yedlin collection label. A careful examination of the specimen using a binocular microscope did not reveal any obvious bavenite. The specimen consists of fine-grained, pearly pale yellow to silvery scaly muscovite matted in sub-parallel fashion on etched gray quartz crystals typical of the phenakite assemblage of the deposit. No other reference is known. (Bavenite should consist of white to tan simple rectangular blades or needles loosely clustered.) An identical appearing, similarly associated, specimen of the silvery matted fine-grained mica proved to be a mixture of muscovite and kaolinite (George Robinson, personal communication, 1991).

"beauxite" (gibbsite? q.v.)

Aurora; Limewood?

BEMENTITE



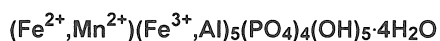
Castle Hill - Dudley deposit; TDR2 WELS - southwestern and northwestern Maple Mountain P; T9R3 WELS - southeastern Hovey Mountain P

Bementite is a microscopic constituent of the Dudley deposit, **Castle Hill** manganese ores. White (1943) was ambivalent about the identity of bementite, but in one instance said: "The microscope also reveals that the cores of some masses of braunite consist partly of well-crystallized bementite." Miller (1947) said, "The Aroostook manganese ores are mineralogically complex. The manganese-bearing minerals are so finely disseminated that it is almost impossible to recognize them with the naked eye, and not easy to identify them even in the laboratory."

Microscopic and x-ray studies have established, however, that the most abundant manganese mineral in both types of ores is braunite ... and that a pink form of bementite ... is also common. Manganiferous carbonate is visible in some of the ore and is especially abundant in specimens from the Dudley deposit. The pinkest carbonate, which is also richest in manganese, approaches mangandolomite in composition. Manganiferous carbonate is probably also disseminated through much of the rock in which individual carbonate crystals are submicroscopic."

Of the Hovey Mountain prospect, **T9R3 WELS** and Maple Mountain prospects, **TDR2 WELS** ores, Miller (1947) reported: "Manganese minerals are so finely disseminated in the ore as not to be separately visible. They are presumed to be predominantly braunite and bementite, for the central district ores appear to be geologically and genetically similar to the ores of the northern district. The principal difference visible in the field is an apparent decrease in the amount of carbonate and increase in the amount of hematite." Pavlides and Milton (1962) reported: "Bementite is not as abundant in the deposits on Maple and Hovey Mountains as it reportedly is in the northern district." Additionally, Pavlides and Milton (1962) reported an aberrant variety: "A fibrous bementite-type (hydrous manganese silicate) mineral is also present in the rhodonite-bearing veinlets but is generally more abundant in stringer-like offshoots from these veinlets; under the microscope it is usually pale yellow or pale brown, weakly pleochroic, and uniaxial negative. X-ray patterns are referable to the bementite group..." Skow et al. (1956) and Eilertsen (1952) earlier cite observing the species.

BERAUNITE



Greenwood - Emmons Q; **Newry** - Bell Pit, Dunton Q; **Paris** - Mount Mica Q; **Rumford** - Red Hill Q; **Stoneham** - Cole Q, Lord Hill Q

Beraunite is a secondary phosphate found in the siderite assemblage (q.v.). It looks very similar in its various Maine occurrences. The interrelationship between this species and eleonorite is discussed under the latter material.

The Emmons quarry, **Greenwood** has produced pale green acicular beraunite crystals (less than 1 mm) in the siderite assemblage associated with rockbridgeite and strunzite.

Beraunite from the Bell pit, **Newry** occurs as a minute dusting of grass-green to gray-green mineral (to 1 x 2 mm) on massive quartz associated with butterscotch-colored laueite (to 1 mm) near fairfieldite or sometimes as a similar dusting on splintery clear hydroxylapatite crystals (to 1 mm) in the siderite assemblage. Very tiny black dots of rockbridgeite, tiny (much less than 1 mm) reddish brown tight clusters of jahnsite-(CaMnFe) (to less than 1 mm), and earthy avocado-green mitridatite can be associated. The hydroxylapatite very loosely resembles the

"more splintery" strunzite with which it is frequently intimately associated and can be distinguished only with difficulty. It is sometimes possible to observe the "c" pinacoid of the hydroxylapatite using a high power microscope.

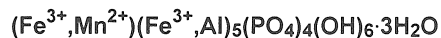
Dunton quarry, **Newry** beraunite is found in cellular, etched cavities in the siderite/rhodochrosite filling (to several centimeters) of the blue tourmaline "eyes" in cleavelandite. The green beraunite varies through various shades of medium to dark green into the golden browns, tans, and orange shades of its oxidized end-member equivalent eleonorite. Beraunite forms individual acicular crystals (to less than 1 mm) at the Dunton quarry and, apart from forming small patches of mineral (1x1 mm), is not ordinarily systematically arranged in the cluster. The beraunite is frequently found directly on tightly clustered quartz terminations (to 1 mm each) or occasionally with other secondary phosphates of small size (1 mm or less) including laueite crystals, jahnsite-(CaMnFe) clusters, rockbridgeite botryoids, stewartite clusters, earthy mitridatite, etc. Seaman (1975a) reported additional associations, but as those species occur in slightly different parageneses (e.g. Moore, 1973) their juxtaposition would be accidental: bermanite, ludlamite, vivianite, xanthoxenite, wardite, and whitlockite.

Beraunite is found at the Mount Mica quarry, **Paris** as earthy green coatings in fairfieldite and siderite matrix in blue elbaite eyes.

Red Hill quarry, **Rumford** beraunite is grass-green and forms a dusting on siderite and triphylite with strunzite, hureaulite, etc.

Beraunite from Lord Hill, **Stoneham** consists of a drusy coating of dark green mineral on altered triplite associated with pink hureaulite, brown mitridatite, black rockbridgeite crystals (much less than 1 mm), tan fluor-hydroxylapatite botryoids, pinkish-brown acicular rhodochrosite/siderite, and dark red-brown radiating jahnsite-(MnMnMn).

Beraunite - Variety Eleonorite (Beraunite Group)



Newry - Bell Pit

Beraunite was first named by Breithaupt (1841) while eleonorite was named by Nies (1877, 1880). The first modern "beraunite" formula was given by Koenig (1890) as $\text{Fe}_3(\text{HO})_3(\text{PO}_4)_2 \cdot 2\frac{1}{2}\text{H}_2\text{O}$. Breithaupt (1841) and Bořický (1867) earlier presented analyses showing only ferric iron, also. Koenig (1890) called his material eleonorite, but later systematists referred to the material as beraunite. Beraunite has clear priority as a name, but beraunite was redefined by Frondel (1949) based on material from Middletown, New Jersey: "The analysis is of considerable interest because it reveals a small but significant content of ferrous iron, not hitherto reported in beraunite..." (The implication is that many early analyses of iron-bearing

minerals were not carefully performed and small amounts of one valence were unrecognized and/or unseparated.) Frondel (1949) reported that the New Jersey mineral was color zoned orange-brown to greenish brown, but did not discuss the implications on the valence of iron implied by such a color zonation. Fanfani and Zanazzi (1967) solved the crystal structure of material from the Eleonor mine (type locality for eleonorite), Giessen, Germany and found by microchemical analyses that "... gave results in a large range with an average ratio $\text{Fe}^{\text{II}}/\text{Fe}^{\text{III}}$ of 1:5.9. This fact suggests the formula $\text{Fe}^{\text{II}}\text{Fe}_5^{\text{III}}(\text{OH})_5(\text{PO}_4)_4 \cdot 6\text{H}_2\text{O}$ as more probable for beraunite, though the mineral usually occurs in a more or less oxidized state; the result of this oxidation is the loss of the hydrogen content without damage to the crystal structure." It is interesting that the crystal structure determination supporting the definition of beraunite was performed on material which was a partially oxidized equivalent of that material. Eleonorite is a member of the beraunite group which has essentially all ferric ions, instead of ordered ferrous and ferric ions, and is stabilized by the conversion of one water group into an hydroxyl group to balance the conversion of one Fe^{2+} into one Fe^{3+} (Paul Moore, personal communication, 1974).

At the Bell Pit, Newry, eleonorite forms golden brown radial clusters of crystals (very much less than 1 mm) in small patches (1x1 mm) on massive quartz in the siderite assemblage. It is very scarce. Schoonerite (q.v.) could be confused with eleonorite except that schoonerite has a pearly to bronzy luster.

BERLINITE

AlPO_4

unspecified outcrop, proprietary information in a Phelps Dodge mining report

Berlinite is a very rare phosphate which is found in very few localities in the world. A traverse grab sample collected from "an outcrop in a swamp" was found with small grains of cassiterite by a Phelps Dodge exploration geologist (Sidney A. Williams, personal communication, 1985). As the results of the exploration were proprietary in nature, the locality has not been revealed. (Berlinite is a very difficult mineral to identify. It has identical properties to quartz including refractive indices and response to X-rays. Only chemical tests distinguish it from quartz.)

BERMANITE

$\text{Mn}^{2+}\text{Mn}^{3+}_2(\text{PO}_4)_2(\text{OH})_2 \cdot 4\text{H}_2\text{O}$

Greenwood - Emmons Q; **Newry** - Dunton Q; **Stoneham** - Lord Hill Q

Bermanite is a very rare secondary phosphate in Maine. It forms very tiny orange- to reddish-brown clusters of platy crystals. The crystals are generally so small that even clusters of crystals are difficult to spot using microscopic examination.

Exceptionally lustrous dark coppery red bermanite patches (to 2 mm) of tiny crystal plates (much less than 1 mm) with a coppery pearly internal reflection have been found on mitridatite and black-stained fractures in lithiophilite and rhodochrosite from the Emmons quarry, **Greenwood**. An additional coppery red manganese phosphate is known in this association. These unidentified crystals (much less than 1 mm) have a jagged, thin, lath-like shape.

At the Dunton quarry, Newry, bermanite forms crenulated platelets (less than 1 mm) which form clusters (to 2 mm) which superficially resemble carnation flowers with a bright coppery red color. The bermanite is found in altered triphylite vugs in blue tourmaline eyes in cleavelandite. Seaman (1975a) listed additional associations, but as those species belong to slightly different parageneses (e.g. Moore, 1973) their juxtaposition must be regarded as accidental: beraunite, laueite, rockbridgeite, stewartite, wardite, whitlockite, and xanthoxenite. Some bermanite identifications, e.g. Bjareby # 798, 2889, 2923, and 2928, have been made on jahnsite group minerals.

Bermanite forms deep coppery red vitreous homogeneous patches (1-2 mm) of tiny (much less than 1 mm) crystals in vugs in triplite from the Lord Hill quarry, **Stoneham**. Colorless hureaulite crystals and colorless strunzite crystals are also associated in the black-stained triplite nodules frozen in quartz.

BERTRANDITE

$\text{Be}_4\text{Si}_2\text{O}_7(\text{OH})_2$

Albany - Bumpus Q, Pingree Ledge Q, Wardwell #2 Q (Bluff Pit); **Auburn** - Greenlaw Q, Keith (Towne) Q, Maine Feldspar Q, Pulsifer Q; **Bethel?**; **Brunswick**; **TD** - Bemis Stream P; **Georgetown** - Consolidated Q; **Greenwood** - Emmons Q, Harvard Q, Ohtonen Q, Tamminen Q, Tiger Bill Q, Waisanen Q, West Hayes Ledge Q; **Hebron**; **Newry** - Bell Pit, Dunton Q, Nevel Q; **Norway** - BB #7 Q; **Paris** - Mount Marie Q, Mount Mica Q, Slattery Q; **Phippsburg** - Thomas Q; **Poland** - Berry-Havey Q; **Stoneham** - Foster Hill Q, Lord Hill Q, Melrose Q; **Sumner** - Biron Q; **Topsham** - Fisher Q, Standpipe Hill Q, William Willes #1 Q

Bertrandite is widespread in small amounts in Maine pegmatites. It is seldom found in quantity. Much has been made of V-twinning in bertrandite, but twinning is not particularly common in Maine crystals. Bertrandite has a perfect cleavage parallel to the "b" pinacoid. (Bertrandite is so commonly associated with blue fluorapatite in Maine, that all such specimens should be carefully examined for the presence of bertrandite.)

Pingree Ledge quarry, **Albany** has produced colorless, thin bladed, deeply striated bertrandite crystals (to 10 x 10 x 2 mm)

sometimes individually placed in albite vugs and sometimes with color-zoned purple and clear fluorite crystals (to 5 mm). Twins have been reported by Farrington and Tillotson (1908), but single crystals only were figured showing a new form {203}. The locality has produced abundant, thin-bladed albite crystals in the same size range as the bertrandite and which can look very much alike on careless inspection. An identification clue by Farrington and Tillotson (1908) is: "The distinctive characters of the base ["c" pinacoid] are its pearly luster and striations \parallel to a (100)." Groups of bertrandite crystals can be arranged like a distorted box-works or "house-of-cards" arrangement of crystals and are sometimes found on incomplete quartz crystals which show only a few prism faces and which line small cavities in the albite pegmatite. Water-clear jackstraw groupings of platy albite in albite matrix can resemble bertrandite at the Pingree Ledge quarry.

Bertrandite is found as tiny (<1 mm) brilliant plates in a yellow sericitic clay replacing pale blue-green beryl from the Bluff Pit area, furthest southeastern opening of the Wardwell quarry group, Albany (Neil Wintringham, personal communication, 1991).

Auburn has produced bertrandite groups similar to the Lord Hill quarry, but the valencianite or zygadite variety of albite can form part of a matrix for the bertrandite. Crystals are up to 8 mm, but are not well terminated in general. Keith (Towne) quarry bertrandite crystals (to 1 mm) form square rectangular splendid prisms to thin plates in clusters and rosettes (to 2 mm) on the edges of yellow muscovite crystals (to 1 cm). J. S. Towne apparently found bertrandite crystals (to 3x5 mm) loose in a cavity at his workings as a box with about 2 cm³ of loose, thin, simple rectangular crystals is known (YU 4889). Additionally, bertrandite is found at the etched interface between albite and lepidolite. A small amount of sericite is evident and the thin to rectangular prisms are striated on all faces. Occasional right-angle twinned, capped crystals (1 mm and less) have been observed. Similar, but etched, thin rectangular bertrandite crystals (1 mm and less) are found in albite and clear, etched beryl breccia. The Greenlaw quarry produced etched microcline crystals (to 15 cm) with surfaces coated with yellow-stained imperfect bertrandite crystals (to 8 mm) with blue fluorapatite crystals (to 4 mm), quartz, etc.

Bertrandite crystals from an unspecified quarry in **Brunswick** consist of gray translucent rectangular plates (to 4 mm) clustered on coarse microcline crystal faces (to several cm). The bertrandite is not conspicuously twinned and the crystal faces show small channels and troughs which are developed parallel to the rectangular edges. Patches of several square centimeters have been seen (YU 4863). (All observed specimens have been credited to Thomas Lamb.)

Morong (1990) noted bertrandite from the Consolidated quarry, **Georgetown**: "as microscopic, clear and colorless, glassy, striated tabular crystals with chisel terminations, with angles and morphology of bertrandite. One appears twinned at

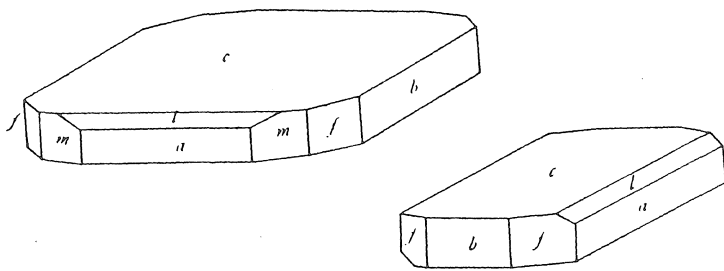
the same angle as a bertrandite twin. Associated with albite (matrix), carbonation-apatite [sic] (white, discoidal hexagonal crystals), and a late-stage sheet-silicate."

The Waisanen quarry, **Greenwood** has produced some excellent bertrandite crystals. The rhombic-shaped, tabular crystals are found in compact muscovite-quartz pocket-lining matrix from the cavities which produced hydroxyl-herderite. Rectangular bladed bertrandite crystals (usually to 3 mm) show striated "shaved" thin edges on the terminations. The frequently orange, iron-stained crystals are internally clear and almost colorless. One simple tabular and rectangular bertrandite was found grown between two smoky quartz crystals and was over 2 cm on the longest edge. Hebron-type fluorapatite as well as typical blocky fluorapatite and limonite-replaced pyrite crystals (to 4 mm) are sometimes associated. Frank Perham (1963) reported: "It [bertrandite] occurred as white wafer-thin flakes about $\frac{1}{8}$ " in diameter, usually in vugs where beryl crystals have been decomposed, or as $\frac{1}{8}$ " to $\frac{1}{4}$ " long needle-sized crystals. The needle crystals are very distinctive as they have a pearly, silver sheen and occur usually flat lying on quartz crystals." *House-of-cards* clusters (to 5 cm) of pearly platy bertrandite crystals (to 3 mm) were found on rusty quartz crystal faces at the Waisanen quarry.

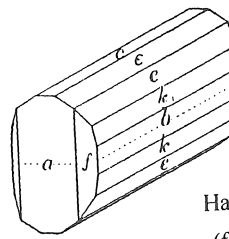
The Harvard quarry, Greenwood has produced micro-mount-size bertrandite. The crystals are tabular rectangular with low-angle faces clipping the otherwise square ends. The clear bertrandite crystals (1-2 mm) are found in cookeite and quartz vugs in etched microcline as well as elbaite-bearing cleavelandite. Pale blue fluorapatite is frequently associated and occasionally lilac-colored fluorapatite. A few of the Harvard quarry crystals show "V-twinning." Bertrandite specimens (YU 4866) which come from the late nineteenth century workings of the Harvard quarry [Hamlinite locality] have a rod-like character (to 3 mm) and a square cross-section. The bertrandite rods are found with blue fluorapatite in vuggy brown-stained albite, sometimes with brilliant brown scaly todorokite botryoids.

Bertrandite from the Tiger Bill quarry, Greenwood is found as individual, almost tabular crystals (to 2 mm) with a rhombic cross-section with clear quartz crystals (to 4 mm), white fluorapatite crystals (to 1 cm), and clear albite crystals in vugs stained by limonite, coated with a light dusting of clay, or just uncoated. The bertrandite can be grouped in parallel stacked clusters of simple rectangular crystals. Small hydroxyl-herderite crystals (to 4 mm) are sometimes associated.

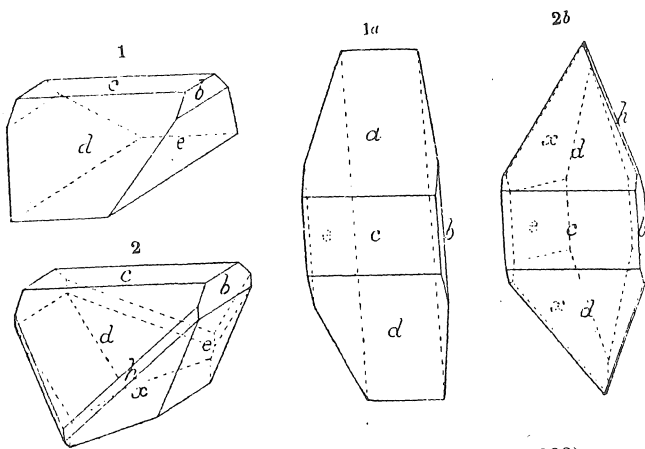
Emmons quarry, Greenwood bertrandite is found in a variety of environments. Tiny (1 mm and less) thin clear bertrandite crystals can be found densely coating etched muscovite fracture surfaces or densely coating quartz fragments which have partly recrystallized to small (to 4 mm) parallel growth crystals. Sometimes drusy white bertrandite coatings can have a "snow on the roof" appearance and can be selectively deposited on parallel growth quartz crystals, muscovite, etc. The bertrandite terminations are sometimes serrated and steep. Bertrandite, with prismatic habit with square cross-section, is also found in albite vugs



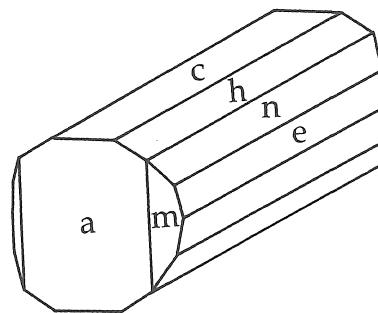
Pingree Ledge Q, Albany
(from Farrington and Tillotson, 1908)



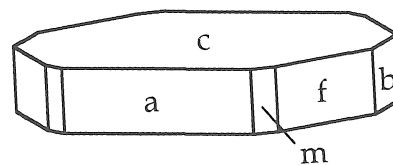
Harvard Q, Greenwood
(from Penfield, 1897)



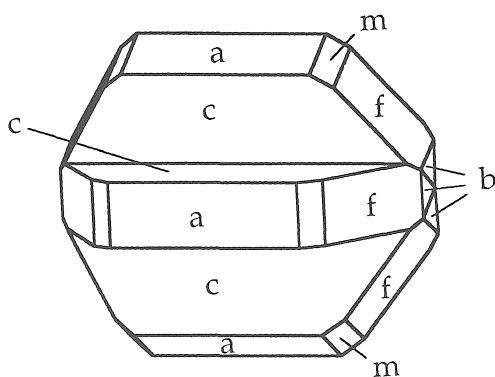
Lord Hill Q, Stoneham (from Penfield, 1889)



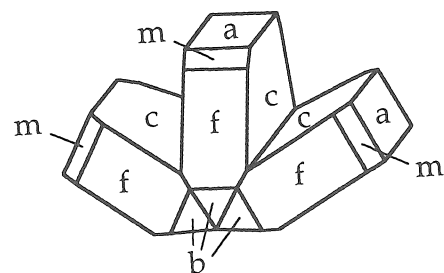
Harvard Q, Greenwood
(redrawn from Penfield, 1897)



West Hayes Ledge Q, Greenwood



Bertrandite twins, West Hayes Ledge Q, Greenwood



Bertrandite

which are lined by albite crystals (to 3 mm) along with goethite replacements of rhodocrosite group crystals associated with crackled white fluorapatite crystals (to 4 mm). Additionally, bertrandite of prismatic habit and square cross-section has been found with lustrous gemmy blue fluorapatite crystals (to 3 mm) on albite crystals (to 5 mm). The faces which cut the *b* axis of the bertrandite crystals are generally rounded and have rounded intersections with each other. The large *c* face can be striated in directions parallel to the horizontal axes and contiguous sectors have right-angle striation intersections.

Bertrandite crystals (to several mm) from the Ohtenon quarry, Greenwood have been found with blue fluorapatite (Bjareby, 1953).

An outstanding find of bertrandite was made at the West Hayes Ledge quarry, Greenwood (Duane Leavitt, Dennis Gross, personal communication, 1993). The tabular crystals are remarkable for their thickness (2 x 2.4 x 0.4 cm) and rank among the largest North American bertrandite crystals known so far. (The huge Colorado bertrandite crystals are generally paper-thin.) One cluster (12 x 13 x 7 cm) consisted of lightly limonite-stained bertrandite crystals (to 1 cm) coated on one side with a druse of milky quartz crystals (to several mm). The West Hayes Ledge quarry bertrandite can have a sub-adamantine luster and show a pearly internal flash parallel to the broadest face. A doubly terminated three-spoked v-twin (2.2 x 2.2 x 1.6 cm) somewhat resembling a small butterfly might be the world's best bertrandite twin.

Bertrandite has always been a scarce mineral at Newry. The Bell Pit crystals (to 3 mm) are found in vugs in albite. The crystals are true rectangular prisms with all axial dimensions unequal. The prisms are simple, being relatively unmarked with only a single extra form {011} modifying the simple shape. Bertrandite from the nearby Nevel quarry, Newry consists of thin platy crystals (to 3 mm) in concentrated yet "open" aggregates in cleavelandite with minor sericite. The Nevel quarry, Newry bertrandite usually has a serrated central "stripe" of bertrandite which is either an overgrowth or a true central twin segment. The crystals of bertrandite show a great deal of irregularity and can almost appear that they were "extruded" from some die at varying rates so that the large portion of the crystal tapers in steps according to the crystallographic requirements of the intermediary, alternatingly developed faces. Right-angle twinning is sometimes evident. Dunton quarry, Newry bertrandite is highly inconspicuous. The very pale yellow-tinted to colorless crystals (1 mm and less), which have a slight pearly luster and some right-angle twinning, are found in albite vugs along with milky white to gray fluorapatite crystals (to 1 mm). Some of the Dunton quarry bertrandite shows the irregular pinch and swell shape of the Nevel quarry's bertrandite.

The BB #7 quarry, Norway at one time had what was the world record size for bertrandite. A specimen with crystals up to 3 cm was found in the porous pocket lining material of a tourmaline gem pocket. Due to an accident, the crystals were broken and only the terminal ends (still nearly 2 cm long) were

recovered. Small crystals (to 3 mm) are found on limonite-stained quartz crystals (to 6 mm) with tan botryoidal (to 1 mm) cookeite on albite and microcline matrix. Subsequent finds in the country of South Korea have equaled the BB #7 and Waisanen finds. The current bertrandite record is held by a locality in the Governador Valedares district, Minas Gerais, Brazil, where crystals to 5 x 2 x 1 cm have been found (Robinson and King, 1993a,b).

Haven noted, in his diary for September 28, 1941, collecting at Mount Marie quarry, Paris (Morrill, 1966): "We also collected minute bertrandite crystals in a vug which Charlie Marble said looked like a bird's nest." The whereabouts of the described specimen is unknown.

The Berry-Havey quarries area, Poland has produced abundant micromount-sized bertrandite crystals (to 4 mm). The bertrandite is found with blue fluorapatite crystals (to 5 mm) and clear quartz crystals (to 4 mm) on albite. Limonite is found staining the various species.

Lord Hill quarry, Stoneham has produced large pure clusters (7-9 cm) of pearly transparent colorless bertrandite crystals from the crystal pockets there with albite or cleavelandite, muscovite, and quartz matrix. Occasional hydroxyl-herderite crystals (to 4 mm) can be associated. The 3-5 mm crystals are intergrown in jackstraw or house-of-cards fashion, despite their short tabular habit. The crystals show many rounded faces and sometimes do not look "properly" terminated. "V"-twins are not uncommon. Some peculiar "Roman sword" terminations on bertrandite crystals (to 5 mm) are known (YU 4865) implanted on pocket-lining muscovite crystals. Bertrandite was present with the original hamlinite as slender cream-colored blades (0.5 x 3 mm) in sheaves of almost acicular crystals. Petar (1929) listed only Stoneham for Maine bertrandite.

Bertrandite from the Sylva Biron quarry, Sumner is generally small, and individual crystals (2 mm) occur in albite vugs along with tan to brown sericite.

BERYL



Albany - Bumpus Q, Donahue Q, Farwell Mountain A, Fleck Q, Flint Mountain P, Frenchmans P (= French Mountain P?), French Mountain P, Foster Q (= Pingree Ledge Q?), General Electric (Glass Quartz) Q, Hatch Q, Johnson Q, Nutting-Pechnik Q, Pingree Ledge Q, Rattlesnake Mountain A, Rattlesnake Mountain Q, Scribner Q, Songo Pond Q (Kimball Ledge Q), Square Dock Mountain A, Stearns P, Wardwell Q, Wentworth P; **Andover** - Bald Pate Mountain A, Ellis River L, Lead Mountain P, Sawyer Brook A; **Andover North Surplus** - C Pond trail, Moody Mountain A, Saddleback Mountain A; **Andover West Surplus** - Frye Brook A; **Auburn** - Emery Q, Greenlaw Q, Groves Q, Keith Q, Kennedy Q, Littlefield Q, Maine Feldspar Q, Pulsifer Q, Wade Q; **Avon** - North Avon Slide A; **Baldwin?**; **Batcheldors Grant** - Evans Notch A; **Blue Hill** - Long Island A; **Bowdoin** - Coombs Q,

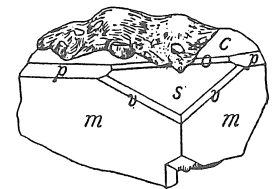
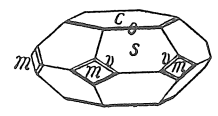
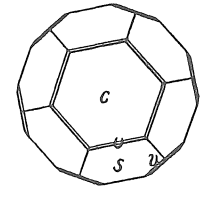
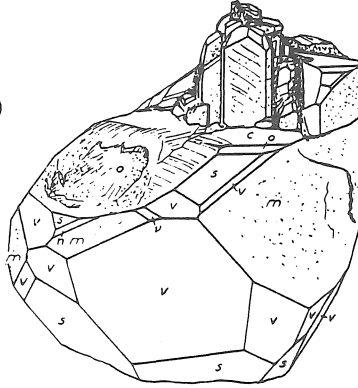
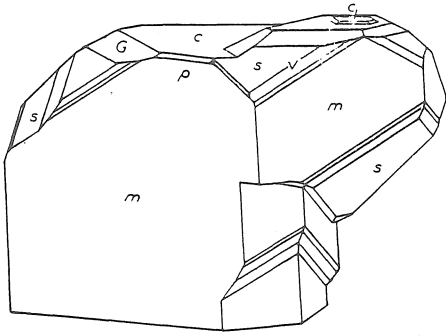
Gustin Q, Ordway Q; **Bowdoinham** - Adderton Q, Barrett Q, Booker Q, Dingley Road Q, Purington Q, Umberhind Q, West Booker Q; **Bridgton?**; **Brownfield?**; **Brunswick** - Garland Q, Dwelly Q, LaChance Q, Morse Q; **Buckfield** - Bennett Q, Bessey Q, Fletcher Q, General Electric Q, Irish Q, Orchard Q, Owls Head Q, South Streaked Mountain A, Westinghouse Q (= Dudley Ledge Q); **Byron** - Brimstone Mountain A, West Branch Swift River A; **Cushing** - South Cushing A; **Dayton** - Union Falls dam A; **Dixfield** - Howe Ledge P; **Edgecomb** - White farm P; **Franklin Plantation** - Catherine Hill P, T10SD; **Freeport** - Taylor Q; **Frye** - Mount Binford A; **Fryeburg** - 1/2 mile west of the public house; **Georgetown** - Comstock Q, Consolidated Q, Golding Q, South Perkins Island A, Todds Bay Q, Tourmaline P; **Gilead** - Wheeler Q; **Gorham** - Dundee Falls A; **Grafton** - Saddleback Mountain A; **Greene?**; **Greenwood** - Beryllium Corporation Q, Bird Hill A, Emmons Q, Gross P, Harvard Q, Heikkinen Q, Hicks Pond Q, Nobles Corner Q (= BB #7 Q?), Nubble Q, Patch Mountain Q, Tamminen Q, Tamminen Senior Q, Tiger Bill Q, Waisanen Q, West Hayes Ledge Q; **Hebron** - Barrett Q, Hibbs Q, George Hibbs Q, Hobart Hill Q, Mahue Ledge Q, Mount Rubellite Q, Sanitarium Q, Streaked Mountain P; **Hollis** - Hollis Center road cut; **Lincoln Plantation** - Azischohos Mountain A; **Livermore** - road cut, International Paper Mill excavation, Tessier P; **Livermore Falls** - East Livermore A; **Lovell** - Bartlett P (=Durgin Mountain P), Foster Hill Q, Flat Hill, Maxim Q, McKeen Mountain Q, Sabattus Mountain A, Slab City P; **Lyman** - Brock P; **Mexico** - U.S. Route #2 road cut; **Milton/Woodstock** - Abbots Mills A brook; **Minot** - LaFlamme Q, Pitts-Tenney Pegmatite P; **Monmouth?**; **Newcastle** - Edgecomb Q; **Newry** - Bell Pit, Beryllium Corporation P (western Meadow Mountain), Broome P, Brundage Ledge P, Cummings P, Double Cross Q (=Marys Q?), Dunton Q, Nevel Q, Rose Quartz Crystal A, Scotty Q, Three Ledges Q, Whitehall Q; **North Yarmouth?**; **Norway** - BB #7 Q, Dunn Q, Turkey Hill Q; **Oxford** - Jordan Q; **Paris** - Hoopers Ledge Q, Little Singepole Mountain Q, Lower Hoopers Ledge P, Mount Marie Q, Mount Mica Q, Number 4 Hill Q, Ryerson Hill Q, Singepole Mountain Q, Slattery Q; **Parsonsfield** - Leavitt Plantation A; **Peru** - Hedgehog Hill Q, Lobikis Q, Mockus Ledge Q, Speckled Mountain A; **Phippsburg** - Denny Reed Point A, Feldspar Q, McKay farm P, Parker Head Q, Perkins Island Q, Robbins Q, Rogers Q, Thomas Q; **Poland** - Berry-Havey Q, East Poland Q; **Pownal** - Lower Tryon Mountain Q, Hinkley P, Upper Tryon Mountain Q; **Richmond?**; **Rumford** - Bellevue P, Black Mountain Q, Brown-Thurston Q, Carver Q, Elliot Q (North Rumford Mica Q), Ford Hill Q, Goddard Ledge Q (= Silvers Ledge P), Ladd Q, Red Hill Q, Route #5 road cut, South Twin Mountain A, Squag Hollow A, Whitecap Mountain A; **Standish** - Oak Hill P, Oak Hill road cut, Steep Falls A; **Stoneham** - Adams Ledge Q, Aldrich Q, Andrews Ledge Q, Barbour P, Blueberry Mountain A, Cole Q, Durgin Mountain A, Foster Hill Q, Butters Mountain-Great Brook A, Harding Hill Q, Edwin McAllister farm Q, Hollis McAllister farm Q, Lord Hill Q, McKeen Mountain Q?, Melrose Q, Palmer Mountain A, Speckled Mountain A, Sugar Hill Q, Warren Q, Virginia Lake Q; **Stow** - Bussell Q, Deer Hill Q, Little Deer Hill Q, Lower

Colton Hill P, Orman McAllister P, Pine Hill A, Shell Pond A, Shirley Brook A; **Sumner** - Robinson Q; **Topsham** - Consolidated #1 Q, Consolidated #2 Q, Fisher Q, Fisher Extension Q, Graves Q, Mallet Q, Porcupine Hill Q, Russell Brothers Q, Standpipe Hill Q, Staples Q, Trenton Q, Wilhelm P, William Willes #1 Q, William Willes #3 Q, Yedlin L; **Vienna**; **Warren** - Starrett Q; **Waterford** - Knight #1 Q, Knight #2 Q, Saunders Q; **Wayne?**; **West Bath** - Davis Q; **West Paris** - Immonen #1 Q, Perham Q; **Windham** - Dundee Falls A; **Winslow** - Winslow Tin M; **Winthrop** - Woolworth farm A; **Woolwich** - Trott Cove Q; **York?**; **T6 North of Weld** - Blueberry Mountain A; **T10SD** - Catherine Hill P

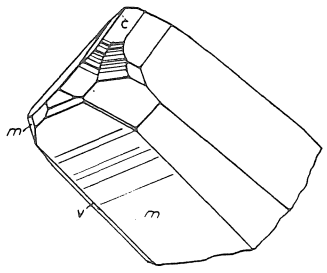
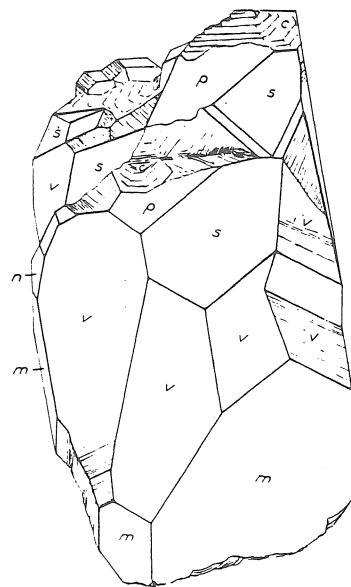
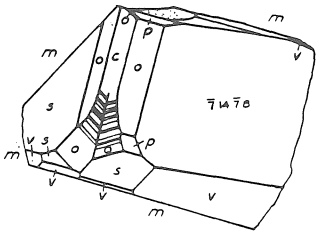
Beryl has been an important ore in Maine. During the 1940's and 1950's, in particular, it was actively mined. Some of the sites were exploited only for that mineral, while some quarries recovered beryl as a byproduct. Bastin (1910, 1911), Petar (1929), Cameron et al. (1954), and Barton and Goldsmith (1968) summarize some of the beryl mining activity in Maine and New England. Beryl has a number of varietal names. Clear colorless beryl is called goshenite. However, the original material from the original occurrence in Goshen, Massachusetts was pink (Shepard, 1852). Gem yellow beryl is called golden beryl or heliodor, while gem pink beryl is called morganite after gem enthusiast and financier John Pierpont Morgan. Aquamarine varies from deep blue to green into lighter shades of either color. Today, many collectors reserve the name aquamarine for gem blue beryl only, but historically aquamarine was either green or blue (Sinkankas, 1981). Schlegel (1957) listed only the gem beryl locations of Kunz (1892a).

Cesium beryl, which properly should be called cesian beryl, was first found in the world at a locality in Norway, probably Tubbs Ledge quarry, by Nathan Perry. In the article announcing cesium occurring in beryl, Mount Rubellite quarry, Hebron was listed as a co-occurrence, but with nearly twice as much cesium oxide as the Norway beryl (Penfield, 1884). (Originally, the name cesium was spelled caesium.) Cesian beryl has generally been applied to pocket beryls of light color which generally are cloudy. Massive white beryl has also received the designation, most commonly without reason. Ford (1910) gave a qualitative discussion of how alkalis in general affected the optical properties of Maine beryl. Ford's (1910) chemical analysis of Hebron beryl shows that while cesium is by far the most important alkali by weight, sodium and lithium predominate by sheer number of atoms present, however.

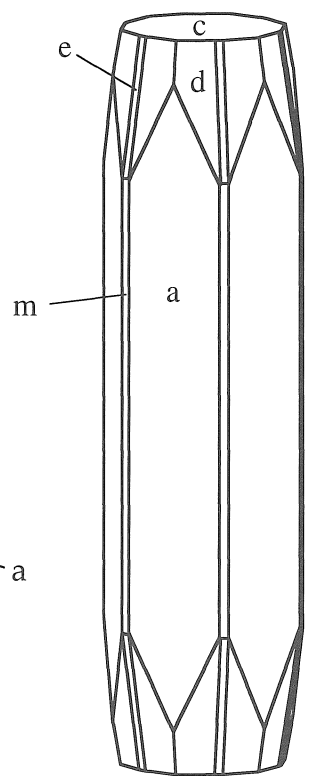
Emerald was the preferred name for beryl until Vauquelin demonstrated in 1798 that emerald was identical to the then rare species beryl (Schuh, 1990). Jackson (1838a) demonstrated the use of the name: "Beryl, a sub-species of the emerald, occurs in Maine, in large and beautiful crystals, some of which are from 6 to 8 inches in diameter. It crystallizes in the form of a 6 sided prism, with plane terminations. Its color is of various shades of green, and the nearly transparent varieties of a sea-green color are used in jewelry, under the name of aqua-marine; the latter



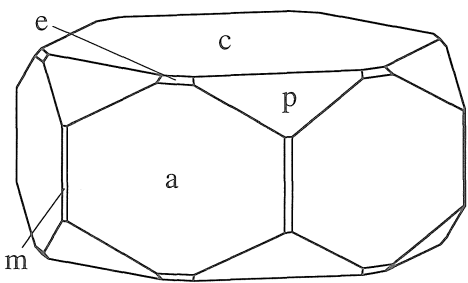
Mount Mica Q, Paris
(from Ford, 1906)



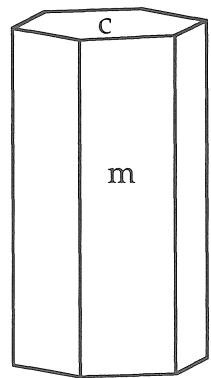
Mount Mica Q, Paris (from Hurlbut and Wenden, 1951)



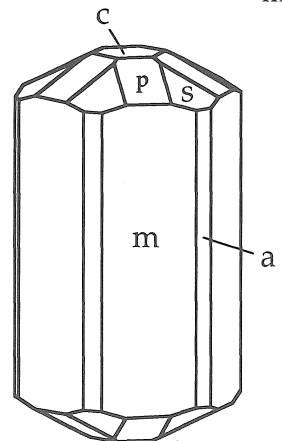
Booker Q,
Bowdoinham



Morganite, Berry-Havey Q, Poland



Bumpus Q,
Albany



Aldrich Q,
Stoneham

Beryl

variety is found in Bowdoinham, imbedded in quartz veins, which traverse granite. The other dark grass-green varieties are also found there in the granite itself, and in the soil derived from its decomposition." The preference for referring to beryl by its older name, emerald, continued for many years and is still a rare practice today. Note also the color of aquamarine! Despite the requirement for emerald beryl to have a very particular range of beautiful green color, which is generally caused by chromium or vanadium, a few collectors are willing to call any green beryl by the name emerald. Hamlin (1870) wrote: "With the exception of the emerald, all of the gems in more or less perfection are found within the limits of the United States." To date, no Maine beryl has ever had true emerald color, though some truly beautiful green shades have been discovered. Of course, emerald was found in North Carolina subsequent to Hamlin's (1870) report. In general, those collectors trying to adhere to the very specific color requirement of emerald have probably only found misidentified tourmaline. It is particularly interesting to note that despite the reports of Maine emerald, there are none available for examination. If you are ever told about Maine emerald, be sure to ask to see the specimen. The matrix for emerald is so distinctive, it will be immediately apparent where the specimen really came from.

Beryl crystals are easy to recognize, crystallographically. The usual habit is the prism and "c" pinacoid. Complex crystals are not rare, however. Bickford (1949) mentioned 12-sided beryl crystals from an area at the foot of Butters and Durgin Mountains [Stoneham?]. Eighteen-sided beryl crystals have been found at a woods ledge "near the Consolidated quarry," Georgetown (Cliff Trebilcock, personal communication, 1991). Most multi-sided beryl crystals received no particular notice unless the "extra" faces are nearly equally developed with the prism. Ford (1906) figured a complex tabular pocket beryl from Mount Mica quarry, Paris.

In general, the varietal names of beryl are *gem* names and the use of these names applied to non-gem material is inappropriate. It should be unnecessary to say gem aquamarine, gem morganite, gem heliodor, etc. Vorobeyevite signifies any pink beryl, gem or non-gem. Non-gem "aquamarine" should be called blue beryl, etc.

Beryl - Variety Aquamarine

Aquamarine means "water of the sea." Many early reports of aquamarine were of green beryls as they were more common than blue specimens. From today's vantage it is difficult to know if green or blue aquamarine was meant. Today, gemmy green beryl is not commonly called aquamarine (see Sinkankas, 1981), and most of the reports below signify blue aquamarine. Much beryl which has been called aquamarine is actually goshenite with a pale blue or green tint. The distinction is not well defined, but clear, pale tinted beryl should not be over-enthusiastically called aquamarine. Cloudy, blue beryl is known by the varietal

name blue beryl. There is hardly a Maine beryl-bearing pegmatite which hasn't produced at least some facetable beryl, many examples of which could be called aquamarine. Very fine facetable deep aquamarine crystals (to 25 x 8 x 8 cm) have been found in quartz at the Songo Pond quarry, **Albany**. The Songo Pond quarry aquamarine does not usually constitute more than 5-10% of any one crystal (Jim Mann, personal communication, 1993; see also Hanscom (1993) and Hayes (1993)).

Putnam and Perham (1968) reported pale aquamarine[?] from **Andover**: "Gem beryl was reported to be in many [quartz?, pegmatite?] veins on the north east side of Bald Pate Mountain in Andover by the late Elbridge Woodworth of Norway. Veins from 6 inches to 20 inches wide ran diagonally down the mountain side."

Pocket aquamarine crystals (to 5 x 2 x 2 cm) from the Greenlaw quarry, **Auburn** are scarce. The crystals can have an etched pitted termination with a matrix of white albite crystals (generally <1 cm), yellow blocky muscovite crystals (to 5 mm), and rarely purple apatite (<1 cm).

Excellent aquamarine crystals (to 25 x 8 x 8 cm) have been found in quartz at the Orchard quarry, **Buckfield**.

Schaller (1917b) imprecisely reported of **Fryeburg?**: "Good beryl of gem quality was obtained by Mr. F. H. Peterson, of Fryeburg, Me. Three crystals - 8 by 14, 5 1/2 by 14, and 6 by 22 inches - considerably flawed, yielded some gem material. A smaller crystal, several inches long and 3/8-inch thick yielded some good aquamarine. The market for aquamarine is said to have been good."

A "pocket" crystal (25 x 25 cm) with a thin termination layer composed of light aquamarine from Mount Mica quarry, **Paris** is figured in a Maine State Museum publication (1973) along with cut aquamarines and cut morganite from Stoneham and Topsham.

Kunz (1892a) declared: "Beautiful transparent beryls have been found at Streaked Mountains, Norway, Lovell, Bethell [sic], and Franklin Plantation, Me., and very good ones at Mount Mica and Grafton, Me. At Albany, Me., have been found beautiful transparent golden-yellow beryls that would cut into perfect gems of over 2 carats each."

Pale aquamarines and goshenites are being found at a previously-known prospect which is being coded the "Wicked-Good Beryl Locality," **Phippsburg**. The name not only preserves a "Maineism" of speech, it designates a locality whose traditional name will be soon revealed, giving the collectors some temporary security to collect at the locality, but which will not result in an "anonymous" locality designation. Specimens with no labels cannot be confidently attributed in all cases. The aquamarines are embedded in granular quartz and can be easily exposed with careful work. The pale aquamarines are of medium size (to 8 x 1 cm), usually completely transparent and virtually flawless, have vitreous faces with slightly etched edges, and tiny first-order pyramids in combination with second-order prism and "c" pinacoid.

Excellent simple doubly terminated hexagonal aquamarine crystals (to 10 x 2 cm) have been found in the ledges exposed on Whitecap Mountain, **Rumford**. The matrix consists of granular, lightly smoky quartz. The color is light, but faceted stones to several carats have been cut from the beryl found there.

Kunz (1883a) wrote of the famous **Stoneham** aquamarine find: "At Stoneham, Maine, two fine crystals have been found in a pasture; one of which will furnish a fine blue gem over 20 karats [sic] in weight. The crystal of which only one half was found is 5 inches long and 1 inch across; it is equal in color to any from Siberia, but has been badly broken by frost or by the hand of some one who was ignorant of its value." The giant aquamarine was probably first reported by Kunz (1884a₁):

"In addition to the topaz and other minerals from [Lord Hill] Stoneham, Maine, the finding of two beryls, of exceptional beauty for this country, may be mentioned; they were found several miles apart and some distance [approximately 6 km] from the topaz locality. They were discovered by chance, within the last two years, by farmers, in pastures in this township. The first is only one-half of the original crystal and has been roughly used by some one who possibly discarded it as worthless after breaking it, or may have broken it in taking it from the rock. It is 120^{mm} long and 54^{mm} wide, and was evidently at least 190^{mm} long and 75^{mm} wide. The color is a rich sea-green as viewed in the direction of the longer axis, and sea-blue of a very deep tint through the side of the crystal. The color and material in the crystal are the finest that have been found at any American locality, and if not broken, would be equal to the finest foreign specimens known. If cut, it will still furnish the finest colored large gem of this mineral found in the United States, weighing at least 20 carats, and a number of small ones weighing from one to six carats.

The other crystal referred to is doubly terminated, being 41^{mm} long and 15^{mm} in diameter. Over one half of it is transparent with a faint green color; the remainder is milky green and only translucent. At the junction of the two colors in the crystal there is the appearance of a flocculent precipitate, looking as if it had almost completely settled, leaving the upper half perfectly clear. The observed planes are: *O* largely developed, *I*, *i*-2, 1, 2-2, 3-³/₂. The finding of these two crystals in such a manner can but lead one to think that rich material must be stored in the vicinity and would warrant further search.

(Since the above paper was read [August, 1883] the locality has been worked to some extent, and a number of very fine crystals have been found by several parties; among these are several transparent pieces, yielding nearly as fine gems as the ones described, and also some remarkable translucent crystals; one of these measures 910^{mm} long and 110^{mm} in diameter and is of very fair color. One fragment weighing 660 grams (now in the possession of Mr. Perry) that had originally been entirely transparent but was cracked by weathering, still has a very large clear space, and apparently is a part of the crystal described before. ...)"

Kunz (1885) further indicated: "The beryl locality at Stoneham ..., Maine, has yielded fully \$700 worth of gems and specimens to the different workers, one crystal selling at \$75 for gem material. Some very fine blue beryls were found here." The

reports indicate that some systematic search was made after the initial aquamarine discovery and perhaps blasting in rock was attempted. Kunz (1886a) revealed as a matter of fact with little explanation: "The finest cut beryl (Aquamarine), ever found in the United States is from Stoneham, Maine. It measures 35 mm. by 35 mm. by 20 mm. It is brilliant-cut and weighs 133³/₄ carats [137.16 metric carats]. The color is bluish-green, and, with the exception of a few hair-like internal striations, is perfect." The large cut aquamarine was figured by Kunz (1886a, 1887b). Kunz (1892a) homogenized some of the beryl reports and noted of the giant gem beryl: "In addition to this remarkable gem, the same crystal furnished over 300 carats of fine stones." Marble (1950b) wrote: "More than fifty years ago a miner in Stoneham picked up a 'pretty stone,' which he sold for \$50.00, and which was finally sold to Tiffany Co. of New York City for \$1000.00; a choice mass of beryl, variety aquamarine, which yielded one practically perfect gem of 133 carats in addition to a number of smaller stones." Marble's (1950b) article probably referred to the statistics given by Kunz (1885 and 1892b): "At Stoneham, Maine, fine aquamarine has been found, which was cut into about \$1,500 worth of gems." The first sale price seems to be the \$75 aforementioned. While worldwide beryls now exist which very far surpass the described crystals, the Stoneham crystal may have been exceeded in quality only by one from Topsham considering American specimens, though many fine crystals are known from Idaho and Colorado. The Topsham crystal would not yield a prettier symmetrical cut gem, however. Maine tradition holds that the Melrose Farm at the foot of Sugarloaf Mountain is the source of the large aquamarine fragments, but there are no contemporary accounts to substantiate the belief.

The Barbour prospect, near the Beryllonite locality, both on the Melrose farm, Stoneham has produced excellent sea-green beryl crystals (to 25 x 4 cm) in smoky quartz. Some of the terminated crystals are fine aquamarines (to 12 x 1.5 cm).

Kunz (1885) reported: "One fine-cut light sea-green aquamarine beryl from **Sumner**, Maine in Mrs. Merchant's cabinet, weighs about 7 carats." Specimen whereabouts unknown.

Aquamarine is found at a number of **Topsham** localities including the Consolidated #1 quarry, William Willes #1 quarry, and Standpipe Hill quarry. Cut blue gems exist from these three quarries.

Beryl - Variety Morganite

Auburn - Greenlaw Q, Pulsifer Q; **Buckfield** - Bennett Q; **Greenwood** - Tamminen Q, Waisanen Q; **Newry** - Dunton Q; **Paris** - Mount Mica Q; **Poland** - Berry-Havey Q; **Topsham** - Fisher Q

Much beryl which has been called morganite is actually goshenite with a pale pink tint. The distinction is not well defined, but clear, pale-tinted beryl should not be over-enthusiastically called morganite. Morganite is exclusively a gem name while vorobeyevite has been used for transparent as well as milky

pink beryl. Some gem trade articles (National Jeweler, 1992) have referred to morganite as "pink emerald." The practice is similar to calling citrine "yellow amethyst" or calling aquamarine "blue emerald."

Morganite with small gemmy areas (less than 1 carat) in smoky quartz has been found at Frenchman's prospect, **Albany**.

A few pale morganite crystals (to 5 x 5 cm) were found at the Pulsifer quarry, **Auburn**. The prism faces are usually frosted while the terminations are glassy. Light milky pink non-gem beryl has been found in quartz and cleavelandite at the Groves quarry, Auburn.

Sterrett (1916) wrote: "During operations for feldspar in the Mount Apatite region, near Auburn, Me., in 1914, a few finds were made of minerals of value as gems or of interest as specimens. Among these was a beryl crystal 12 inches in diameter and 22 inches long, with a light pink color. Much of this crystal was opaque or only translucent, but in some parts it was clear enough to cut into gems. This beryl was found in a quarry of the Maine Feldspar Co., and a specimen of the cut gem was kindly given to the survey by Mr. N. G. Smith, of the Maine Feldspar Co., and Mr. M. L. Keith, lapidary, of Auburn, Me. The cut gem weighs 1.2 carats, is perfectly clear and flawless, shows a very light pink color, and has great brilliance. In some lights the pink is not especially noticeable and the beryl resembles the caesium beryl found at many localities in Maine. Larger gems showing deeper color were also cut from the crystal." Morganite crystals (to 3 x 3 cm) were also found at the Greenlaw quarry, Auburn.

Morganite has been known from the Bennett quarry, **Buckfield** since its earliest mining days. Many of the crystals were tabular and poorly formed, while some completely etched fragments were found. Several large morganite crystals were found at the Bennett quarry in 1989. The largest crystal produced a number of gem stones of which one was over 184 carats and is held by the Maine State Museum, Augusta. Thompson (1989) wrote:

"In September, they encountered a superb morganite crystal believed to be the finest in its size range ever found in Maine (or possibly all of New England). The sharp, transparent crystal has the tabular shape typical of morganite, and is 7.0 cm (2.8 in) wide and 4.5 cm (3 in) thick... Nicknamed "The Peach", it is doubly terminated and has a distinctive pink color. A spray of white cleavelandite blades attached to one termination further enhances the specimen.

On October 7, the miners were excavating a large pocket when they encountered an enormous morganite crystal surrounded by crystals of milky quartz... This transparent morganite is 30 cm (12 in) in diameter and 23 cm (9 in) thick, and thus may rank among the world's largest morganite crystals. It has lustrous terminations and a deep pinkish-orange color that is unusual for Maine beryl. It was extracted as a matrix specimen about 1 m (3.2 ft) across and formed an impressive display piece with the surrounding quartz crystals. ... Several smaller, hand-sized morganites were found in the same pocket, and deep blue fluorapatite crystals occurred on a quartz crystal matrix."

The weight of the largest Bennett quarry morganite ("Rose of Maine"), off matrix, was about 22 kg (Ron Holden, personal communication, 1991). A large portion of the "Rose of Maine," showing some crystal faces, is preserved in the Harvard University collection, the rest of the specimen was cut into numerous small gemstones. The "Peach" is also preserved at Harvard University. The discovery of the Rose of Maine was followed by numerous newspaper accounts (e.g. *Advertiser Democrat* 10/19/1989 [Norway, Me.]; *Sunday Sun Journal* 10/22/89, 1/15/90 [Lewiston, Me.]; *Portland Press Herald* 10/28/89, 1/9/90 [Portland, Me.]; *Bangor Daily News* 1/9/90, 1/18/90, 1/25/90 [Bangor, Me.]; *Boston Globe* 1/13/90 [Boston, Mass.]; *Kennebec Journal* 1/25/90 [Augusta, Me.]) as well as news film accounts. For size comparison, Duparc et al. (1910) described a morganite from Antsirabé, Malagasy which weighed 25 kg: a 21 cm cube would be an approximate equivalent volume. Gaines (1976) reported that the morganite crystals from Cerro de Urucum, Galileia, Minas Gerais, Brazil were found by the hundreds "in size up to 20 cm. between opposite prisms and 8 cm. thick." The morganite crystals from Cerro de Urucum; Kunar, Afghanistan; Pala, California; and Hunan, China are generally very much more attractive than Maine specimens, except for 'The Peach,' which is of world-class quality. Sinkankas (1981) listed a 400 carat gemstone from Hiriart Hill [San Pedro quarry], Pala, California and one of 598.7 carats from Malagasy. A pink, but completely milky, beryl crystal from Haddam Neck, Connecticut is about 45 x 25 cm. Sinkankas (1981) listed a 12.5 cm, in diameter, morganite crystal from the White Queen quarry, Pala, California.

A large morganite was found in cleavelandite at the Emmons quarry, **Greenwood** in the 1930's(?). Stan Perham (1966) reported: "One piece -- mostly gemmy throughout the top of it -- was about twenty inches high and maybe fifteen inches in diameter as reported. I saw fragments of this which would seem to bear out the size. One cutter is reported to have started a hundred carat cushion cut gem. It split and two much smaller stones resulted. With little question as much as twenty-five thousand carats of gem stock occurred that would have yielded two to three carat stones or larger." Hess et al. (1943) apparently described the same crystal, found in 1931: "[pollucite] enclosed one pink beryl that was almost equidimensional and 12 to 16 inches through." Another similarly sized morganite was found by Joe Pollack in the late 1960's or early 1970's, but that crystal was broken for poundage, very little being processed into gems. The Pollack specimen had a large proportion of small facetable areas and was simply referred to by the beryl varietal name, vorobeyevite. Marble (1951c) earlier noted: "Further investigation revealed that the pink Beryl and the Pollucite were not recognized by the miners at first but were thrown on the dump as Quartz. The pink Beryl has a strong resemblance to the rose quartz in the lower opening but I have never seen any Rose Quartz in the upper or larger mine." Had the morganites been carefully measured and widely reported when they were discov-

ered, either might have been world records. A symmetrical morganite crystal as cited by Perham (1966) would have weighed approximately 128 kg or five times the world record credited to Malagasy by Duparc et al. (1910).

A small excellent morganite crystal on agglomerated to brecciated blue gray elbaite and lepidolite on quartz has been found at the Mount Mica quarry, **Paris**. The crystal (3.3 x 4 x 2.9 cm) has a milky zone on the prism with clear glassy termination and core (HU 32719). Several morganite crystals (to 7 x 7 x 5 cm) with small first- and second-order pyramid faces and with more etched and horizontally streaked prism faces were found at the Mount Mica quarry in 1991.

Pink to pinkish lilac morganite has been found at the Berry-Havey quarry, **Poland**. One crystal (10.1 x 7.1 x 3 cm), with some cleavelandite and fine-grained lepidolite attachments, has lustrous c pinacoid and second-order prism faces along with frosted first-order pyramid faces (to 5.5 x 2.2 cm). The pyramid faces were originally selectively coated by fine-grained muscovite. Threads of milky white color are evident through the pinacoid.

An irregular gemmy to cloudy, 7 x 10 cm morganite crystal has been found at the Fisher quarry, **Topsham**, along with several smaller etched fragments of morganite.

Beryl - Variety Heliodor

Fred Pough (personal communication, 1992; see also Pough et al., 1950; and Sinkankas, 1981 for review) indicated that heliodor is a modern gem name given by a German company in 1920 in order to market an orange-yellow gem beryl found in Namibia. The former name golden beryl was the exclusive gem and common name, and a variety of gem yellow beryls, today, are called heliodor despite the original restriction of orange-yellow color. Much beryl which has been called heliodor is actually golden beryl with a milky translucency. The distinction is not well defined, but milky, non-gem, golden beryl should not be over-enthusiastically called heliodor.

Kunz (1885) reported of **Albany**: "At Albany, Maine, Mr. N. H. Perry has recently found beautiful transparent golden yellow beryls that would cut into perfect gems of over 2 carats each."

The Booker quarry, **Bowdoinham** has produced small pale yellow to pale green transparent pocket beryls (to 1.7 cm) which show steep dihexagonal bipyramid modifications characteristic of Topsham pocket beryls. Some eighteen-sided heliodor crystals (less than 1 cm) with several orders of pyramid faces are found free-standing in vugs in albite. Columbite crystals (to 2 mm) can be seen as surface inclusions in the beryl, similar to specimens from the LaChance quarry, Brunswick. A number of "secret" locations for pale yellow to colorless gem pocket beryls (usually less than 3 x 0.5 cm) exist in the Topsham, Bowdoin, and Bowdoinham area. Golden beryl, with occasional gemmy areas, has been found in blocky simple hexagonal crystals (to 15 cm) in smoky quartz at the Coombs quarry, Bowdoin.

Colorless and transparent "pencils" of beryl (crystals to 5 x 0.4 cm), some with patches of rusty golden brown stain have been found at the Barrett prospect, Bowdoinham (Cliff Trebilcock, personal communication, 1991). Similar beryls, though smaller (less than 1 cm), were also found at the Booker prospect, Bowdoinham.

Very beautiful heliodor crystals have come from the LaChance quarry, **Brunswick**. The crystals vary from lemon yellow through rich yellow-orange. Facetable areas are small however, and these crystals are invariably more desirable as specimens than as small cut stones. Some crystals have been found free-standing in albite vugs as well as frozen in smoky quartz. A peculiar feature of some of these crystals includes a skeletal termination with small rims of the prism projecting above the edge of a pyramidal termination without basal pinacoid. The crystals may taper either toward the termination or the point of attachment. Small (to several mm) columbite crystals can be found on the heliodor prism faces, and occasionally as inclusions.

Stan Perham (1966) wrote of heliodor from the Hibbs quarry, **Hebron**: "A little westerly of the main quarry was a prospect hole put in by W. Scott Robinson many years earlier and in this place was quite a showing of dark smoky quartz with lovely golden beryl crystals. I haven't a factual record, but I think Mr. L. B. Merrill cut several gems weighing up to 3 or 4 carats of honey yellow golden beryl. There were many small $\frac{1}{4}$ to $\frac{1}{2}$ carat gems of this fine color."

Some outstanding gem-pocket transparent beryl crystals were found about 1894 at the Trenton quarry, **Topsham** along with smoky quartz crystals showing parallel development of faces. The largest doubly terminated crystal (about 12.5 x 2.5 x 2.5 cm long) was flawless and very pale yellow to green in color. This crystal is at the Field Museum, Chicago, Illinois and appeared in a color plate (Kunz, 1899). The crystals from this locality show simple first-order prism and "c" pinacoid and a very unusual high-angle first-order bipyramid. English (1896) advertised: "SUPERB BERYLS FROM MAINE; large, terminated crystals; a splendid lot just arrived; 50¢ to \$7.50; gemmy crystals without terminations, 25¢ to \$2.00. Two fine matrix specimens, \$7.50 and \$12.50. Do not miss them."

The color of the Trenton quarry crystals varied from a pale aquamarine through goshenite and frequently to a pale heliodor. The lightly tinted crystals were frequently doubly terminated with a steep pyramidal modification and were remarkable in that almost all of the crystal was flawless. The surfaces of the crystals frequently show large (to 2 mm) rectangular growth/etch features. Kunz (1895) described this beryl: "During the past year the Trenton Flint and Spar Company, of Topsham, Me., in mining for feldspar, came upon a number of pockets filled with remarkable crystals of beryl - green, yellow, and white. Some of these were doubly terminated crystals 5 inches long and an inch in diameter. Nearly all possessed more or less transparency, and would cut into gems, some of them being quite equal to those from the Ural Mountains. Their cutting is, in some cases, marred

by what appears to be a highly developed rhombohedral cleavage indicated by shadowy planes visible within the crystal. Their forms are also interesting; some are perfect quartzoids, with extremely regular hexagonal pyramids; others were slightly tapering, showing very acute scalenohedral planes." No bipyramidal beryl "quartzoid" crystals from Topsham are known today. Bastin (1911) reported of the Trenton (G. D. Willes) quarry: "Cavities up to 1 foot in diameter and of various form are rather a constant feature of the coarser portions of the pegmatite in the northern part of the quarry. They may occur within the areas of pure quartz or feldspar, on the border between quartz and feldspar masses, or more rarely in the coarse graphic granite. Usually they contain groups of somewhat smoky semitransparent quartz crystals, some of which make handsome cabinet specimens. In a few, transparent green tourmalines and aquamarines (beryl) of gem quality have been found." Small quartz pockets of the kind described by Bastin (1911) were observed in the Trenton quarry wall during the 1992 field season.

Kunz (1897) wrote: "During the past year many fine crystals of beryl of gem value have been found at Topsham, Maine, one a crystal 12 inches long and 2 inches in diameter." While it may be surmised that the Trenton quarry was the source, the connection is unclear especially as the phrase "of gem value" is used rather than one which directly referred to the transparency typical of the famous Trenton quarry crystals. The quote may have referred to the crystal eventually illustrated by English (1934) now preserved in the Chadbourn collection at Northeastern University.

Heliodor has also been occasionally found at the Coombs quarry, **Bowdoin**, Hobart Hill Q, **Hebron**, Mount Marie quarry, **Paris**, Thomas quarry, **Phippsburg**, Hinkley prospect, **Pownal**, and the Durgin Mountain area, **Stoneham**.

Sterrett (1914) noted of **Stoneham**: "Fine golden beryl and aquamarine are reported to have been found on the land of Charles Andrews, on Speckled Mountain..."

Other Beryl Descriptions

The majority of Maine beryl specimens are obviously not of gem quality. Etched pocket beryl which is generally not facetable, but which has a uniform character that could serve for ornamental purposes, has been found at a number of Maine pegmatites. Some of the locations include Pingree Ledge quarry (green), **Albany**; Barrett prospect and Booker prospect, **Bowdoinham**; Bennett quarry (pale blue, colorless, and pink), **Buckfield**; Emmons quarry (goshenite to milky), **Greenwood**; Mount Mica quarry (pink), **Paris**; and Consolidated #1 quarry (green), Fisher quarry (milky blue-gray), and Trenton quarry (pale green, pale blue, and colorless), **Topsham**. The majority of the following descriptions, however, are concerned with collector quality specimens and beryl ore crystals.

As early as 1838(a), Jackson wrote of beryl from **Albany**: "Very large crystals of beryl have recently been found in the town

of Albany, between Bethel and Waterford. I have not visited the place, but have seen a specimen of large size, which was sent to Professor Cleaveland, in Bowdoin College." Enormous opaque beryl crystals were found at the Bumpus quarry, Albany in 1928 and again in 1950. Beryl crystals from the Bumpus quarry vary from milky sea-green to pale milky blue and are usually found frozen in microcline and gray quartz, and occasionally in rose quartz. The crystal shape is generally a hexagonal prism with "c" pinacoid, but the crystal cross-sections can vary in size along the prism length. Gedney and Berman (1929) described the giant beryls:

"Three crystals are well exposed by the mining operations and are each about seventeen feet long and a yard or more in thickness. The largest has a length of about eighteen feet, a diameter of four feet, and an estimated weight of about eighteen tons. Beside these easily observed crystals there are exposed portions of seven others which give indications of being fully as large.

One of the more prominent of these has a diameter of four feet and is exposed for a length of fourteen feet, although neither extremity of the crystal has yet been uncovered. Another of equal thickness has been exposed for a distance of eight or nine feet without reaching either end. ... The larger crystals appear to be in groups radiating outward from a common center very much like the huge spodumene crystals of the Black Hills of South Dakota. The attitude of the crystals in the quarry wall seems to indicate that there are at least two, and perhaps three, of these radial groups partially disclosed.

The crystals of beryl are closely grouped in the area exposed. No two so far observed are inclined at the same angle and they often lie one across the other with much the same appearance and attitude in the quarry wall as the logs in a log-jam in one of our Northwestern rivers. ... In general the beryl is a light apple-green in color, and more or less milky to opaque. It occasionally varies to an aquamarine variety which, however, is quite commonly badly fractured. Several attractive specimens of aquamarine and a few broken fragments three or four inches across of golden beryl were noted on the dumps at the quarry."

"In front of the South entrance to the American Museum of Natural History, in New York City, stand two pieces of one of the very large Bumpus quarry crystals. They were placed there, through the generosity of the late Mr. J. P. Morgan, the great benefactor of the Museum's collection of minerals" (Sampter, 1950). The crystals are no longer at their stated location, but, instead, are located in a "Dog Run" area near the north end of the museum (Joseph Peters, personal communication, 1990). Spence (1929) briefly wrote on the huge beryls and provided an illustration.

World Record?

When the Gedney and Berman (1929) article appeared, the Bumpus quarry beryl probably was not the largest known in the world, or even in Maine, but it was noted by Palache (1932) as the world's largest. Palache (1932) used 18 x 4 feet (5.5 x 1.2 m)

as the record, which yields a calculated weight of 15.7 avoirdupois tons or 14.3 metric tons of beryl (using an assumed density of 2.7 g/cm^3). The Maine Feldspar quarry, Auburn had a larger, "world record," beryl crystal and was never accorded the recognition (Bastin, 1911). The calculated weight of the Auburn beryl would have been about 17.5 avoirdupois tons (15,900 kg). The Auburn record was broken by beryls from the Ingersoll #1 pegmatite, Keystone, South Dakota. Jahns (1953) wrote of South Dakota beryl:

"... it was measured at different times by Hess ([1933] p. 289), who reported a basal diameter of 45 inches, and by Connolly and O'Harra ([1929] p. 254), who reported the diameter of another section as 46 inches. Although its length never was determined accurately, this prism probably weighed more than 30 tons. A mass of beryl weighing approximately 100 tons is reported from the same pegmatite by Page {personal communication, 1952}, who also notes a tapering prismatic crystal, once exposed in the Bob Ingersoll No. 2 mine, that was 18 feet long and 6 feet in maximum diameter."

The South Dakota beryl was a world record crystal, but the desultory manner in which it was excavated prevented its being noticed by Palache (1932) as it had not yet been exposed to record length. At no time was the South Dakota specimen exposed and intact, so the discovery was not reliably measured either to length or weight. The weight calculated for the Ingersoll #2 quarry, South Dakota beryl (18x6 feet) yields a calculated weight of 35 avoirdupois tons (31,000 kg). No dimensions are available for the "100 tons" crystal.)

Twenty-one years later, the Maine record actually was broken. Neumann (1952) reported of the Bumpus quarry: "One beryl (aqua) crystal was extracted in October 1949. It was 27 feet long, $4\frac{1}{2}$ feet across the base and 9 inches at the top. The crystal yielded 26 tons of beryl. This is probably the largest beryl crystal found at any deposit to date." The statement concerning the record is obviously contradicted by various references cited here. Even the actual weight of this second Bumpus crystal is open to question as the calculated weight of a symmetrical prism would be about 30 avoirdupois tons (27 metric tons) versus the calculated weight of a conical crystal yielding 11.6 avoirdupois tons (10.6 metric tons). Neumann (1952) tabulated total Bumpus quarry beryl production at 255 avoirdupois tons and estimated that the beryl grade was 0.8 per cent. The results of diamond drilling of the Bumpus pegmatite were reported by Stewart (1952). The current world record, for any mineral, is held by a beryl from Malakialina, Malagasy with dimensions of 18 x 3.5 meters and an estimated weight of 379.5 metric tons (Rickwood, 1981) or fifteen times the size of any Maine beryl.

Very fine powder-blue beryl crystals (to 25 x 8 x 8 cm) have been found embedded in quartz at the Kimball Ledge quarry (Songo Pond quarry), **Albany**.

Beryl from Moody Mountain, **Andover North Surplus** was reported by Jorgensen (1960) from granite pegmatites in Mooselookmeguntic? granodiorite where a "deep blue aquama-

rine about $\frac{3}{4}$ " in diameter" crystal was found embedded in quartz. Sea-green to deep blue crystals were also found up to 6 cm.

Large beryl crystals were found at the Maine Feldspar quarry and the Greenlaw quarry as well as other adjacent quarries, **Auburn**. Bastin (1911) reported that one beryl from the Maine Feldspar quarry was 6 x 1.2 m and this may have been a world record size at the time: "One hexagonal beryl found about 1898 is reported by J. S. Towne to have been 4 feet in diameter and 20 feet in length, but the majority do not exceed 1 foot in length and a few inches in diameter." Even though the crystal was a world record size, the fact that it was not called to any one's attention may have been the reason that it was not generally recognized. It is noteworthy that Bastin's (1911) report would have been read frequently by Palache as he had several students study Maine pegmatites including Kenneth Landes. No other mention of the record Maine Feldspar quarry beryl has been seen.

One beryl crystal's section (15 x 15 x 15 cm) from the Greenlaw quarry was generally opaque medium green in color, but graded into golden beryl and facetable heliodor on one end. Kunz (1885) described a beryl from the Hatch Farm quarry: "The crystal is broken diagonally across, thus showing the structure to very good advantage. It is 30 cm. high and 22 wide, and has fifty different layers, twenty-five of beryl, and the remaining twenty-five of albite, quartz and muscovite." The description continues (Kunz, 1892a): "All the corners of the hexagonal prism are carried out in full, giving the beryl an asterisk appearance..."

In 1838(a), Jackson wrote: "In Bowdoinham, granite rocks abound, and they include an abundance of rich and beautiful crystals of beryl and garnet. - The fine transparent sea-green crystals are found in a vein of greasy quartz, but it is now difficult to obtain good specimens, since they have been mostly extracted by mineralogists and collectors. Being disappointed on a former visit to this place in 1827, I thought that when the rocks had decomposed, we might find the beryls in the soil, and by digging into the earth, Mr. Alger and myself, aided by a laborer, succeeded in obtaining in a few hours no less than two bushels of crystals."

Some outstanding bright lemon yellow beryl crystals (to 6 cm) have been found embedded in smoky quartz and albite at the LaChance quarry, **Brunswick**. The beryl has a peculiar uniformly cloudy layered appearance and occasional transparent areas. Tiny (to several mm) columbite crystals are sometimes found on the crystal faces of beryl and occasionally as inclusions. Large tan to green beryl crystals (to 45 x 6 cm) have come from the Morse quarry, Brunswick.

Landes (1925) wrote of the Bennett and Orchard quarries, **Buckfield**:

"Beryl is common in quartz and feldspar at the northwest corner of the large quarry, and appears in even greater abundance in the small open cut four hundred feet beyond. Here hardly a square yard of the pegmatite face may be found which does not contain a section of a beryl crystal. The crystals are strongly prismatic, up to eight centimeters in

diameter and twenty centimeters long. Some odd shapes appear. One crystal abruptly doubles its diameter, without displacing the vertical axis. Several crystals exhibit a decided tapering along the prism zone. The color ranges from bluish green to green, usually somewhat mottled. All in this class are opaque or translucent."

Landes (1925) continued:

"The beryl of Class II rarely exhibits crystal boundaries. Its solubility in the later solutions has usually resulted in a severe etching, which has destroyed the outlines of the original crystal. These etched forms are known as 'pocket' beryls, because of their characteristic occurrence in the vugs of pegmatites.

One white transparent crystal was evidently partly buried in the wall and partly emergent into the pocket, for one-half the crystal is highly etched, while the other half is unharmed, with crystal boundaries intact."

Colorless cloudy to transparent beryl crystals were found in quartz crystal-bearing pockets at the Bennett quarry in 1990. The crystals (to 6 cm) are tabular with etched pyramid and prism faces and lustrous "c" pinacoid. The crystals have lightly etched large first-order and small second-order pyramids and strongly etched second-order prism. The crystals are also asymmetric with only one end of the crystal showing pyramid faces and with the opposite end showing none.

Sterrett (1914) wrote of the Fletcher quarry, Buckfield: "Very fine caesium beryls have been obtained from the mine of J. H. Fletcher, a little over 2 miles southwest of Buckfield, Me., and about one-fourth mile west of the Lewis mine. The Fletcher mine was also worked by Perien Dudley and was opened by a cut extending north into the hillside. ... Many small fragments of brilliant transparent colorless and pale greenish beryl were observed in the workings. ... The largest beryl crystal found is reported to have been nearly 4 inches in diameter with one end composed of clear gem material."

Charles Marble wrote to Orman McAllister (July 6, 1950; personal library of Robert Whitmore) about **Byron** beryl: "I located a place in Byron on the West Branch last summer along with Irving Frost. I had been after it for eight years. It showed xtls of beryl up to 14 in. across. I tried to get the chance to work it (and so did 8 or 6 others) but a couple fellows from Andover made a deal this season. The first blast gave 1500 lbs. beryl - 2 or 3 more blasts and the beryl was about gone and they quit."

Shepard (1830) reported on **Fryeburg** beryl:

"We are indebted to Mr. Cook, the Preceptor of the Fryeburg Academy, for a knowledge of the interesting deposit of *Beryls* that occurs in this town. It is situated about half a mile west of the public house, upon the western declivity of a granite hill, which lies directly upon the public road. The Beryls occupy a vein a few feet in width, and ten or twelve in length. In dimensions, they vary from one, to two or three inches in diameter; but the closely aggregated manner in which they occur, is not very favorable to a high degree of finish in their form.

Crystals that are tolerably complete, may however, be obtained, and occasionally, those with polished, terminal faces; but we find them, more generally, with faces very unequally produced; as, with two lateral faces very widely extended and imparting a tabular appearance to the crystal, or with four planes so enlarged as to give a rhomboidal aspect, or finally, with the alternate faces protracted in such a manner as to form a trihedral prism[.] The most interesting circumstance connected with these crystals, however, is their color, which varies from a delicate bluish green to a white; those of the first mentioned shade, possessing the ordinary transparency of the species, while those of the latter are only translucent on the edges. ... The longer crystals of Beryl offer the same peculiarity as respects the fractures and reunion of the laminae at right angles to their axes, as were noticed in the large Beryls of Acworth. The deviation from a straight line which the axis suffers, in consequence of this disturbance, amounts in some instances to 5 or 10°; and the quartz which penetrates between the joints, is in layers of half an inch in thickness. In addition to this peculiarity, we observe here, also, a slight curvature in some of the crystals, unattended by any fracture in the prism."

Mount Rubellite quarry, **Hebron** is not well known for its beryl, however, True (1869) said: "Some very beautifully transparent and perfectly white specimens from Mt. Rubellite, in Hebron, are in the cabinet of S. R. Carter, Esq., of that town." No specimens of this quality are now known.

The world's first cesian beryl was reported from (Nathan Perry's Tubbs Ledge quarry?), **Norway** and the Mount Rubellite quarry, Hebron by Penfield (1884):

"My attention was first called to the occurrence of alkalis in beryl, by the detection of caesium in the qualitative analysis of an unknown silicate from Norway, Maine, resembling in outward appearance a specimen of poorly cleavable feldspar. A quantitative analysis was made in which the presence of beryllium was not suspected, and it was not till the results of the analysis failed to yield any satisfactory formula, that a further examination was made and the mineral was proved to be beryl. ... After finding alkalis in one beryl it seemed to be of interest to test others from various localities. The result has been to show that, as far as tested, they always contain alkalis, although sometimes only in small quantities. ... From Hebron, Maine. The material was taken from a fragment of a very much cracked, colorless crystal imbedded in lepidolite... It is interesting showing that the beryl contains much more caesium than the lepidolite in which it is imbedded."

Beryl containing considerable alkalis (1.61 weight % Cs₂O) was reported from an unspecified locality (Tubbs Ledge quarry?), **Norway** by Penfield and Sperry (1888). They postulated that high cesium-bearing beryls were always low in beryllium contents.

The Irish quarry of the Mount Mica quarry group, **Paris** had some extraordinary white beryl noted for its rubidium content (bulk analyses revealed up to 2.19 weight percent alkalis with unseparated potash, rubidia, and cesia amounting to 0.21

weight percent. Spectrographic analyses revealed thin zones in the beryl with cesium amounting to "2 to 6" weight percent and rubidium amounting to 0.1 weight percent (Hurlbut and Wenden, 1951)). The crystals were composed of healed shards of crystals recrystallized after a gem pocket explosion which shattered the parent crystal during the formation of the pegmatite. The irregular shard crystals reached from 1 to 20 x 7.5 x 5 cm. The crystals have a milky white core and a thin (several mm) overgrowth of colorless beryl and the surfaces of the crystals are smooth and lustrous, yet have a slightly melted appearance. Seaman (1949) was there and reported: "On the east slope of Mt. Mica at Paris, Maine, a new pocket about two to three feet in height and breadth, and about eighteen feet in length, was opened up in a renewal of working there near the base of the quarry. This may be a continuation of one of the mineral zones of Mt. Mica itself, out of which were found a large number of very interesting, flattened and somewhat distorted colorless, caesium-rubidium beryl crystals which are being studied at Harvard at the present time. Many of them are very much flattened and elongated in the prism zone and do not show nice hexagonal cross sections as does [sic] most caesium beryl crystals. Again most caesium beryl crystals have relatively short prism faces while these are much elongated. The crystals were originally thought to be amblygonite or topaz. The beryls were of chief interest but the pocket also yielded a large number of smoky and colorless quartz crystals and groups of albite crystals the latter often intergrown with muscovite crystals. Some tiny flattened columbite crystal plates were found in vugs in the albite and some arsenopyrite or lollingite near the pocket itself. The pocket was opened up in August." Leavens (1965, 1988) wrote of cesium zonation within a Mount Mica quarry, Paris beryl. Several transparent but flawed beryl crystals (to 11 x 10 x 5 cm) with simple etched prism and large "c" pinacoid and small first- and second-order pyramids and small second-order prism were found at the Mount Mica quarry in 1991.

Ford (1906) figured some pegmatite pocket beryls from the Mount Mica quarry: "Figure 4 represents an incomplete crystal found at Mt. Mica, Paris, Maine, now in the mineral collection of the American Museum of Natural History in New York. It shows a short development of the prism m with prominent faces of the second order pyramid s ; also small replacements of another pyramid of the second order o ($11\bar{2}2$), of the pyramid of the first order p , and of the dihexagonal pyramid v ($21\bar{3}1$). The crystal is transparent and colorless like pure quartz, and attached to it are plates of lepidolite. Figure 5 is likewise of a colorless crystal from Mt. Mica belonging to the Brush Collection, nearly complete, quite symmetrical in development and about 15^{mm} in diameter. It is characterized by small faces of the prism m and a large development of the pyramid s , while o and v were observed as small truncations." Shepard (1830) noted of the Mount Mica quarry: "The *Beryls* occur in that part of the ledge which abounds more particularly with black Tourmalines, and are diffused among the imperfect crystals of this substance, common feldspar and quartz. They rarely exceed an inch in length; are quite perfect, and of a white color, or of a white slightly tinged with

blue." Pale, greenish blue massive beryl (to 7 cm) has been found in cleavelandite at Mount Mica quarry.

Gemmy pale green beryl crystals (8.1 cm; HU 92833) have been found in offset "train wreck" crystals in smoky quartz at the Thomas quarry, **Phippsburg**.

Although **Poland** has never been an important beryl locality, excepting a few morganite crystals, Sterrett (1911) was able to report: "Dr. O. C. Farrington, of the Field Columbian Museum, of Chicago, reports the purchase of a crystal of golden beryl from Poland, Me., by the museum. The crystal is hexagonal in form and measures 2½ by 1 inch. The purchase price was \$60."

Maillet et al. (1949) indicated that commercial production of beryl from the Black Mountain quarry, **Rumford** to 1942 was 33 tons. "The beryl is white but in places is so clear that it might be mistaken for quartz. It is doubtful whether more than 70 percent recovery of the beryl could be made by hand sorting, owing to the difficulty of distinguishing it from quartz and albite. The beryl is closely associated with mica and occurs closer to the schist contact than the quartz, feldspar, and spodumene." Hess et al. (1943) chemically analyzed a white beryl from the Black Mountain quarry.

Cole (1951) wrote of the North Rumford Mica quarry (Elliot Q), Rumford: "... a large mass of white quartz had been left in the center of the pit. In one side of this quartz mass a sizable beryl crystal of unknown length had been removed, for the crystal form was plainly in evidence in the quartz matrix, and some of its six sides were from eight to ten inches across. A section of this large crystal still remained in place, and the writer obtained several pieces which afterward were cut. The color of this beryl was of a pale blue without a trace of green."

Doten (1936) analyzed an alkali beryl from the Oak Hill road cut, **Standish**.

Golden beryl has been found in sharp simple hexagonal crystals (to 10 cm) frozen in smoky quartz and white microcline matrix at the Melrose quarry, **Stoneham** as well as a large production of green and bluish white beryls. Sterrett (1914) noted of Durgin Mountain, **Stoneham**: "Beryl is abundant in crystals ranging up to more than 2 inches thick. They are mostly opaque or only translucent, but some fragments of crystals were seen on the dump having small brilliant portions that were dark golden yellow, yellowish green, bluish green, and nearly colorless. Most of the beryl crystals seen were exposed for a distance of 15 feet in a streak or belt extending north across the pegmatite outcrop."

Kunz (1892a) refuted Cleaveland's (1816, 1822; also Bruce, 1814) **Topsham** emerald report: "... but as no true emeralds from ... Topsham are in existence, this may really be a dark-green beryl, as the species beryl is in that locality called emerald." No specimens known. See also discussion under emerald.

Shainin (1947, 1948) said of beryl in Topsham: "Beryl is an uncommon mineral in the pegmatites. Crystals up to 10 inches in diameter were reported by Bastin¹ [1911] to be moderately abundant in the William Willes [#1] feldspar quarry, 1½ miles

northwest of Cathance Station ... and some gem beryl was reported found with green gem tourmaline in cavities in the Trenton (G. D. Willes) quarry. During the present investigation scattered crystals were found in the core of the pegmatite in the [Consolidated] No. 2 quarry and a few small crystals were found on the dump of the Trenton quarry. Although crystals of beryl may be recovered occasionally during feldspar mining, it seems evident that only trifling amounts of the mineral are present in the area."

For the most part, large beryl crystals are found near the core of a pegmatite and are frequently found partly rooted in feldspar with the sharper of the beryl faces embedded in quartz. For example, at the William Willes #1 quarry, Topsham, vivid sea-green beryl crystals (to 40 x 10 x 10 cm) have been found in granular, light smoky quartz in contact with creamy yellow to tan blocky microcline.

Watts (1916) made the interesting statement concerning the Graves quarry, Topsham: "Beryl is present locally, but not in sufficient quantity to constitute a menace."

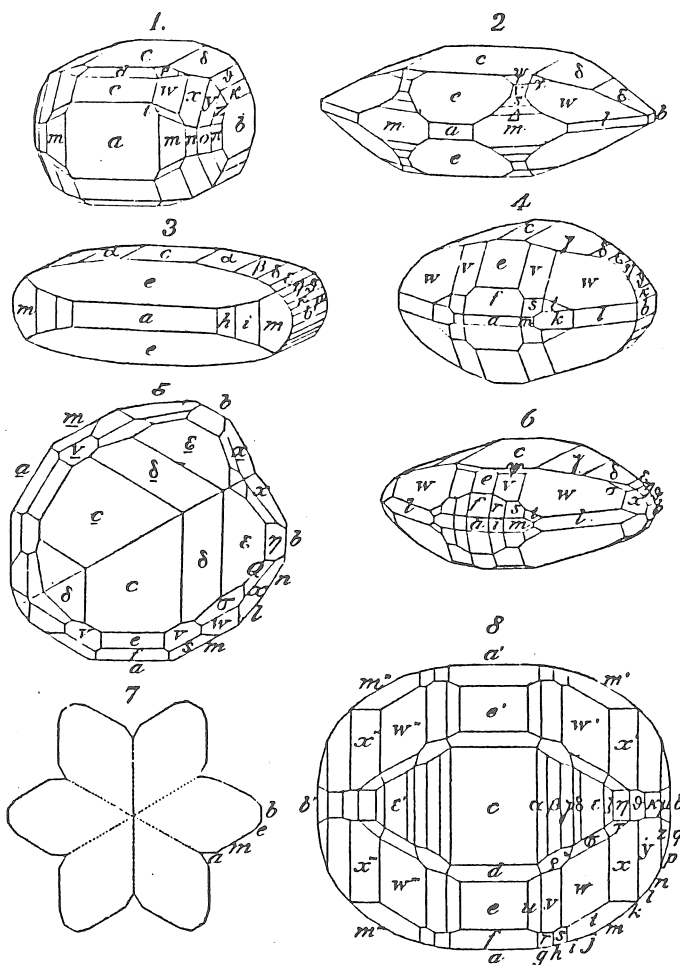
Graton (1905) reported beryl from the Winslow Tin mine, Winslow. Small (less than 1 cm) white beryl crystals can be found with simple prism and "c" pinacoid embedded in "margarite" (=muscovite) and fluorite matrix. Hillebrand (1889) earlier reported on the beryl: "The crystals analyzed were from a specimen in the National Museum found in a tin mine near Winslow, Me. The beryl is of interest on account of its color, which is white, with a faint greenish hue under certain conditions of light. Mr. J. S. Diller examined the crystals and reported as follows: 'The white beryl which you gave me to examine is full of gas and liquid inclusions, most probably air and water, to which the light color of the beryl is due. Besides these it contains a considerable amount of fine ferritic dust, but on the whole is about as pure as minerals usually are. The beryl itself is fresh, and has suffered but little, if any, alteration'."

*BERYLLONITE

NaBePO₄

Greenwood - Emmons Q, Harvard Q, Nubble Q; **Hebron?** - Mills Q; **Newry** - Bell Pit, Dunton Q, Rose Quartz Crystal A; **Norway?** - BB #7 Q; **Rumford** - Black Mountain Q; **Stoneham** - Beryllonite L, Harndon Peak?, Lord Hill Q; **Topsham** - Fisher Q

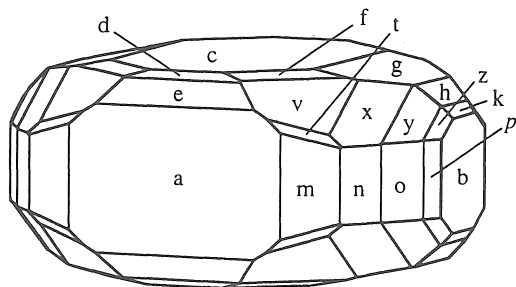
Maine has the type location for beryllonite. It was first found in early 1886 by Sumner Andrews at a small prospect reported by Dana (1888) and Dana and Wells (1889a,b) as being on "McKean" Mountain, but they apparently used information supplied to them. [A tradition in Maine has it that Edward Dana visited the Beryllonite Locality with members of the Andrews family.] Currently, the name of the mountain is Sugarloaf Mountain - one of many similarly named hills in Maine. The hill has also been called Sugar Hill. Attwood (1974) does not indicate that a McKean Mountain ever existed in Maine, though there is



Beryllonite, Beryllonite L, Stoneham
from Dana and Wells (1889a)

a McKean Hill several kilometers south in Lovell. The Beryllonite Locality may have been mistakenly thought to be on "McKean" Mountain or just called by that name in order to mislead collectors to the wrong location. The correct town name, **Stoneham**, was used by Dana (1888) and Dana and Wells (1889a,b). Additionally, many labels incorrectly attribute the Beryllonite Locality to the Melrose quarry. The Melrose quarry occupies a nearby area, but the actual spot where the beryllonite was, and always has been found, is a mudslide-covered area just to the east of the Melrose quarry. The locality has also incorrectly been called Sugar Hill and inexactly called Melrose farm. Only one locality in Maine has produced loose beryllonite crystals found in soil: Beryllonite Locality, Sugarloaf Mountain, Stoneham. Part of the locality confusion might be attributable to secrecy. Dana (1888) revealed: "The name of the gentleman to whom the credit of finding this mineral is due and that of the locality, are at his request withheld for the present."

Type-locality beryllonite crystals (to 4 cm) are usually etched and have frosted surfaces and are generally much simpler



Beryllonite, Stoneham (Data from Dana, 1889a, b)

than the crystal drawings produced by Dana and Wells (1889a,b). The crystal drawings represent the ideal combination of forms and no crystal has been found which exactly resembles the drawings. The drawings are actually composites of the many crystals observed and represent the cumulative total number of observed forms. Beryllonite is colorless and the crystals usually contain numerous internal flaws and minute fluid inclusions. Small gems have been cut from broken beryllonite fragments, but terminated gem crystals are always far more valuable than the total value of the gemstones they could cut. Only a few of the tabular beryllonite crystals have been found on smoky quartz crystal matrix; most were found loose in the disintegrated pegmatite debris. Associated minerals found loose in the debris of the mudslide along with the beryllonite include: microcline, albite, smoky quartz crystals (to 45 kg), muscovite, columbite, cassiterite, beryl, fluorapatite, and triplite. (Other localities in the world which have produced terminated beryllonite crystals on matrix include the Ilha da Lavra, Tacquaral, Itinga district, Minas Gerais, Brazil where the crystals there are about the same size as Stoneham's: 3-5 cm by 1 cm. Beryllonite has also been found at Mont Saint-Hilaire (1-2 mm crystals in matrix), Quebec and at the Rio Tinto mine, Ungava, Labrador (white granular to several cm with sphalerite), both in Canada; and Viitaniemi, Finland (masses to several cm as well as 1 mm crystals). Large etched pseudo-crystal cleavages as well as true terminated crystals (to 16.5 x 11 x 7 cm) have been found at Paroc near Pachigram, Kunar, Nuristan, Afghanistan and resemble Dunton quarry, Newry masses, but the Afghan crystals are far superior in appearance.)

The Lord Hill quarry, Stoneham has produced, at least, one specimen of beryllonite. The beryllonite forms an "X" intergrowth of tabular crystals (8 mm long) composed of clear beryllonite which is fibrous perpendicular to the elongation of the beryllonite. The inside of the "X" crystals is etched with tiny open cavities with some tan clay in-filling. The exterior of the beryllonite is partially clean and partially coated by clay as well as eosphorite crystals (to 2 mm) and hydroxyl-herderite crystals (to 2 mm). The matrix is cleavelandite and quartz.

Frew (1958) reported that beryllonite had been found at Harndon Peak, Stoneham, but no specimens are known.

Beryllonite has been found at the Emmons quarry, **Greenwood**. The tabular fragments (to 2 x 4 mm) are white with a

fibrousness perpendicular to the large surfaces and a small amount of dark brown limonite adhered to the beryllonite. The only beryllonite specimen was found loose in an albite vug and very closely matched the albite's white color.

Stan Perham (1961) reported on Greenwood beryllonite: "At the Nubble Mine about 1958 a westerly contact in the back part of the pit was excavated; a large quantity of clear and slightly cloudy (asteriated) white quartz was put out on the southerly side of the big dump. A collector that year found a piece of beryllonite, badly etched, about the size of an acorn." The whereabouts of the specimen is unknown.

Putnam and Perham (1968) wrote of beryllonite from the Harvard quarry, Greenwood: "... when and by whom?" Beryllonite (Bjareby collection) from the Harvard quarry consists of a fibrous appearing cross-section of a colorless tabular crystal (to 6 x 2 mm) nested in a cleft between frosted quartz crystals (to 8 mm). A golden brown tuft of goethite needles (to 1 mm) was associated on the beryllonite. The "fibrousness" is caused by several cleavages vying for expression. The only crystal face observed (parallel to the tabular aspect) is rounded and etched. The beryllonite so blends into the matrix that it is difficult to spot.

Morrill et al. (1958) reported beryllonite without description from the Mills quarry, **Hebron** (the actual location of the Mills quarry is probably in Paris). No specimens are known.

The Dunton gem quarry, **Newry** produced large masses (20 x 8 x 10 cm) of beryllonite during the search for tourmaline and rare minerals. The material is very pale yellow to white and shows a splintery to fibrous texture. The host mineral is cleavelandite. The beryllonite has been replaced by a number of secondary phosphates including abundant hydroxyl-herderite, various kinds of "roscherite," moraesite, uralolite, and hydroxylapatite. Palache and Shannon (1928) described the material along with its associations and chemical analyses and said that the beryllonite alters to partly cavernous pseudomorphs. Secondary, terminated crystals (to 5 mm) of beryllonite have been observed in the large, etched masses of beryllonite frozen in cleavelandite. The crystals are tabular and have a flat, much etched to frosted basal termination and a "corrugated" prism zone. King (1975b) wrote: "Beryllonite is cream-white to colorless, has a perfect basal cleavage and a less perfect orthopinacoidal one, and has numerous fluid inclusions. The crystals are tabular. Alteration of beryllonite develops a fibration normal to the crystal flattening. Because the crystals are imbedded in cleavelandite, they have vague outlines. The largest crystal mass was 8 x 5 x 4 cm." See also Dunn and Gaines (1978). Subsequently, King (1987b, 1988) reported on the alteration of beryllonite masses:

"up to 20 cm ... Amber-colored, radially fibrous botryoids of hydroxyl-herderite up to 3 mm form clusters up to 10 cm and constitute the first stage of alteration ... Iron-rich roscherite (Lindberg, 1958) formed in the second phase of alteration. It occurs as red-brown to dark brown radially fibrous botryoids up to 4 mm in clusters up to 7 cm that are occasionally directly on beryllonite, but more often are on hydroxyl-herderite. Relatively fresh looking iron-rich roscherite botryoids some-

times show cavernous interiors suggesting dissolution from within. This [iron-rich roscherite] material can also be found as earthy, partly decomposed masses. In a very late alteration phase, acicular, white moraesite and uranolite crystals up to 1 mm in patches up to 5 cm are co-genetic and coat the previously mentioned minerals. Uralolite from the Dunton pegmatite fluoresces green when exposed to short wave ultraviolet irradiation while moraesite does not. All of the alteration products can also be found in interstices in cleavelandite without direct contact with the parent beryllonite. The only other phosphates in the sequence at the Dunton pegmatite are hydroxyl-apatite in 1 to 2 mm bundles of transparent crystals and a snow-white, radially fibrous, botryoidal perham[ite]-like mineral whose chemistry has not yet been characterized."

The article also contained the editorially introduced unauthorized statement about polysynthetic twinning in the Newry beryllonite, yet thin section evidence has not yet revealed the presence of such a feature in the Dunton quarry material. (Botryoidal hydroxyl-herderite, formed as a replacement of beryllonite, has been inappropriately called "baseball beryllonite.") A single mass (5mm) of beryllonite has been found in a blue tourmaline eye (q.v.) at the Dunton quarry.

The Bell Pit, Newry has produced at least one 5 x 7 x 2 mm corrugated crystal of clear beryllonite. The beryllonite crystals have the cog-wheel shape similar to the familiar shape of some bourmonite. The beryllonite is very difficult to spot without magnification as it occurs in transparent-montebrasite-lined vugs and blends in with them. The matrix consists of minor siderite in massive quartz. Small (less than 1 mm) "sprigs" of white francolite dot the termination and striations of the beryllonite. (Specimens from the "West Paris company" workings (Bjareby #100), Newry are indistinguishable from poor specimens from the Dunton quarry and may have come from that location or from the Nevel quarry. Both localities were worked, to some extent, by that company in the time period of the specimen's discovery, though the Nevel quarry was the only one very actively mined.) Stan Perham (1965) noted beryllonite without description from the Nevel quarry, Newry at: "... both upper and lower mines."

"Beryllonite" from the Rose Quartz Crystal area, Newry is presumed to have been misidentified. Specimens observed have been albite, montebrasite, hydroxyl-herderite ("baseball beryllonite"), etc.

A single specimen of beryllonite from the BB quarry area, Norway was reported by S. Perham (1961): "Kenneth J. Fisher of Philadelphia showed the writer a specimen taken from a pocket of the B.B. Mine No. Norway in 1954. We established that the specimen came from the first pocket encountered before the big tourmaline pocket of that year was opened on August 13. The surrounding matrix had been lithiophyllite [sic] albite cassiterite and non gem [sic] tourmaline attached to this matrix formation was a botryoidal specimen of white beryllonite very similar in every way to the Newry, Me. finds. Old specimens in collections should be observed very closely for oddities if col-

lected here during that time. Frondels Whiskers [strunzite] are also reported from near the pocket[.]" The description does not suggest that the material was identified other than visually. The report does not adequately suggest that the material was beryllonite. The association of strunzite, etc. suggests that the botryoidal material could have been fairfieldite (q.v.) or hydroxyl-herderite. The botryoidal material has been called "baseball beryllonite," but it is clear that the material needs verification and precise identification. No specimens known.

Beryllonite from the Black Mountain quarries, Rumford is similar to the Dunton quarry beryllonite. It is found in tabular white masses (to 2 cm) which show a fibrous texture and is associated with a number of replacement minerals including, "roscherite," rhodochrosite, hydroxyl-herderite, eosphorite, and hurlbutite. Beryllonite twins with an "X-shape" (to 1 cm) have been found replaced by green "roscherite" and coated by red-brown rhodochrosite which is fibrous perpendicular to the beryllonite pseudomorphs. Bjareby (1965a) wrote on the occurrence.

"Benjamin Burbank of Brunswick, Maine, discovered many years ago, 1930 era, a pocket in the Fisher Quarry at Topsham, Maine. In the beginning some unusual herderites were found and with them a section cleaved from what may have been a crystal about 1 1/2 inches across -- thickness unknown. This cleaved section broke into 3 pieces. Mr. Burbank kept one and gave me the other two to show the people at Harvard University. Dr. Palache had Prof. Harry Berman identify the sections I showed him of the cleavage and I have the envelope marked Beryllonite -- O.K. H.B. One section was given Dr. Palache. Possibly pockets around Topsham area should be more closely watched for beryllonite occurrences" (S. Perham, 1961). The observed **Topsham** specimen (HU 119765) is a 1 x 1 x 0.5 cm colorless clear cleavage fragment, which could pass for topaz in appearance. Also reported by Perham (1958).

beta-quartz = high quartz = a high temperature variety of quartz

Beta-quartz is a high temperature variety of quartz which cannot be preserved at temperatures below 573° C, and therefore at surface conditions the internal structure of the mineral spontaneously rearranges itself to adopt a more stable configuration. Beta-quartz frequently develops crystals which have only pyramidal faces and are truly hexagonal. Alpha-quartz is formed below 573° C and has trigonal symmetry, but can be pseudo-hexagonal. Quartzoid is the name given to quartz crystals which have only pyramidal faces (*r* and *z* faces). Quartzoids are frequently thought to be beta-quartz pseudomorphs, but careful inspection of the intersection of the crystal faces will show that most specimens only approximate hexagonal symmetry and that the *r* and *z* faces are slightly offset from each other and were originally therefore alpha-quartz. Alpha-quartz quartzoids are frequently seen in siderite masses in granite pegmatites in Maine. Bastin (1911) used textural evidence for the primary crystal-

lization of beta-quartz to ascribe temperatures of formation to various pegmatites in Maine.

BETA-URANOPHANE



Albany - *Wardwell Q*; **Newry** - *Dunton Q*

Beta-uranophane has been identified by X-ray diffraction (this study) from the Wardwell quarry, **Albany**. The mineral consists of deep yellow gemmy needle crystals (to 1 mm) in free-standing crystals in vuggy microcline as well as flat-lying radial interlocking sprays (to 3 mm) in fractures in quartz. By comparison, uranophane forms silky, finer-grained aggregates of similar size, but with very pale, sulfur-yellow color.

Fron del (1958c) reported beta-uranophane from **Newry** [Dunton quarry?] and described the general occurrence of beta-uranophane briefly: "with altered uraninite in pegmatite." His general description of the species worldwide is: "Found as velvety to bristly coatings or subradial to fanlike aggregates of needlelike crystals that may be as much as 1 mm in length. Also as dense aggregates with a confused fibrous or felted structure as seen under the microscope (usually pseudomorphous after uraninite). The needles usually are somewhat thicker than those of uranophane ... Color usually yellowish green; also greenish yellow, citron yellow, or pure yellow. ... Fluoresces faint green in ultraviolet light." No specimen from Fron del's (1956, 1958c) or Stern's (1950) studies seem to have been preserved, and no other **Newry** specimens are known.

BEUDANTITE



Garland - *Preble Hill M*

Bright greenish yellow drusy crystalline beudantite (X-ray and semi-quantitative chemical analysis, this study) is found at the Preble Hill mine, **Garland**. The mineral forms coatings and irregular globular aggregates (to several mm) in vugs in milky quartz along with occasional carminite. Both beudantite and carminite can be microcrystalline in vugs or form films along fractures in milky quartz. Occasional clear colorless to pale green cloudy mimetite crystals (to several mm) can be associated.

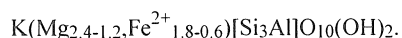
BIOTITE SERIES (Mica Group) - annite and phlogopite end-members

Albany - *Bumpus Q*, *Donahue P*, *Pingree Ledge Q*, *Scribner Q*, *Wardwell Q*, *Wiley-Pechnik P*; **Auburn** - *Greenlaw Q*, *Maine*

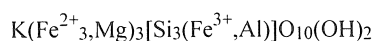
Feldspar Q; **Batchelders Grant** - *Peabody Mountain Q*; **Bath**; **Bowdoin** - *Coombs Q*; **Bowdoinham** - *Jack Q*; **Brunswick** - *Dwellely Q*; **Buckfield** - *Bennett Q*, *Bessey Q*, *General Electric Q*, *Westinghouse Q*; **Denmark**; **Edgecomb**; **Freeport**; **Georgetown** - *Consolidated Q*; **Gilead** - *Peaked Hill Q*, *Wheeler Q*; **Greenwood** - *Emmons Q*, *Harvard Q*, *Heikkinen Q*, *Nubble Q*, *Tamminen Q*, *Waisanen Q*; **Hebron** - *Hibbs Q*, *Mount Rubellite Q*; **Lakeville**; **Lewiston**; **Litchfield** - *Dennis Hill A*; **Lovell**; **Ludlow**; **Mapleton**; **Mexico** - *Gogan P*; **Newry** - *Dunton Q*, *Nevel Q*; **Paris** - *Hoopers Ledge Q*, *Mount Marie Q*, *Mount Mica Q*, *Slattery Q*, *Twitchell Q*, *Whispering Pines Q*; **Peru** - *Hedgehog Hill Q*, *Lobikis Q*; **Phippsburg** - *Thomas Q*; **Poland**; **Rumford** - *Elliot Q*; **Saint George**; **Southwest Harbor**; **Stoneham** - *Aldrich Q*, *Lord Hill Q*; **Topsham** - *Consolidated #1 Q*, *Consolidated #2 Q*, *Fisher Q*, *Mount Ararat Q*, *Porcupine Hill Q*, *Purinton Q*, *Railroad Q* (= *Burbank L*), *Russell Brothers Q*, *Square Pit*, *Standpipe Hill Q*, *Swamp #1 Q*, *Trenton Q*, *Twin Pits*, *William Willes #1 Q*, *William Willes #2 Q*, *William Willes #3 Q*, *Yedlin location*; **Union** - *Harriman P*; **Warren** - *Warren Nickel P*; **Waterford** - *Beech Hill Q*; **West Paris** - *Perham Q*; **Windham** - *Cook Road L*; **T10SD** - *Catherine Hill P*

The significance of biotite as a species name is currently receiving ambivalent treatment. The following discussion will be of more interest to professional geologists than mineral collectors, but the information provided is essentially more historical than technical. The nomenclature of the micas was unspecific until the 1840's, when a great deal of chemical analytical effort was directed at this group and many of the modern names for common micas were generated. The name phlogopite was given by Auguste Breithaupt in 1841. Lepidomelane was named by Johann Hausmann in 1840, while the name biotite was first given by Hausmann in 1847. (Jean Baptiste Biot, for whom the species is named, is cited as having studied this mineral: "One of the uniaxial micas examined by Biot is cited from Topsham, Maine." (Dana, 1850)) In both cases, phlogopite and biotite originally referred to magnesium-rich micas. James Dana (1850) noted for biotite: "Colors various, like the preceding species [phlogopite], usually dark-green or brown, or nearly black; sometimes white or colorless." Edward Dana (1892) listed for biotite: "Colors usually green to black, often deep black in thick crystals, and sometimes even in thin laminae, unless the laminae are very thin; such thin laminae green, blood-red, or brown by transmitted light; also pale yellow to dark brown; rarely white." Phlogopites were described in the same color ranges except for black, although the browns of phlogopite may have ranged into very dark shades. While modern petrologists recognize the overlapping optical properties of phlogopite and biotite, the major distinction of Dana (1850) was that phlogopite was biaxial and biotite was uniaxial. By the time of Dana (1892), the overlapping optical properties were recognized. That is, biotite was no longer essentially pseudo-uniaxial. It was recognized that biotites, which have higher iron contents, have darker colors and stronger pleochroism than phlogopite.

The iron-dominant micas were classed as lepidomelanes until Dana and Brush (1868) recognized the essentially different nature of the black micas from Cape Ann, Massachusetts. Annite was ferrous iron-dominant, but still ferric iron-bearing, in contrast to the ferric iron-dominant character of lepidomelanes. The next edition of Dana's *System* (1892) assigned annite to lepidomelane, without comment, perhaps in recognition of the priority of an iron-dominant species name, without regard for valence. Larsen (1921) listed lepidomelane as the only iron-dominant mica, but annite was relisted as distinct from lepidomelane by Larsen and Berman (1934) who at one point called lepidomelane: "Biotite rich in ferric iron" and at another point: "An iron mica." Larsen and Berman (1934) also listed biotite's composition without magnesium! Winchell (1925) resurrected annite as the ferrous iron-rich mica and Larsen and Berman (1934) gave a formula similar to biotite's. Petrologists and mineralogists frequently have subtle distinctions in the way they use mineralogical nomenclature and this ambivalence is true for biotites even at this writing. Fleischer (1971, 1975) did not list an iron-dominant mica, but showed biotite as a ferroan phlogopite and listed lepidomelane as a "ferrian biotite." Fleischer (1980, 1983, 1987) and Fleischer and Mandarino (1991) have continued the previous distinctions indicated and added annite as a ferrous-dominant true mica. Bailey (1984) classed phlogopite and annite as end-members of the biotite series showing biotite covering the range



Miyano and Miyano (1982) described naturally-occurring ferri-annite



and suggested it could be mistaken for ferristilpnomelane in thin section, etc.

Following the historical nomenclature trends, as well as the nomenclature summaries of Nickel and Nichols (1991) and Fleischer and Mandarino (1991), annite and phlogopite will be used here as end-members of the biotite series. Much of the biotite found in worldwide schists is magnesium dominant and grades into phlogopite while the biotites in pegmatites and granites tend to be iron-richer and grade into annite (Brigatti and Gregnanin, 1987). However, annite (q.v.), the iron-rich member of the series has been found at innumerable locations in Maine schists, etc. Burr (1939c) listed many localities for "sheet" biotite, but it is unlikely that many of these localities would produce more than a few specimens for the purpose required by true sheet mica quality.

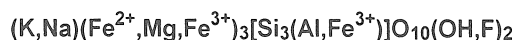
Collector grade biotite crystals are rare in Maine. The Black Mountain quarries, **Rumford** have yielded a few stepped "pagoda" biotite crystals (to 4 mm) in albite vugs. Zoned biotite cleavages (to 10+ cm) with muscovite rims (1+ cm thick) have

been found at several pegmatites such as the Fisher quarry, **Topsham**, the Wheeler quarry, **Gilead**, Mount Mica quarry and Singepole Mountain quarry, **Paris**, etc. An unnamed pegmatite northeast of the Consolidated #1 quarry, Topsham has produced prismatic, pseudo-hexagonal annite/biotite crystals (to 5 x 5 x 5 cm). Similar crystals have been found at the Twin Pits, north of the Consolidated #2 quarry.

Bastin (1910, 1911) indicated the large size of the Trenton quarry, Topsham pegmatitic biotite: "Biotite is moderately abundant in certain parts of the pegmatite, penetrating the feldspar and quartz as long, lath-shaped masses, the largest of them 2 yards long by 3 inches wide and one-fourth of an inch thick." Of the William Willes #1 quarry, Topsham, Bastin (1910, 1911) said: "Biotite is about as abundant as muscovite and occurs in the characteristic lath-shaped crystals. One of these was 4 feet long, 8 inches wide, and 1 inch thick. Much of the biotite is decomposed to what appears to be chlorite colored with hematite." Additional large masses are indicated for Mount Ararat quarries, Topsham, etc. Shainin (1948) used the parallelism of the pegmatite biotite with the host biotite gneiss as supporting evidence for a replaced nature of the gneiss by pegmatite. Shainin (1948) said: "Biotite is a common accessory in the wall zones and occurs mostly in 'bladed' crystals a foot long, one to three inches wide, and one-eighth to one-quarter of an inch thick. Some crystals at the No. 1 and No. 2 quarries are twenty feet long, eight feet wide, and one to three inches thick; they appear to have formed along fractures in the pegmatite. Most of these fractures are of very small extent, and commonly the area of a fracture surface is no greater than the area of the biotite crystal that coats it. Three planes of parting in the biotite, roughly normal to cleavage, intersect at exactly sixty degrees, and break the crystals into a number of long blades and rhombs." Sharp, pseudo-hexagonal biotite crystals (to 5 cm) have been found at several unspecified Topsham quarries and prospects.

Hess and Fahey (1932) discussed the cesium-bearing biotite of South Dakota and made the observation: "It is the first mica, other than lepidolite, known to carry cesium. Micas of similar appearance were found at the border of the pegmatite on Tin Mountain [South Dakota] ... [and] at the border of the cesium bearing pegmatites in the town of Newry, and on Hodgeon Hill near Buckfield, Maine."

Biotite Series - ANNITE (Mica Group)



Auburn - Hatch Farm Q; Cupsuptic quadrangle - Albee and Dixville Formations; diorite near the central granite of Flagstaff Lake igneous complex - Eustis, Flagstaff; Gardiner - glacial drift boulders; Kingfield; Litchfield - Dennis Hill A; Lucerne pluton - Amherst, Bucksport, Clifton, Dedham, Ellsworth, Great

Pond, Orland, Otis, Penobscot, Surry, T32MD; Norway; Passadumkeag River pluton - Burlington, Carroll, Grand Falls, Kossuth, Lee, Lincoln, Springfield, T3ND, T3R1 NBPP, T4ND, T5ND BPP, T5R1 NBPP, T6R1 NBPP; Rangeley and Oquossoc quadrangles - Byron, TC, TD, TE, Rangeley Plantation, T6 North of Weld; Stonington - Crotch Island Q; Topsham - Consolidated #1 Q, Consolidated #2 Q, Fisher Q; Whitney Cove pluton - T5ND BPP, T5R1 NBPP, T6ND BPP, T6R1 NBPP

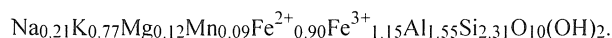
Annite is a black mica of the biotite series which is rich in iron ($\text{Fe}^{2+} > \text{Mg}$, etc.) and the mineral forms a series to the magnesium-dominant ($\text{Mg} > \text{Fe}^{2+}$) species called phlogopite. Dyar and Burns (1986) briefly summarize the finding of ferric-iron in Maine annite and some of the nomenclature problems of black micas. Further studies of annite, from the region of townships **C, D, E, and 6 North of Weld**, as well as **Byron** (Guidotti and Dyar, 1991) indicate that the black micas of that region are ferrous-iron-dominant, but ferric-iron-bearing. Guidotti and Dyar (1991) preferred to maintain the use of biotite as the ferrous-iron, nonferric-iron member of the group, until the nomenclature of the mica group is better formalized. Systematic work has been done to determine the composition of biotites in Maine schists and pegmatites, and the literature currently available suggests a large population of iron-rich compositions.

A sample from Nathan Perry's working at the Hatch Farm quarry, **Auburn** was analyzed by Clarke (1889) and was shown to be annite.

An analysis of annite from an unlocated diorite north or south of the central granite of the Flagstaff Lake igneous complex, **Eustis - Flagstaff** area was reported by Nielsen et al. (1989). Boone (1973) indicated general iron-rich mica compositions based on optical data.

The so-called lepidomelane from **Litchfield** has been shown to be approximately a ferrian annite, but modern data are lacking. Barker (1965) said:

"The *biotite* [emphasis added] in the nepheline syenite has long been called lepidomelane. ... The formula calculated from Clarke's (1886[c]) analysis is:



This biotite satisfies Foster's redefinition of lepidomelane (1960, p. 31) as 'characterized by high Fe^{2+} and Fe^{3+} and by very low octahedral Al and Mg content, and analogous to siderophyllite (as defined herein) but containing Fe^{3+} in place of Al'."

(The above formula is too unsatisfactory to represent siderophyllite.) Clarke (1900c) provided additional chemical analyses of Litchfield annite.

The Lucerne pluton in **Amherst, Bucksport, Clifton, Dedham, Ellsworth, Great Pond, Orland, Otis, Penobscot, Surry, and T32MD** was extensively studied by Wones (1980) who

determined that the black mica was composed of $\text{Fe}^{2+}/(\text{Fe}^{2+} + \text{Mg}) \geq 0.75 \leq 0.86$ and therefore very good annite (based on at least 31 samples).

Annite has been shown, by chemical analyses, to be a component of schists in the **Rangeley Plantation - Byron - TD - TE - T6 North of Weld - Sandy River** region by Guidotti (1974) and Guidotti and Henry (1988). Holdaway et al. (1988) analyzed annites in rocks from and between the **Anson - Gardiner - Norway - Rangeley quadrangles**. Harwood (1966) reported annites in the Albee and Dixville Formations, **Cupsuptic quadrangle**.

Topsham has annite in virtually every one of its granite pegmatites. Sheets (to 7 x 15 x 0.3 cm) are common, many of which show pseudo-hexagonal outline and occasionally are thick and show columnar development. Quarries of the Consolidated quarry group at the end of Tedford Road are particularly rich in annite.

The Whitney Cove pluton, **T5ND BPP, T5R1 NBPP, T6ND BPP, T6R1 NBPP**, has annite analyzed by Gates and Moench (1981) and the highest iron contents are in its "rim facies." A total of 32 biotite variety of annite analyses were reported by Gates and Moench (1981) for the Passadumkeag River pluton, **Burlington, Carroll, Grand Falls, Kossuth, Lee, Lincoln, Springfield, T3ND, T3R1 NBPP, T4ND, T5ND BPP, T5R1 NBPP, T6R1 NBPP**.

Biotite Series - PHLOGOPITE (Mica Group)



Gardiner; Hebron; Lewiston; Norway - Crockett Ridge Q; Old Speck Mountain quadrangle - lime silicate granulite; Sangerville Formation - Greenwood, Norway; Smalls Falls Formation - Rumford quadrangle; Vassalboro Formation - Augusta, Benton

Phlogopite is a component in many schists and gneisses. Phlogopite can vary in color from amber through brown and black. In very rare cases, colorless phlogopite is known, but has not been reported from Maine. Collector grade specimens have rarely been found in Maine. Burr (1939c) listed **Gardiner and Lewiston** phlogopite without comment. Milton (1960) reported phlogopite from lime silicate granulite in the **Old Speck Mountain quadrangle**.

Bronzy brown transparent platy to crudely hexagonal phlogopite crystals (1-3 mm) are found in the Patch Mountain Formation exposed in the Crockett Ridge road metal quarry, **Norway**. The phlogopite is embedded in calcite along with diopside, graphite, titanite, etc. (Guidotti, 1965a).

Guidotti et al. (1975) reported phlogopite compositions in the Smalls Falls Formation, **Rumford quadrangle**.

Ferry (1976) reported phlogopite compositions in the Vassalboro Formation, **Augusta** and **Benton** and mapped a biotite isograd.

BIRNESSITE



Shawn Creek of the Forks quadrangle [Parlin Pond?]

Birnessite forms 1 cm earthy to waxy irregular very dark brown, almost black, botryoidal nodules and lumps in stream sediments in Shawn Creek, The Forks quadrangle [**Parlin Pond?**] (Nowlan, 1976a,b; Potter and Rossman, 1979).

BISMUTH

Bi

Brooksville - Callahan M; **Brunswick** - Bagley Ledge Q; **Cooper** - American Molybdenum Company M; **Franklin?** = T10 SD?; **Greenwood?** - Tamminen Q; **Hancock?**; **Lubec?** - Lubec Lead M; **Newry** - Dunton Q; **Sorrento** - Golden Circle M; **Stoneham** - Lord Hill Q; **Sullivan?**; **Topsham** - Fisher Q; **T10SD** - Catherine Hill P

Park and Bastille (1973) reported bismuth without description as a "subordinate" part of the ore at the Callahan mine, **Brooksville**.

Seaman (1975a) listed bismuth without description from Bagley Ledge quarry, **Brunswick**.

Hess (1908) described the occurrence and specimens of molybdenite at the American Molybdenum mine, **Cooper** and said: "Besides the minerals already described, a single piece of native bismuth the size of a hazelnut was found by the writer."

Bronzy-brown tarnished bismuth? grains (to 2 mm) have been found embedded in fine-grained lepidolite from the Tamminen quarry, **Greenwood** (HU collection).

Jackson (1838a) noted of **Lubec**: "Besides lead, zinc and copper ores, described as occurring at Lubec, an ore of bismuth has been found, which was analyzed by my friend A. A. Hayes." If the "analysis" was made by blowpipe, the identification could have been a confounding of other potential results. Houghton (1861) continued the report and by the time of Morrill and Hinckley (1959) the report had been changed to indicate [native] bismuth. No specimens known.

Gunnar Bjareby was cited by Yedlin (1965, see also Bjareby, 1965b) concerning the Dunton quarry, **Newry**: "I discovered native bismuth at Newry, Maine..." The bismuth consists of bright coppery to "creamy" metallic cleavages (to several millimeters) in patches (to 1 cm) in cleavelandite with minor lepidolite nearby.

The *Maine Mining Journal* (July 9, 1880) reported for **Sorrento**:

"GOLDEN CIRCLE. - A recent assay made by Mr. Fisk of Ellsworth, of ore from this mine gave the following result: \$374.84 gold. We also publish an analysis by Prof. Bartlett, which is as follows:

Gentlemen: I have completed a careful analysis of the metallic crystals found in the Golden Circle quartz and find it to be composed of the following substances, estimated in one hundred parts:

Bismuth.....	78.58	per cent.
Tellurium.....	1.60	"
Lead.....	.45	"
Gold.....	1.55	"
Sulphur.....	2.85	"
Silica.....	14.10	"
Silver and Loss.....	.87	"
Total.....	100.00	

The analysis was made on the crystals, freed as much as possible from the quartz. The results are extremely interesting since it adds another rare compound to our already full list of minerals and one too that was scarcely looked for. The quartz contains not only native bismuth but minute quantities of telluride of gold as well. Further examination will probably show other compounds of tellurium and bismuth. In the analysis native bismuth and gold tellurium are taken together since it was impossible to separate the crystals before making the assay. I have quite a large button of pure bismuth saved from the assay, which I am pleased to say is the first bismuth metal ever extracted from Maine ores.

Respectfully yours,

F. L. BARTLETT, State Assayer.

Portland, July 1st, 1880."

Additional mentions of Golden Circle mine bismuth are found in the *Maine Mining Journal* (September 17, 1880; October 8, 1880; May 27, 1881). Steuart (1905) wrote: "... it [gold] also occurs with metallic bismuth in Hancock County." No Sorrento bismuth specimens are currently known. See tetradymite.

Bright bronzy metallic bismuth cleavages (to 2 mm) from the Lord Hill quarry, **Stoneham** are found grouped (to 1 cm) as inclusions in gray, dull bismuthinite (to 1⁺ cm) in albite.

Bismuth is found at the Fisher quarry, **Topsham** as 2-3 mm metallic grains among lepidolite cleavages in cleavelandite (chemical analysis, this study).

Burr (1917) listed bismuth from the Catherine Hill prospects, **T10SD**. No specimens known.

BISMUTHINITE (Stibnite Group)

Bi₂S₃

Brunswick - Bagley Ledge Q; **Lovell** - Sabattus Mountain A; **Newry** - Nevel Q; **Stoneham** - Lord Hill Q, Melrose Q, Rattlesnake Mountain A; **Stow** - Upper Colton Hill P; **Topsham** - Fisher Q, Standpipe Hill Q, Tarbox Q

Bismuthinite is the bismuth-dominant relative of stibnite and resembles stibnite in virtually every way. The minerals have a perfect cleavage, metallic luster, and frequently show curved grains.

Seaman (1975a) listed bismuthinite without description from Bagley Ledge quarry, **Brunswick**. No specimens known. Locality lost.

Nevel quarry, **Newry** bismuthinite grains (to 3x5 mm) have been found in quartz matrix. The silvery metallic bismuthinite sometimes has a gun-metal blue tarnish.

Melrose quarry, **Stoneham** bismuthinite can occur in large cleavage fragments (3 x 3 x 1 cm). The gray metallic bismuthinite, dull due to slight alteration, can be found in quartz and muscovite matrix. Rattlesnake Mountain, also in Stoneham, has produced bright silvery bismuthinite (to 2 x 5 cm) frozen in white microcline and muscovite and sometimes associated with pale blue beryl. At both Stoneham locations, a golden tarnish is sometimes observed which gives the mineral a visual similarity to bismuth. Bright bronzy metallic bismuth cleavages (to 2 mm) from the Lord Hill quarry, Stoneham (analyses, this study) are found grouped (to 1 cm) as inclusions in gray, dull bismuthinite (to 1+ cm) in albite.

Bismuthinite from the Standpipe Hill quarry, **Topsham** forms silvery gray, dull metallic, curved to slightly dislocated crystals (to 45 x 3 cm! [Morrill et al., 1958]) embedded in microcline-smoky quartz-muscovite pegmatite (If the report is accurate, this would probably be a world's record.). No long specimens of Maine bismuthinite are preserved and the reported length may have been seen in a specimen in the quarry wall, but no other data are known. The bismuthinite from Standpipe Hill quarry frequently has a discontinuous tan to grass-green waxy coating of bismutite. Silvery white metallic bismuthinite also occurs in masses up to 2 x 5 cm in gray to white or pink albite along with muscovite and quartz. A faint green series of "spots" might be associated malachite and/or bismutite. An identifying feature is the distinct fibrous texture of the bismuthinite and the usual curved nature of the crystals. The bismuthinite frequently has a slight bronzy to bornite-blue tarnish. Wheeler and Wheeler (1878) wrote: "BISMUTHINITE is found at Fisher's quarry and at Tarbox's quarry, associated with columbite." The location of Tarbox's quarry is unknown and no specimens are known from there.

BISMUTITE

$\text{Bi}_2(\text{CO}_3)_2\text{O}_2$

Stoneham - Lord Hill Q; **Stow** - Upper Colton Hill P; **Topsham** - Fisher Q, Standpipe Hill Q

Tan to white waxy bismutite pseudomorphs of rod-like bismuthinite crystals (to 3 mm) are found embedded in sericite at the Lord Hill quarry, **Stoneham**.

White, waxy bismutite is found coating bismuthinite in microcline at the Upper Colton Hill prospect, **Stow**.

Bismutite is found as a tan to emerald green powdery to waxy coating on bismuthinite at the Standpipe Hill quarry, **Topsham**. It is also found here as rivulets in gray bismuthinite in smoky quartz. Also from the Standpipe Hill quarry, bismutite is found in dark brown siderite. The waxy mineral varies from light yellow through deep yellow and dark yellow brown and can form botryoids when in vugs.

black manganese = black oxide of manganese - general name for unidentified black, earthy minerals supposed to have manganese in them

Dover; Greenwood; Hodgdon; Woodstock

bog iron = general name for earthy to indurated limonite, hematite, etc. found in swales, bogs, etc.

Jackson (1838a) indicated a major attempt at winning bog iron:

"With him we visited the iron foundry at Shapleigh, on the corner of Newfield, and examined the extent of the ore which is found in that vicinity. The bog iron ore is found upon the little [sic] Ossipee river, in Newfield, and is of a very good quality, yielding from 40 to 45 per cent. of excellent cast iron. It occurs at the head of a pond South West from the furnace, in a peat swamp. Of this low land, about 15 acres belong to the iron company, and the ore has been traced about 100 yards back from the South bank of the river. Its longitudinal dimensions have not yet been ascertained, but it appears to be a very extensive deposit. The order of layers I found to be as follows.

A thin layer of peat occurs on the surface, below which there are of

Shot ore, 8 inches;

Pan " 14 "

The bottom is white siliceous sand.

Three men can dig 7 or 8 tons of the ore per diem, and deliver it at the works.

The furnace was erected last year, under the direction of Mr. Thomas Bates, of Bridgewater, Mass. It is of small size, and cost but \$11,000. It was put in blast on the 9th of August, 1837, and has furnished about 1½ tons of iron per diem. The works appear to be profitable to those concerned, and will be prosecuted vigorously. Formerly, sea-shells were carried from the coast, to supply the furnace with lime for a flux, but since that time, limestone sufficiently good for the purpose has been discovered in abundance, in the immediate vicinity, and will save the expense of transporting shells."

Jackson (1838a) provided an extended discussion of the manufacturing process.

BORNITE

Cu_5FeS_4

Acton - Boston-Acton M; **Auburn?**; **Baileyville** - Woodland Dump road quarry; **Bingham** - Wyman Dam excavation; **Blue Hill** - Bisbee M, Douglass M, Favorite M, Granger M, Twin Lead M; **Brooksville** - Callahan M; **Concord** - Robinson M; **Crawford?**; **Lubec** - Lubec Lead M, West Quoddy Head A; **Norridge-wock?**; **Pembroke** - Big Hill M; **Surry** - Sunburst M; **Union** - Harriman P; **Warren** - Warren Nickel P; **Wesley** - Rollins M; **Woolwich** - U.S. Route #1 road cuts

Bornite is a mineral which is frequently misidentified, because people have most frequently seen and remember the worldwide specimens sold as souvenirs which are usually chalcopyrite which have been chemically treated to give an iridescent tarnish. Chalcopyrite is frequently naturally tarnished, as well. Untarnished bornite is dark pink to coppery bronze metallic color with some "gun metal blue" tarnish along with other colors. A scratch on bornite will reveal the true internal color of a sample.

Gates (1977) wrote of "stop D" at an unnamed quarry on the Woodland Dump road, **Baileyville**: "Cookson Formation - Thick but irregularly bedded cordierite-rich metasandstones displaying primary bedding features are exposed in the quarry wall and in blasted blocks. Fracturing here is related to two intersecting faults; mineralization in the fractures includes pyrite, chalcopyrite, bornite and quartz."

The Douglass mine, **Blue Hill** has good visible bornite specimens. Masses several centimeters across were not uncommon. The bornite cuts into fine-grained disseminated chalcopyrite (to 1 mm) in matrix. The quartz-rich matrix also has albite grains and iridescent brassy chalcopyrite grains (to 1 cm).

Forrest Shepherd is quoted by Hitchcock (1862b) concerning bornite (horseflesh ore) from **Lubec**:

"It is with great pleasure that I have recently observed six well defined spar veins from one to two feet in diameter, four of which show copper ore on the surface. The veins are situated on the land of Benj. Fowler, Esq., at West Quoddy, near the Carrying Place.

One vein appears rich in the yellow sulphuret, and another yields specimens of the purple or horse-flesh ore, and all give promise of future mineral wealth. Still another vein on the same property, although somewhat subdivided on the surface, yet carries yellow copper ore, accompanied with magnetic iron pyrites. Were this property on Lake Superior it would probably be taken in hand at once."

Bornite, calcite, chalcopyrite, fluorite, and malachite were reported from the Sunburst mine, **Surry** (MMJ, March 3, 1882).

Rainville and Park (1976) only say of the Harriman prospect, **Union** and Warren Nickel prospect, **Warren** that: "Other sulfides that have rarely been observed include bornite..."

Arthur Hussey (personal communication, 1992) reported of **Woolwich**: "Bornite and chalcopyrite in grains up to 2 or 3

mm occur sporadically within pink feldspar grains of pegmatites exposed in roadcuts along U.S. Route #1 in Woolwich. Weathering of the primary sulfides has produced the relatively common malachite seen along fracture surfaces in the pegmatites and associated wall-rock gneiss of the Cape Elizabeth Formation. The fact that the malachite is difficult to find today might suggest that recent increases in acid rain has leached much of the mineral in the near-surface parts of the roadcuts."

BOULANGERITE

$\text{Pb}_5\text{Sb}_4\text{S}_{11}$

Blue Hill - Black Hawk M

Boulangerite has been found at the Black Hawk mine, **Blue Hill** as gray thin bladed, unterminated crystals (2 x 0.2 mm) in milky quartz vugs. Yates and Howd (1988) describe one association: "The sulfosalt minerals tetrahedrite, bournonite, and boulangerite, identified optically and with the microprobe, appear only in galena-rich samples and are intimately intergrown with galena. Figure 3a shows a grain of galena replaced by bournonite along a chalcopyrite-galena grain boundary. Boulangerite forms euhedral blades and is associated with anhedral tetrahedrite, galena, and chalcopyrite masses..."

BOURNONITE

PbCuSbS_3

Blue Hill - Black Hawk M

Yates and Howd (1988) describe one association from the Black Hawk mine, **Blue Hill**: "The sulfosalt minerals tetrahedrite, bournonite, and boulangerite, identified optically and with the microprobe, appear only in galena-rich samples and are intimately intergrown with galena. Figure 3a shows a grain of galena replaced by bournonite along a chalcopyrite-galena grain boundary. Boulangerite forms euhedral blades and is associated with anhedral tetrahedrite, galena, and chalcopyrite masses..."

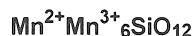
bowenite = a variety of antigorite (Serpentine Group)

Eustis

Stan Perham (1963b) noted: "Bowenite, a hard serpentine that looks much like Jade, has been found here in place during 1963 and was identified by the writer. Rumors of new finds of Jade being made during the past five years, in the Eustis region, have been heard. In Wyoming, this mineral of bowenite is known to occur in the Jade fields." Yellow to yellow green, hard gem serpentine is known by a host of varietal names which partly have regional significance. Lander (1955) made one of the earliest

descriptions of gem serpentine from the **Eustis** area and used the more universal varietal name, retinalite (q.v.).

BRAUNITE



Castle Hill - Dudley deposit; **TDR2 WELS** - Maple Mountain P; **Hodgdon** - Henderson Hill on Houlton Road; **T9R3 WELS** - Hovey Mountain P

Pavlidis (1952) said of the mineralogy of the banded manganese ore of Hovey Mountain, **T9R3 WELS** and Maple Mountain, **TDR2 WELS**: "Laboratory study of these rocks indicates that braunite ... probably is the principal manganese-bearing mineral. In these deposits, it is almost invariably associated with hematite, and together these minerals form the massive manganiferous, banded hematite, the highest grade unit in the sequence. Rhodochrosite ... occurs intimately admixed with the braunite and hematite as well as in laminae entirely free of them. The manganese garnet spessartite ... is present also but is not believed to be an important 'ore' mineral. Rhodonite..., bementite..., pyrophanite..., stilpnomelane..., and material that suggests manganian penninite (chlorite), neotocite (amorphous) ..., and manganian talc are present also, but these are almost wholly restricted to veinlets generally confined within the manganiferous, banded hematite. The nonmanganiferous minerals in these sedimentary rocks include quartz, feldspar, sericite, chlorite, muscovite, cryptocrystalline apatite, barite, phlogopite, calcite, dolomite, magnetite, and pyrite." Skow et al. (1956) estimated the braunite composition of ore to be at about 8 % based on modal analysis.

Further study by Pavlidis and Milton (1962) of Hovey and Maple Mountain ore provided additional description: "Braunite... is an important manganese mineral in the hematitic manganese deposits. It is found both in hematitic shale and slate and in banded hematite ironstone, mixed with other minerals in laminae of paper thinness to an eighth of an inch thick. It occurs also in pods as much as an inch across which are in places connected by thin layers. Such pods are more common in the hematitic shale and slate than in the banded hematite ironstone. At a few places, the pods have a concentric structure in which the black outer shell contains more braunite than the lighter colored core." MacMillan and Turner (1956) experimented with the Maple Mountain - Hovey Mountain ore to concentrate its components. Pavlidis and Milton (1962) indicated that the concentrically zoned pods are typical of the Dudley deposit, **Castle Hill**.

bravoite = vaesite

BRAZILIANITE



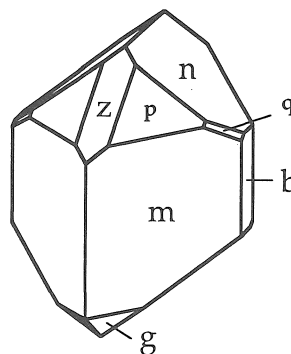
Greenwood? - Harvard Q; **Newry** - Bell Pit, Dunton Q?, Nevel Q?, Rose Quartz Crystal A?; **Paris** - Mount Mica Q

Fairbanks (1964) wrote of the Harvard quarry, **Greenwood**: "Shortly after brazilianite was recognized at New Hampshire's Palermo mine, an actual mine with its underground workings, I found a perfect undistorted bright yellow crystal of the mineral in a block apparently blasted out during the Harvard University's operation of the quarry on Noyes Mountain, Greenwood, Maine. ... Unfortunately they missed this gemstone otherwise it would not be known today as brazilianite." Brazilianite had also been noted by Morrill et al. (1958). Some reports could have been a misreading of Seaman (1949): "The brazilianites were identified at Harvard by Miss Mary Mrose. They are, however not as fine as those from the Palermo Quarry at North Groton, New Hampshire." The reference was to Newport, New Hampshire, however. Seaman (1975a) noted of brazilianite: "... has been found as small, colorless crystals at the Harvard Quarry in Greenwood and at the Dunton Gem Mine at Newry." No specimens known. Mary Mrose [USGS] found brazilianite at the Nevel quarry and the Rose Quartz Crystal locality (Cliff Trebilcock, personal communication, 1994).

Brazilianite has been reported from several localities at **Newry**, but the only verifiable occurrence is from the Bell Pit. The pale yellow (to 8 mm) crystals are found in the siderite assemblage. The crystals are vitreous and translucent and have a steep, chisel-like termination.

Brazilianite was listed from the Dunton quarry (Morrill et al., 1958), but no specimens are known. Specimens of phosphophyllite (q.v.) from the Dunton quarry, Newry may have been misidentified as brazilianite.

The so-called brazilianite specimens from the Rose Quartz Crystal area near the summit of Mount Plumbago, Newry are pale yellow and are found with rose quartz crystals. No data has been available to support the existence of brazilianite at this locality and all of the observed specimens are misidentified



Brazilianite, Bell Pit, Newry (redrawn from King, 1989b,c)

yellow montebrasite crystals. Fairbanks (1964) wrote of Newry brazilianite: "The presence of the mineral in certain Plumbago Mountain quarries has been known for some time. I was shown a bright yellow piece lacking crystal faces considered to be citrine but, as I noted, much softer than quartz. Identity as brazilianite was suggested pending additional tests. Unlike the Palerino [sic] crystals those from Maine have excellent color and smaller crystals at least are flawless."

Francis (1985) listed brazilianite from the Mount Mica quarry, **Paris**. The brazilianite from the Mount Mica quarry has been seen only in two thin sections (Sidney A. Williams, personal communication, 1987). The thin sections were described by Williams (written communication to Richard Thomsson, 1984):

"One band consists mainly of coarse, thin tabular siderite crystals. They are arranged in fan-shaped aggregates and small quartz grains in the interstices indent the siderite. The siderite aggregates in fact seem to replace a coarse grained mineral (feldspar?) once present. Very minute grains of microcline(?) occur among the siderite plates sparingly.

Long, blue, poikilitic prisms riddled with quartz grains are embedded in coarse quartz and bunches of very thick muscovite books. This assemblage follows siderite-rich bands, also filling in between the siderite masses.

Isolated from the siderite are patches of very coarse, finely twinned oligoclase riddled with irregular stringers of quartz. The oligoclase is studded with wedge-shaped euhedra of brazilianite that show some marginal decay to palermoite, further to an irregular network of evansite seams. The final alteration assemblage includes kaolin and hisingerite."

A second thin section was also described by Williams:

"The rock is a pegmatite composed primarily of very large, interpenetrating subhedra of albite. The crystals show broad, degenerate twinning. They host a few grains of brazilianite that in turn show some decay to palermoite, etc.

A peculiar patch of coarse siderite plus microcrystalline siderite-kaolin set in the albite is separated from the latter mineral by a rim of bright blue tourmaline with a few books of muscovite. An enormous garnet grain in the rock is also veined and isolated from the albite by a persistent rim of coarse inky blue tourmaline and quartz."

The brazilianite shows x-shaped twinning, which is hitherto unknown in the species. Cross-sections of the twins show a sharply pointed termination as well as acute but blunted shapes. Based on examination of the thin section (this study) the mineral's optical properties are not dissimilar to phosphophyllite's. The brazilianite identification could not be confirmed.

brittle silver = stephanite?

Hancock? - *McFarland M*; **Lowell?** - *Shorey M*; **Sullivan?** - *Sullivan M*

Mining terms and their translations can lead unsuspecting compilers of mineral lists astray. Frequently, an informal miner's term has a common specific equivalent and becomes strengthened in credibility in the mistaken translation.

The ore of the McFarland mine, **Hancock** was written about (MMJ, November 12, 1880): "We are now daily taking out what mining men tell us is good ore, rich in argentiferous galena.[sic] with frequent showings of brittle and native silver." No specimens known.

The Shorey mine ore, **Lowell** was described (MMJ, November 26, 1880): "A week's work disclosed a vein from 6 to 18 feet in width, thoroughly charged with brittle silver, and so much so like the Sullivan ore that the difference is not perceptible even by assay." No specimens known.

Sullivan "brittle silver" was sometimes listed explicitly as stephanite (q.v.) (Kempton, 1879). No specimens known.

BROCHANTITE

Cu₄(SO₄)(OH)₆

Brooksville - *Callahan M, Cape Rosier M*; **Lubec?** - *Lubec M*; **Topsham** - *Fisher Q*

Brochantite was found in a small area on the western rim of the Cape Rosier mine, **Brooksville**. Continued mining in the Callahan mining operation of the pit completely excavated the area with very little trace of the matrix on the dumps. The brochantite was stubby and tabular in habit (to 1 mm). The color is blue-green and the crystals are translucent to opaque. Associated species include linarite, caledonite?, and rare chalcophyllite. Carpenter and Foster (1960) said, "Brochantite is also widely disseminated throughout the oxidized ore and associated with smithsonite. It occurs as minute green prismatic crystals 0.1 mm in length and apparently has been mistaken in the past for single crystals of malachite. Brochantite can be distinguished from malachite by the fact that brochantite dissolves in cold dilute hydrochloric acid without effervescence."

Bjareby (1964) wrote of **Lubec** brochantite: "In New England the basic copper sulfate brochantite is quite rare and by casual observation easily can be mistaken for malachite. The first occurrence was reported a few years ago at the Cape Rosier Mine, Harborside, Brooksville (Hancock County). The second find was made on material from the Lubec Lead Mine (Washington County), and sent to me by Mr. and Mrs. Clifton Grey [sic], an unusually keen couple of mineral collectors from Old Town, Maine. One of the specimens had a small tuft of divergent crystals resembling malachite but after some close inspection were found to be brochantite." No specimens known, including from the Gray collection.

A single specimen of brochantite from the Fisher quarry, **Topsham** is in the Bowdoin College Cleaveland Cabinet. The brochantite is a dark blue-green coating and thickly lines the

interior of a vug (to 7 mm) in albite and may be one of the few granite pegmatite occurrences for the species.

BROOKITE

TiO₂

Brassua Lake - The Forks quadrangles - Hurricane Mountain Formation *mélange* drill core WCS-1; **Bridgton** - road cut Route #117; **Calais** - Red Beach U.S. Route #1 road cut; **East Middlesex Canal Grant** - Location SP-6; **Paris?** - Mount Mica Q; **Topsham** - Consolidated #2 Q

Boone et al. (1989) wrote of shear surfaces in the Hurricane Mountain *mélange*, **Brassua Lake - The Forks quadrangles**: "These foliation surfaces are commonly lined with smears of graphitic material ... and, within lenses that are chlorite-rich, the shears are lined with opaque oxide and very fine-grained TiO₂ (rutile or brookite), a mineral assemblage that reflects a mafic volcanic source." Later, when logging drill core WCS-1, they listed specifically: "480 Phacoidally and roughly cleaved, pale yellowish green, Fe-rich chlorite-epidote-calcite-brookite-quartz phyllite" and "729 Thick flaser lenses of light gray, sericite-rich phyllite and dark greenish gray, thoroughly sheared, chlorite-brookite sericitic greenschist."

Small brown rectangular brookite crystals (to 2 mm) were found in a road cut on Route #117 in North Bridgton, **Bridgton**. The brookite was found with anatase on drusy quartz coatings on fracture surfaces in granite.

Interstitial cavities on fracture surfaces in the U. S. Route #1 road cut in the Red Beach granite, Red Beach, **Calais** has produced black-tipped brown rectangular brookite crystals to 2 mm.

A tentative identification was made of a mineral in a pyroclastic flow at sample location SP-6 between Lobster Mountain and Little Duck Pond, **East Middlesex Canal Grant** by Simmons (1987): "anastomosing veinlets of chlorite and very fine Ti-oxides (anatase or brookite?)."

Brookite was reported from the Mount Mica quarry, **Paris** by Hitchcock (1862b), but his entry comments: "Small dark brown crystals having a brilliant lustre, are often found embedded in albite and other minerals from this locality, which appear to be brookite or oxide of titanium, but I have not been able to procure a sufficient amount of the mineral to ascertain its nature with certainty." While brookite is known from a Maine pegmatite, the identification from the Mount Mica quarry should be discounted. Early chemical tests for titanium and niobium were frequently confounded and the specimens may have been from the manganocolumbite/manganotantalite series. No specimens known.

A small prospect pit on the northern side of the Consolidated #2 quarry, **Topsham** produced translucent to transparent, pale amber to greenish brown brookite crystals (to 2 mm) embedded in sericitic muscovite and associated with anatase (to 3 mm), quartz crystals (to 1 cm), zircon (to several mm), and rutile (to 3 mm) in vugs etched in buff-colored microcline (King, 1992a, 1993a,b).

bytownite - see plagioclase series

C

cacoxenite?

Greenwood? - Harvard Q

Cacoxenite was proposed as the identification of a single crystal spray (about 1 mm) of golden brown needles on a beryl-lonite crystal section intergrown with small quartz crystals (to 3 mm) associated with cookeite (Bjareby #4119) from the Harvard quarry, **Greenwood**. The mineral is probably goethite.

CALCITE (Calcite Group)

CaCO₃

Albany; **Alfred** - North Alfred A; **Appleton**; **Bethel**; **Blue Hill**; **Bristol** - Round Pond Granite Q; **Brooksville** - Cape Rosier M; **Brunswick** - Maine Mining Q; **Bryant Pond** - Bryant Pond Granite Q; **Bucksport** - near Snow mine; **Buckfield?** - Bennett Q; **Calais** - Beaver Lake Granite Q; **Camden** - Jacobs M; **Casco** - Chute P; **Castle Hill**; **Cherryfield**; **Chesuncook Township**; **Clinton**; **Cornish** - Berry Ledge P, Day Hill P; **Crawford**; **Cushing Formation**; **Cutler** - Cross Island Q; **Deer Isle** - Deer Isle M; **Dexter**; **Dover-Foxcroft**; **Eastport** - Broad Cove A, Moose Island A; **Eustis**; **Farmington** - Scheelite P, U. S. Route #2 road cut in Farmington Falls; **Fort Fairfield**; **Frankfort** - Mosquito Mountain Granite Q; **Franklin** - Blaisdell Q; **Freedom** - Thurstons Corner; **Freeport**; **Gouldsboro** - Gouldsboro M, Soule and Gup-til Q; **Greenwood** - Harvard Q, Tamminen Q; **Hancock**; **Harmony** - Higgins Brook A; **Hartford**; **Houlton** - Henderson Hill Extension; **Industry**; **Jonesboro** - Bodwell Q, Fish Granite Q; **Jonesport** - Jonesport Q; **Kennebunk** - U.S. Granite Q; **Lewis-ton** - City Q; **Linneus** - Drew Hill sulfide veins; **Lubec** - Edgecomb Point A, Lubec Lead M, Rogers Island A, head of South Bay; **Mapleton** - Aroostook Q, Haines Mountain A, Route #163 out-crop; **Marshfield** - Machias Granite Q, Marshfield Granite Q; **Mexico** - U.S. Route #2 road cut; **Minot** - LaFlamme Q, Pitts-Tenney Q; **Monson**; **Mount Desert** - McMullen Granite Q; **New-castle-Damariscotta** - U.S. Route #1 road cut; **Norridgewock**; **North Haven** - amygdaloidal greenstone; **North Yarmouth**; **Nor-way** - BB #7 Q, Crockett Ridge Q; **Paris** - Mount Mica Q; **Pembroke** - Big Hill M; **Perry** - Gin Cove A, Frost Cove A, Lewis Cove A, Loring Cove A; **Phippsburg** - The Basin L; **Portland** - Newell Q; **Presque Isle** - Limestone Q; **Rangeley** - Mingo Loop Q; **Raymond** - Camp Hinds L, Szenics P; **Rockland** - Achorn Q, Bartlett Q, Bog Hole Q, Brown Q, Crockett Q, Engine Q, Hardrock

Q, Hurley Q, Magnesia Q, Paint Hole Q, Sleeper Field Q, Soft Rock Q, G. Ulmer Q, O. B. Ulmer Q; **Rockport** - Goose River, Jacobs Q, Riverside Q, Simonton Corners; **Sanford** - Webster P, 200 m L, 600 m L; **Sangerville Formation** - **Greenwood, Norway**; **Searsmont**; **Skowhegan**; **South Berwick** - Spence and Coombs Q; **Spurwink metalimestone**; **Stonington** - New Eng-land Stone Industries Q (Crotch Island); **Strong**; **Sullivan** - Milton M; **Temple** - road cut; **Thomaston** - Achorn Q, Austin Pasture Q, Blackington Q, Beechwood Q, Creighton Q, Crockett Q, Dougherty Q, Dragon Cement Q, Farm Q, Fulling Mill Q, Gay Q, Hardrock Q, Lawrence Q, McLoon Q, Meadow Q, Nichols Q, Snow Q, Soft Rock Q, State Prison Q, Simons Pasture Q, Tolman Q, Williams Q; **Trescott** - Trescott; **Turner**; **Union** - Union Q; **Vassalboro** - road cut; **Vinalhaven** - Sands Q; **Warren** - Knox Q, Starrett Q; **Washington**; **Waterville**; **Weld** - calc-silicate granulite Mount Blue A; **Wesley** - Bacon and Snow Q; **West-brook** - road cut; **Williamsburg**; **Wilton** - "1 mile from Hillman Hill"; **Winslow** - Winslow Tin M; **Winthrop** - Horseshoe Island; **T3R11 WELS** - Ripogenus Dam A; **T10R3 WELS** - diabase NW of Hedgehog Mountain A; **T16R5 WELS** - Square Lake Lime-stone P

Calcite is a widespread, yet inconspicuous mineral in Maine. Not only is it abundant in the marble belt of coastal Maine centered in Knox county (Cheney, 1967), but it is also abundant in calc-granulite metamorphic rocks which are abundantly distributed (Boone, 1955; Guidotti, 1965a; Pankiwskyj, 1965). (The term rhombohedral carbonate not only signifies an unspecified member of the calcite group, but also an unspecified member of the dolomite group as well.) The extensive Patch Mountain Member of the Sangerville Formation, which is the host meta-morphic rock for many western Maine granitic pegmatites, is very rich in granular calcite (Guidotti, 1965a; Hussey, 1981). Calcite is an abundant mineral in the calc-silicate units fre-quented by collectors for grossular, vesuvianite, etc. Dale (1907) listed calcite as an accessory or alteration in Maine granites. Hussey (1971c) noted marble units in the Cushing Formation and the Spurwink (ribbon) Limestone. Marble is essentially monomineralic rock consisting of calcite. Stewart (1956), Bither (1947), Pratt and Allen (1949), Allen (1953) and Cheney (1967) list and map many marble occurrences.

Seaman (1975a) wrote of calcite? from the Bennett quarry, **Buckfield**: "... it has been noted as crystals on quartz crystals..." No specimens known.

The Patch Mountain Member of the Sangerville Formation, which is well exposed in **Greenwood** and **Norway**, etc., consists

of a variable yet high percentage of calcite which is usually massive, snow-white, and fine-grained (about 1-3 mm) and which fluoresces pink (short-wave ultraviolet; Charles Guidotti, personal communication, 1992). The contacts of the formation with intruded pegmatites are frequently recrystallized and show contact metamorphism assemblages: vesuvianite, grossular, etc. Seaman (1975b) reported: "Yellow, scalenohedral calcite crystals have been noted at the contact of the pegmatite with the wall rock at the Tamminen Quarry in Greenwood."

Dale (1907) reported of **Jonesboro**:

"Small cavities lined with crystals occur in granite. They are uncommon in the Maine quarries, but at the Bodwell Granite Company's quarry, near Jonesboro..., there are several about a foot in diameter, lined with quartz crystals and epidote. The center of some of these is filled with calcite (lime carbonate) in very obtuse rhombohedra half an inch across. ... At the Machias Granite Company's quarry, near Marshfield..., there are several geodes, up to 6 inches in diameter, lined with crystals of feldspar and amethyst, with the central space filled with chlorite, epidote, and calcite.

Such cavities are attributed to bubbles of steam or gas that were in the rock while it was in a molten state, which gave room for the growth of crystals and later became filled with epidote and calcite."

It is unlikely that gas bubbles could have formed in this manner given the pressures on the granite at depth. The only modern evidence at the Bodwell quarry for such cavities suggests that the "geodes" are late-stage solution cavities formed along joint surfaces in the granite. The "geodes" probably were not spherical, but were perhaps more discoidal and were centered on fractures. No collector-grade specimens known.

Bastin and Williams (1914) indicated that calcite was an abundant amygdule-filling mineral along with "some quartz and chlorite" at the head of South Bay and Edgcomb Point, **Lubec**. Calcite is an abundant mineral lining vugs (generally no larger than 2 cm) in volcanic rocks exposed at Loring Cove, Lewis Cove, and Gin Cove, **Perry**. Scalenohedral/rhombohedral crystals (to 7 cm) have been verbally reported from the amygdules, but no crystals have been seen by the authors. Bastin and Williams (1914) figured a diabase with calcite amygdules "1 mile north of Perry" (Frost Cove area?). The calcite frequently fluoresces a medium red (short-wave ultraviolet).

Boucot et al. (1964) wrote of a diabase exposed in **Mapleton** and **T10R3 WELS**: "...on the northernmost hill between Hedgehog Mountain and Squapan Lake, on both sides of the Presque Isle-Mapleton road 1.2 miles east of the railroad overpass in Mapleton (Miller, 1947, p. 58), and in a pasture on the west slope of Haines Hill. ... Some of the diabase is porphyritic with subhedral phenocrysts of light-colored feldspar as much as 1.5 cm in greatest dimension, and some has small (up to 4mm diameter) irregular cavities filled with calcite crystals."

Gaudet and Gaudet (1962) reported massive calcite from a U.S. Route #1 road cut, **Newcastle**: "In one cut, only, blasting

uncovered a limestone section and thru this ran a short vein of calcite ranging in color from creamy white to rosy pink. In spots along the vein edges, were amethyst crystals, many of them doubly terminated."

Smith (1901) noted of amygdaloidal greenstone exposed north of **North Haven** village: "On the weathered surface, the grayish greenstone is pitted, while a fresh fracture is spotted with shining calcite grains."

Some nearly white calcite crystals (chemical analysis, this study) occur as tiny scalenohedra (to 1 mm) in the Mount Mica pegmatite, **Paris**.

Smith (1907) listed minerals for what seems to be the Big Hill copper mine, **Pembroke**: "During 1906 considerable prospect work was done here, and shallow openings have been made at a dozen places on the hillside. ... The metalliferous minerals are sphalerite, galena, pyrite, and chalcopryrite, with quartz and calcite as gangue minerals."

Large masses of snow-white calcite (to 10 cm) are rarely found with vesuvianite, diopside, titanite, grossular, etc. at the Webster prospect and the 200 meter and 600 meter prospects in **Sanford**.

Fine calcite crystals are rare in Maine. The lime quarries in **Rockland** and **Thomaston**, however, have produced some very large examples of some unusual habits of calcite crystals. In the Dragon Cement quarry, **Thomaston**, calcite crystals (to several centimeters) form as secondary recrystallizations of the marble along fracture surfaces where ground water has dissolved the marble. Jackson (1838a) reported some of the crystal shapes: "...in hexagonal prisms, surmounted by three sided pyramid ..."; "...in low hexagonal prisms; Tolmans Quarry ..."; and "... in rhomboidal crystals ... in lenticular crystals; Achorn's Quarry ... Rhomboidal crystal of calcareous spar; Cross Island." The "rhomboidal" shape undoubtedly consisted of generally rhombohedral crystals in combination with a scalenohedron with all faces heavily striated. Some sceptered crystals, with the base crystal shorter than the overgrowth crystal (to 5 cm) have been found and superficially resemble some calcite from Schullsburg, Wisconsin.

Tan to pale yellow irregular, steeply rhombohedral calcite crystals (to 1 cm) with rounded matrix attachments, suggesting in-filling of the calcite between cobbles, have been found at an unspecified **Waterville** location.

Snow-white calcite crystals (to 5 mm), with hexagonal prism and basal pinacoid, with tiny pyrite crystals on them were found at an unspecified road cut in **Westbrook**.

A fracture-filled vein (10 cm wide) in the north shore rocks just below the Ripogenus Dam, **T3R11 WELS** contains some exceptional, massive white platy to lamellar calcite. The interesting nature of the platy calcite is its tendency to break perpendicular to the "c" axis so that centered uniaxial interference figures can be observed by using a polarizing microscope (George Myers, personal communication, 1969).

caledonite?

Brooksville - Cape Rosier M

Morrill and Hinckley (1959) listed caledonite(?) from the Cape Rosier mine, **Brooksville**. Various small (very much less than 1 mm) pale robin's-egg blue crystals and grains were seen with brochantite and linarite and some collectors tentatively used that name without substantiation. No specimens available for inspection.

californite?

unspecified Maine locality

Irish (1930) briefly reported pink(!) californite from an unspecified Maine locality. Californite is specifically an *apple-green*, fine-grained variety of vesuvianite. No specimens known.

canaanite (Amphibole Group) = tremolite

Woodstock

Lapham (1882) noted canaanite from Nathan Perry's list of minerals from Woodstock. No specimens known.

CANCRINITE (Cancrinite Group)

$\text{Na}_6\text{Ca}_2\text{Al}_6\text{Si}_6\text{O}_{24}(\text{CO}_3)_2$

Gardiner - drift boulders; **Litchfield** - Dennis Hill A, Sawyer Farm A, Spaulding Farm A; **Monmouth** - south Cochnewagon Pond A; **West Gardiner** - Spears Corner A, Smith Farm A, True Farm A, Wharff Farm A

Cancrinite is a massive, bright yellow to golden orange-yellow alteration of nepheline from the **Litchfield** area. The pure masses have been found up to 10 cm in maximum dimensions. The majority of collected specimens have been found as drift boulders, frequently from Dennis Hill. Outcrops of litchfieldite have been found in Litchfield and Gardiner (Daly, 1918; Barker, 1965). Associated species include: annite, sodalite, nepheline, and zircon.

In 1845 (abstracted also in Silliman et al., 1846), Jackson reported the analyses of cancrinite and nepheline from Litchfield, Maine. Not only are the analyses different from what we would now accept, but also the description of the samples are: the cancrinite is "deep azure blue color" and the nepheline "occurs occasionally in six-sided prisms of a lemon or sulphur yellow color." Cancrinite was such a new species at the time, it might be suspected that a confusion occurred and that the blue mineral was sodalite and the yellow material was, in fact, cancrinite - espe-

cially since the analyses would agree better. In Alger (1844), cancrinite is listed as being "azure blue" from near Ilmensee in Siberia, the only locality that he mentions. Jackson's analysis failed to detect carbonate, but did report substantial sulphate - results you would not expect to be confused. Probably in light of obvious chatter and eyebrow-raising among contemporary mineralogists, Silliman et al. (1846) said: "Dr. Jackson consequently analyzed a specimen of the foreign mineral so far as to ascertain that no carbonic acid exists in it, and that it does contain sulphur and sulphuric acid." The vishnevite/cancrinite from the Ilmen mountains in Siberia (Zavaritsky, 1929) does have appreciable sulfur. Subsequent analyses of yellow Litchfield cancrinite show it to be sulfur-free (Clarke, 1886c, 1900c, Clarke and Steiger, 1902). A blue cancrinite-group mineral does exist which is sulfur-bearing: vishnevite, but this material has yet to be reported from Maine. In addition, no "normal" blue cancrinite has been found in Maine subsequently. The sodalite from Litchfield is sulfur-free, as well, and lazurite is not known from Maine. The quandary remains, "Did Jackson find vishnevite in Litchfield - a material which has never been found there again?" The yellow nature of the nepheline is probably the result of alteration to normal cancrinite or cancrinite crystals mistakenly called nepheline. The inconsistency that nepheline crystals are unknown at Litchfield, but for Jackson's report, is apparent.

A final confusion can be offered to make the story more complex. In all probability, Jackson's cancrinite was not watched while the material dissolved in preparation for analysis and the carbon dioxide bubbled slowly out of the solution unnoticed. The origin of the sulfur is not obvious. Pyrite or other sulfur-bearing minerals are not common from the litchfieldite (cancrinite-bearing nepheline syenite) of the area. One wonders why some of the original Litchfield cancrinite was not re-analyzed along with the Siberian material to check the consistency of the analyses. The sulfate-rich Ilmen material was an unfortunate coincidence as very few of the many cancrinites of the world contain appreciable sulfur.

Several specimens of cancrinite crystals are known from Litchfield. The American Museum of Natural History and Northeastern University collections contain cross-sections of hexagonal cancrinite crystals embedded in deep blue sodalite. The crystals are not terminated and are about 5 mm thick and up to 1 cm long as they are exposed in matrix. All cancrinite crystals so far observed from Litchfield have been completely surrounded by sodalite. (At one time, the AMNH specimen was reputedly the only cancrinite crystal known from anywhere, but not only are there many Litchfield specimens known, superior free-standing crystals have been found at several worldwide locations.)

In 1869, True said of the Litchfield locality: "These minerals are found in large boulders in different parts of the town. The largest we have seen is on the farm of Mr. Rufus Smith. It probably weighed nearly one hundred tons. It has been recently blasted for stone wall. It is one solid mass of these minerals, interspersed with black mica. Such a mass of a rare mineral we have never before seen. ... The Cancrinite is of a sulphur yellow

color, frequently of a columnar structure, and occasionally crystallized in hexagonal prisms." Kunz (1885) added localities on: "... the farms of Moses True, Capt. Joseph Wharff, and Rufus Smith."

Kunz (1892a) said: "The color of cancrinite varies from bright orange-yellow to pale yellow. There are three distinct types of this mineral, the bright orange-yellow, cleavable and transparent, in thin fragments; the pale yellow, not cleavable; and the bright yellow, granular, which is the commonest form. ... Hexagonal crystals of bright yellow cancrinite occasionally penetrate the deepest blue sodalite, forming an exceedingly beautiful stone when polished." [Of course, cancrinite crystals are so rare that these specimens are too important to ruin by polishing.] Haven (1930) noted: "One of the principal localities is Dennis Hill, in Litchfield, an elevation of approximately a little over 400 feet. As far as is known, the only ledges are two small dikes; one in the road just north of Spear's Corner; and the other on the west side of the road about half way up the first hill south of Spear's Corner, both dikes being in the Town of West Gardiner. Last fall new road work had covered the first locality, but fresh material could be found beside the road. At places in this section are dikes of a soda-syenite which may be related to the nepheline-syenite." The locations had earlier been reported by Daly (1918), but the demise of one outcrop is important to note.

Clarke (1900b) experimented with Litchfield cancrinite and Clarke (1900c) reported on the chemical analyses of the three kinds of cancrinite reported by Kunz (1892a). Michel-Levy and LaCroix (1888) reported optical data for Litchfield cancrinite.

True (1869) wrote of Maine cancrinite-bearing rocks: "These boulders are in the same line of drift as the Eleaolite boulders of Monmouth; yet it is a little remarkable that not a particle of Sodalite or Cancrinite has ever been discovered in the boulders from the latter place, while the Eleaolite of Litchfield is never found unless associated with those minerals." Some cancrinite has been subsequently found in the South Cochne-wagon Pond area, Monmouth.

carbonate-apatite = carbonatian fluorapatite or carbonatian hydroxylapatite; see dahllite, fluorapatite, francolite, and hydroxylapatite

CARMINITE



Garland - *Preble Hill M*

Carminite is found as bright red-brown "fuzzy" linings in quartz crystal vugs (to 3 mm) at the Preble Hill mine, **Garland** (X-ray diffraction and chemical analysis, this study). The crystals are very small and not readily visible using ordinary microscopic examination. Occasionally, red-brown films of carminite are

found in fractures in the quartz. A greenish-yellow minutely crystalline or filmy patch (to 3 mm) of beudantite can be associated.

carnotite?

unspecified in **Aroostook County?**; **Cornish?** - *Berry Ledge L*

Morrill and Hinckley (1959) listed of **Aroostook County**: "Carnotite reported. Locality withheld." In a letter from Morrill to Alden Carpenter (March 29, 1959), Morrill wrote: "Carnotite has been exhibited from Aroostook co. ..."

Perham (1956) said: "Recently carnotite has been reported from Cornish, Maine." The Berry Ledge locality, **Cornish** material could have been bright yellow, powdery greenockite. No specimens known.

carpholite?

Sapling - *north end of Indian Pond*

Boone et al. (1989) wrote of **Sapling**: "At the north end of Indian Pond, however, sparse garnet and possibly relict andalusite occur in the matrix of the mélange. The garnet was found only by probe scanning, and is of extremely fine grain size. The core and rim analyses ... on one of the larger, 10-µm-long grains shows a zonation of composition from an almandine-pyrope-rich core to spessartine-rich rim. The grain is lens-shaped parallel to the S_1 foliation, and the zoning is apparently concentric to that shape. It is weakly birefringent, but does not match the optical characteristics of its compositionally closest anisotropic analog, carpholite."

CASSITERITE (Rutile Group)

SnO₂

Andover - *Black Mountain Q?*; **Auburn** - *Greenlaw Q, Groves Q, Keith (Towne) Q, Pulsifer Q*; **Aurora** - *in drift*; **Blue Hill?** - *Saunders M?, Twin Lead M?*; **Buckfield** - *Bennett Q, General Electric Q*; **Bucksport?**; **TD** - *Bemis Stream P*; **Georgetown** - *Consolidated Q*; **Greenwood** - *Emmons Q, Harvard Q, Tamminen Q, Waisanen Q*; **Hebron** - *Hibbs Q, Mount Rubellite Q*; **Newry** - *Bell Q, Crooker Q, Dunton Q, Martin P, Nevel Q, Rose Quartz Crystal L, Scotty Q*; **Norway** - *BB #7 Q*; **Paris** - *Mount Marie Q, Mount Mica Q*; **Peru** - *Perry Q*; **Poland** - *Berry-Havey Q*; **Rumford** - *Black Mountain Q, Brown-Thurston Q*; **Southwest Harbor?**; **Stoneham** - *Lord Hill Q*; **Sumner** - *Mount Tom Q*; **Topsham** - *Fisher Q*; **Warren** - *Starrett Q*; **Winslow** - *Winslow Tin M*; **York** - *riebeckite granite*

Black, lustrous "tin beak" cassiterite twins (to 4 cm) were found at the Pulsifer quarry, **Auburn** with yellow muscovite and albite and its variety cleavelandite. The crystals show the

ditetragonal bipyramid and only occasionally the normal tetragonal bipyramid.

Glacial boulders of quartz from near Route #9, **Aurora** had dark brown cassiterite crystals intergrown in parallel position of equant first- and second-order bipyramids with first- and second-order prisms up to 2 cm (Charles Buck, personal communication, 1969).

Black tin beak cassiterite twins (to 5 mm) with brilliant luster were found at the Bennett quarry, **Buckfield** with cookeite, quartz crystals (to 8 mm), and cleavelandite. Low angle bipyramids are typical. One partial pyramidal crystal (HU 90296) was 14.5 x 11 cm and compares favorably in size, but not quality, with other huge cassiterite crystals from worldwide locations.

Emmons quarry, **Greenwood** cassiterite crystals (to 8 mm) show dominant first-order bipyramids with small, rhombic, second-order prism faces and tiny ditetragonal bipyramid faces in tight clusters in cleavelandite and quartz matrix. Tin beak twinning is sometimes observed. Marble (1951a) noted a twinned crystal of unspecified size from the Emmons quarry.

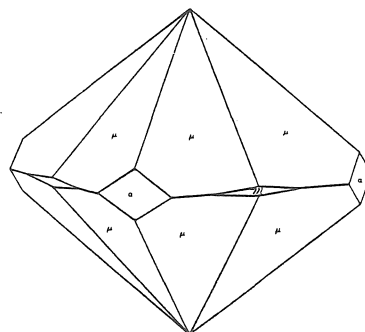
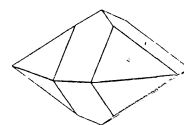
Some of the best Maine cassiterite crystals have come from the Harvard quarry, Greenwood. Ditetragonal bipyramidal crystals (to 3 cm) are found in cleavelandite with green elbaite, quartz crystals, and cookeite. The ditetragonal crystals show very typical habit of crystals with two triangular faces so close to parallel that the angular divergence of the faces can be just barely seen when looking at light reflecting off from the faces. The crystals are black with occasional brown internal reflections, and the faces have a mirror-like smoothness, unlike most Maine samples. A few very distorted tin beak twins are known. Landes (1925) wrote of the Harvard quarry: "Cassiterite was found sparingly, in part in irregular masses or stout pyramidal crystals embedded in cleavelandite, in part in crystals of unusual form attached to a surface of cleavelandite plates. One of these crystals is shown... and is remarkable in showing practically only a ditetragonal pyramid as its bounding form, doubly terminated and as symmetrically developed as a model. The largest of these crystals was not more than four millimeters across. The same rare form, μ (766) ..." Cassiterite masses to 8 x 8 cm have been found at the Harvard quarry.

Cassiterite from the Tamminen quarry, Greenwood has been found as dark brown distorted bipyramids (to 4 cm) with small second order prism faces. Crystals are usually found near crystal pockets in the replacement assemblages.

Kunz (1892a) wrote: "The finer crystals of cassiterite found at Hebron, Auburn, Norway, and Paris, Me., would afford mineralogical gems." No such "gems" known.

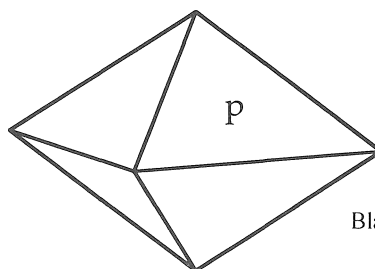
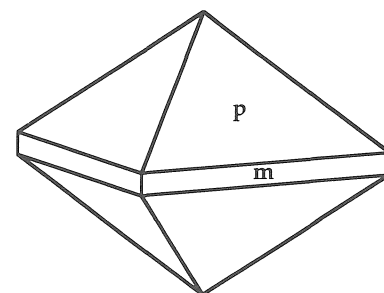
Dunton quarry, **Newry** has several kinds of cassiterite. Single, almost colorless and transparent cassiterite bipyramids (to 1 cm) are known, but are very rare, embedded in cleavelandite. The translucent crystals can be slightly tinged a pale coffee-color through brown and black while the crystals have an oily through adamantine luster. Tin beak twins (to 4 mm) have been found.

Lord Hill Q, Stoneham
(from Palache et al., 1944)

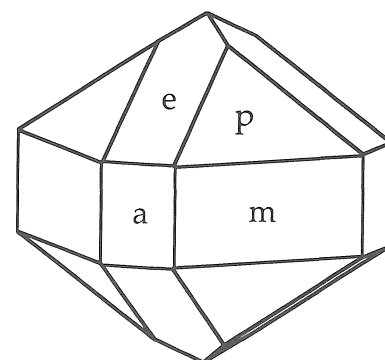


Harvard Q, Greenwood
(from Landes, 1925)

Dunton Q, Newry



Black Mountain Q, Rumford



Route #9, Aurora

Cassiterite

A very large cassiterite crystal from the Nevel quarry, Newry is a poorly formed half crystal (5x4 cm) embedded in brown sphalerite cleavages.

The second best American cassiterite crystal specimen was found at the Martin prospect, Newry. The cluster of two brilliant cassiterite bipyramids (to about 3.5 cm), with several smaller crystals, was found in an indicolite pocket in 1992. (The best cassiterite crystal from the U.S.A., about 7 x 8 x 8 cm with dark brown to black color and waxy luster, is undoubtedly one found at the Herbb #2 quarry, Powhattan County, Virginia.)

Mount Mica quarry, **Paris** has been a well-known producer of cassiterite. Verrill (1863) wrote of cassiterite: "At Mt. Mica in Paris so well known for its rare minerals, he had found the ore in 1854 in a mass weighing about five pounds, and also in small crystals." In 1881, Mount Mica was opened for cassiterite ore, but without success (Hamlin, 1895). Most of the cassiterite is massive brownish black in cleavelandite, but simple black pyramids (to 4 mm) are sometimes found.

Orange-pink transparent ditetragonal cassiterite bipyramids (to 2 mm) with rhombic second-order prism faces embedded in cleavelandite from Black Mountain quarries, **Rumford** are attractive. The color on larger crystals (to 3 mm) can be dark orange-brown. Black, simple bipyramidal cassiterite crystals (to 1 cm) were also found embedded in a fibrous, sericitic replacement of spodumene(?) with tan to pinkish tan eosphorite clusters (to 2 mm), albite, quartz, and kaolinitized albite matrix as well as unaltered cleavelandite. Verrow (1941) noted on Black Mountain quarry cassiterite: "One crystal about a half an inch in size was found in albite." Massive cassiterite is very common at Black Mountain quarry and can be found in dark brown masses (to 500 grams) in cleavelandite.

A particularly large bipyramid (4 cm) of cassiterite with nearly equally developed first and second order bipyramids was found in albite and muscovite matrix at the Fisher quarry, **Topsham**. Small lustrous simple pyramidal cassiterite crystals and tin beak twins (to 3 mm) have also been found at the Fisher quarry.

Schrader et al. (1917) wrote that the cassiterite at the Winslow Tin mine, **Winslow** formed a 2.5 cm vein. No specimens of cassiterite are evident among the waste minerals of the Winslow Tin mine. Today, most of the dump has been washed downstream. Graton (1905) wrote of the association: "Tin occurs at Winslow in a number of narrow veins in mica-schist. The veins are composed largely of lepidolite[?], and fluorite, holding cassiterite, beryl, and mispickel. This deposit was once worked, but with little success." One exceptional specimen (HH collection) consists of prismatic cassiterite crystals (to 1 cm) with pyramidal terminations in a vug lined with margarite crystals (to 4 mm) and terminated, milky white beryl crystals (to 1 cm).

Haff (1939) noted cassiterite and aegirine-augite (q.v.) in a riebeckite granite, **York**.

cerargyrite - see chlorargyrite

cerium ore? = allanite?

Phippsburg?

Jackson (1837a) wrote of the "axinite" of **Phippsburg**: "... and feruginous silicate of cerium in deep brownish black crystals embedded in garnet." Houghton (1861) reported without description "ore of cerium" from Phippsburg, but may have been paraphrasing Jackson (1837a). No specimens known.

cerolite - variant spelling of kerolite

CERUSSITE (Aragonite Group)

PbCO₃

Brooksville - Callahan M, Cape Rosier M; **Garland** - Preble Hill M; **Lincolnvile**; **Lubec** - Lubec Lead M; **Pembroke** - Big Hill M = Pembroke Copper M; **Rockport** - Riverside M

Porous fine-grained sphalerite, pyrite, and galena forms the matrix for generally untwinned cloudy gray to milky white bladed cerussite crystals (to 2 mm) at the Callahan Open Pit mine, **Brooksville**. Pseudo-hexagonal "bipyramidal" twinned crystals (to 1 mm) are less common. Cerussite crystals from the earlier Cape Rosier mine were generally 1 mm or less, untwinned, and were on sericite, chalcopyrite, and malachite impregnated matrix.

Untwinned cerussite crystals (to 3 mm) are found as blocky to pointed crystals in rusty vugs in quartz and galena at the Preble Hill mine, **Garland**.

Indistinct gray cerussite crystals (to 3 mm) in tight clusters approaching massive aggregates impregnated with sericite and blebs of unaltered galena were found at an unspecified mine in **Lincolnvile**.

Blocky cloudy-gray, twinned cerussite crystals (to 2 mm) are found in clinocllore-quartz matrix with waxy films of hydrozincite at the Lubec Lead mine, **Lubec**.

Clear to cloudy white intergrown pseudo-hexagonal "bipyramids" of cerussite (to 2 mm) are found in limonitic cavities in galena cleavages at the Big Hill mine (= Pembroke Copper mine), **Pembroke**.

cervantite?

Levant?

Smith (1882) listed cervantite without comment from **Levant**. Though the report is not unreasonable, a white powdery alteration of stibnite from there might have been cervantite or some other species such as stibiconite. The inconsistent sight

identification of cervantite, even on a worldwide basis, has been a problem. No specimens known.

chabasie - variant spelling of chabazite

CHABAZITE (Zeolite Group)



Phippsburg?; **Woolwich** - *unspecified road cut*

Jackson (1839) listed from **Phippsburg**: "Quartz crystals and chabasie?" Houghton (1861) repeated chabazite from Phippsburg, but no specimens are known.

Chabazite has been found as tan to pale yellow simple rhombohedral crystals (to 2 mm) both singly and in clusters on a rock fracture surface from an unspecified road cut, **Woolwich**. The pale pink chesterlite variety of microcline crystals (to 2 mm), colorless albite crystals (to just less than 1 mm), and colorless quartz crystals (to 2 mm) are associated. One tiny white unterminated crystal (1 mm) with a square cross-section shows vertically oriented vicinally striated development, and the absence of pearly luster suggests an unusual zeolite might be associated. The matrix is a granite, with white and pink oligoclase variety of albite and two micas. The muscovite is pale yellow while the more abundant black to dark brown biotite is greasy appearing and usually altered with a bronzy brown rim or completely changed interior. A few of the biotite grains show a dark green color suggesting clinocllore, and a few rounded grains (to 1 mm) of magnetite are evident.

chalcedony = unbanded, unincluded, cryptocrystalline quartz

Newry? - *Dunton Q; Pembroke Group rhyolite* - **Cutler, Whiting; Perry** - *Loring Cove A; Phippsburg* - *Denny Reed Point*

Fraser (1930) wrote of the Dunton quarry, **Newry**: "Locally pollucite is fairly common. It occurs closely associated with spodumene and in such a manner as to appear to be replacing it. Pollucite is commonly found in fractured masses, the fractures being filled with a dull white variety of chalcedony. This association is so general in this deposit that it can often be used as a criterion to distinguish pollucite from quartz." Though Fraser (1930) observed a great deal of chalcedony, no chalcedony has been recently observed in the pollucite specimens preserved from this locality, but fine-grained lepidolite and pale purple damourite veinlets have been observed recently.

Excellent botryoidal gray to tan chalcedony-lined vugs (to 10 cm) are found in a quartz vein in the tidal area of Denny Reed Point, **Phippsburg**. Hussey (1985) noted that the chalcedony is associated with late fault breccias.

Gates (1961) said of the flow-banded rhyolite of the Pembroke Group south of Lively Brook, **Whiting** and along Great Ridge, **Cutler**: "The microscope shows that the bands consist of minute hematite flakes scattered through fine-grained chalcedony."

CHALCOCITE



Blue Hill - *Douglass M; Brooksville* - *Callahan M, Cape Rosier M, Perkins P; Brunswick?* - *Brunswick Naval Station; Franklin - Franklin M, Franklin Extension M; Sullivan - Morancy M; Union - Union Limestone Q; Warren - Warren Nickel P; Woolwich?* - *road cut U.S. Route #1*

Black metallic masses of chalcocite (to several centimeters) are found intergrown with chalcopyrite from the Douglass mine, **Blue Hill**. Earl (1950b) noted some associated ore minerals: "The ore minerals observed in the pit and on the dump are pyrite, chalcopyrite, pyrrhotite, chalcocite, arsenopyrite, zinc blend[e], magnetite, and cuprite." Earl (1950b) did not observe chalcocite in 645 meters of drill core. Forsyth (1953) reported: "Chalcopyrite shows marginal alteration to chalcocite and at the same time appears to be corroding and replacing quartz."

Chalcocite was reported without description from the Callahan mine, Harborside, **Brooksville** by Park and Bastille (1973), but it probably formed metallic black masses (to many millimeters) embedded in chalcopyrite -, sphalerite -, and pyrite-bearing ore. A small lens was discovered during the underground mining in the late 1960's which contained chalcocite crystals (Gardiner Gregory, personal communication, 1990). The material consisted of highly porous sphalerite, chalcopyrite, and pyrite ore particles (to 3-4 mm) loosely held together by calcite. Within the porous sulphide matrix, at least one geniculate twin crystal (2 mm) of chalcocite was found.

Young (1962) reported of the Perkins prospect, Brooksville: "The primary sulfides identified are pyrite, chalcopyrite and pyrrhotite; their occurrence is predominantly as disseminated grains, but chalcopyrite in thin veinlets was noted. A few grains of secondary chalcocite were identified in hand specimen."

A single specimen of chalcocite? was labeled: "chalcocite, naval base, Brunswick, Me." The matrix consists of a dark gneiss with 2-5 mm layers. Small metallic black grains (to 2 mm) are present. Specimen untested.

Young (1962) further reported of the Franklin and Franklin Extension mines, **Franklin**: "Sulfides identified in dump specimens are: pyrite, pyrrhotite, arsenopyrite, sphalerite, galena, chalcopyrite, and chalcocite."

Small (1 - 2 mm) gray-black chalcocite grains are found embedded in chalcopyrite, sometimes with covellite, at the Morancy mine, **Sullivan**. Young (1962) found chalcocite in the shaft wall.

Barker (1965) noted of the Union Limestone quarry, Union: "*Chalcocite* - Black sectile masses up to six inches." Some malachite alteration was also noted. No specimens known.

chalcophanite?

Rumford - *Black Mountain Q*

Wintringham (1954, 1955, 1962) reported that the "franklinite" from Black Mountain, **Rumford** probably was chalcophanite. The specimen in question was still preserved in a collection in New Jersey and a portion was obtained for investigation and consisted of black sphalerite with tan siderite (Neil Wintringham, personal communication, 1992).

CHALCOPHYLLITE

$\text{Cu}_{18}\text{Al}_2(\text{AsO}_4)_3(\text{SO}_4)_3(\text{OH})_{27}\cdot 33\text{H}_2\text{O}$

Brooksville - *Cape Rosier M; Unity?*

Chalcophyllite is known from a few specimens from the old Cape Rosier mine, **Brooksville**. The chalcophyllite consists of less than 1 mm light bluish-green opaque pseudohexagonal plates associated with brochantite, cuprite, smithsonite, and linarite in limonitic allophane in talc matrix. The area where the brochantite was found was on the western rim of the pit and this portion of the rock was excavated by the newer Callahan open pit.

Smith (1882) noted chalcophyllite from **Unity**, but that listing may have been a confounding of chlorophyllite (q.v.). No reasonable occurrence or specimens known.

CHALCOPYRITE

CuFeS_2

Acton - *Boston-Acton M; Addison; Alder Stream; Appleton - Appleton Mining & Smelting M; Attean - Sally Mountain P, West Sally Mountain P; Bethel - West Bethel A; Bingham - Wyman dam excavation; Blue Hill - Bay View M, Bisbee M, Black Hawk M, Blue Hill M, Douglass M, Favorite Copper M, Granger M, Long Island A, Mammoth M, Owen M, Owen Lead M, Revere M, Saunders M, Stewart M, Stover Hill M, Twin Lead M, Wheal Freddie, White Star M; Bradstreet - Catheart Mountain P; Brooksville - Blodgett P, Callahan M, Cape Rosier M, Jones-Dodge P, Perkins P, Tapley #1 M, Tapley #2 M; Brunswick - Bagley Ledge Q; Bucksport - Hinks Property; Castine - Emerson M; Cherryfield - Britton M, Narraguagus M?; Columbia - Harrington M; Concord - Robinson M; Cookson Formation - Calais, T21; Cooper - American Molybdenum M; Corinna;*

Crawford; Deer Isle - *Deer Isle M; Dexter; Dover-Foxcroft; East Moxie - Black Narrows A; Eastport - Moose Island A, Road Metal Q; Edmunds - Hobart Stream A, U.S. Route #1 road cut; Ellsworth - Brimmer P; Falmouth; The Forks - Black Narrows A; Franklin - Franklin M, Franklin Extension M, Swan M; Gardiner; Garland - Preble Hill M; Georgetown - Consolidated Q; Gilead - Wheeler Q; Gouldsboro - Gouldsboro M, Kerona M, West Bay M; Greenwood - Nubble Q; Guilford - Bennett M; Hampden - Argonaut M, Consolidated M, Lawrence M; Hancock - Copperopolis M, Harvey Elliot M, Robert Emmet M, Grant Cove M, Western Union M; Hope - Fish Pond A; Jackson - Jackson Gold M; Jim Pond; Katahdin Iron Works - Katahdin Iron Works M; Knox - Stone M; Lamoine; Lincolnville - Lincolnville Gold and Silver M; Linneus - Drew Hill sulfide veins; Lower Enchanted; Lubec - Lubec Lead M; Lucerne granite contact - Carroll, Kossuth, Springfield; Machias; Milbridge - Cherryfield M; Moxie Gore; Newfield; Newry - Dunton Q, Scotty Q; Paris - Mount Marie Q; Parlin Pond - Bean Brook Mountain P, Pyrite Creek P, West Pyrite Creek A; Parmachenee - First East Branch Magalloway River A, Thrasher Peaks A; Parsonsfield; Pembroke - Barrett P, Big Hill M; Penobscot - Hercules M, Highland P, Clyde Limeburner P; Phillips; Pocomoonshine gabbro-diorite - Alexander, Crawford, Grand Lake Stream, Indian Township, T21, T26 ED BPP; Portage; Readfield; Ripley; Rockland; Rockport - Riverside M; Rumford; Sangerville; Sedgwick - Edgemoggin [sic] M; Smalls Falls Formation; Steuben - Greeley & Jones M; Standish - Oak Hill P; Stoneham; Sullivan - Morancy M, Sullivan M; Surry - Campbell P; Tim Pond - Black Mountain A; Topsham - Square Pit, Swamp #1 Q; Trescott - Trescott Silver M; Union - Harriman P, Union Limestone Q; Warren - Warren Nickel P; Waterford - Saunders Q; Wesley - Bacon & Snow M, Rollins M, Seavey Lake A; West Falmouth; Whiting - Cooper Copper M; Winslow; Winterport; Winthrop; T3R4 BKP WKR - Hardin P*

Chalcopyrite is well-known in Maine due to numerous mines and prospects investigated in the 1880's. Many locations are listed by Fournier (1970), Forsyth (1955a), Greenwood (1968), Holman (1935), Houston (1954, 1956), Nowlan (1976b), Pease (1968), Schrader et al. (1917), Seaman (1975a), Smith (1907), Stickney et al. (1965), and Young (1962, 1963). Chalcopyrite is commonly found as inclusions in pyrrhotite in the Smalls Falls Formation of western Maine (Charles Guidotti, personal communication, 1991).

Most of the **Blue Hill** mines produced good massive brassy chalcopyrite and notably so from the Black Hawk and Douglass mines. The Black Hawk mine may have produced the only crystals known in Maine. Chalcopyrite crystals, complexly intergrown (to 4 mm) in quartz vugs, are barely recognizable as disphenoidal due to re-entry angles, etc. Diamond drill cores reported on by Earl (1950b) revealed sporadic deep finds of chalcopyrite in the Douglass Mine area, Blue Hill. Doyle (1970) wrote of the Black Hawk mine ore: "The ore zones lie within a series of gently folded beds in a south plunging fold of the

Ellsworth Formation. These zones are confined to quartzite beds with internal red-brown biotite laminae. Ore minerals: sphalerite - pyrite - chalcopryrite - occur as tabular bands and irregular but elongate pods in the sandy and biotite layers. There are three quartzite-biotite bands in the mine area."

Large masses of interlayered fine-grained, dull brassy, chalcopryrite and fine-grained sphalerite were found at the Callahan Open Pit mine, **Brooksville**. Earl (1950a) revealed that chalcopryrite was found in many portions of diamond drill core collected at the Tapley mine, Brooksville.

Dark gray phyllite and schist forming the northern contact zone with the Lucerne granite, **Carroll**, **Kossuth**, and **Springfield** has sulfide pods and contact metamorphic mineral assemblages (Doyle et al., 1961): "Accessory minerals include hornblende, chlorite and occasional crystals of cordierite. The sulfide zones of possible economic significance are widely exposed in this black schist and phyllite unit. Pyrite occurs throughout as individual undeformed cubic crystals. Pyrrhotite and the occasional chalcopryrite showings are confined to well defined zones within the unit, and are often sheared into lineations parallel to the strike."

Chalcopryrite masses (to several cm) occur in rusty quartz pegmatite at the Nubble quarry, **Greenwood**. Pyrite is also associated.

Chalcopryrite in tiny grains (1 mm) is found in siderite with phosphates in blue tourmaline eyes in cleavelandite from the Dunton quarry, **Newry**.

Excellent secondary copper minerals were found with small masses of chalcopryrite at the Barrett prospect, **Pembroke**.

Boudette (1991) noted of the Hurricane Mountain Formation, **Tim Pond**: "Disseminated chalcopryrite occurs on south flank of Black Mountain."

Chalcopryrite in triphylite or gray apatite has been found at an unspecified locality in **Topsham** (PM 168-43-29287). Chalcopryrite with minor malachite coating has been found in pegmatite at the Square Pit, Topsham.

Rainville and Park (1976) say of the Harriman prospect, **Union** and the Warren Nickel prospect, **Warren**, "Chalcopryrite is the third most abundant sulfide and constitutes 3 wt percent of all sulfides. It occurs as simple intergrowths with granular pentlandite in pyrrhotite, irregular grains in pentlandite, isolated grains within the silicates, fracture fillings, and early segregation droplets. Some chalcopryrite, along with granular pentlandite, appears to be an unmixing product of pyrrhotite. [Their] Figure 7 demonstrates incomplete pentlandite replacement with isolated islands of pentlandite remaining in chalcopryrite."

Cameron et al. (1954) wrote of the Saunders quarry, **WATERFORD**: "A worm-shaped body of quartz, perthite, and wedge muscovite occurs in the pegmatite of the easternmost pit; this pod is 15 percent mica. Small irregular masses of pyrrhotite and chalcopryrite are present in this unit."

chalybite = siderite

Houghton (1861) listed chalybite from Williamsburg (No. 6 R 8) without description. It may have been found in a brown vein in slate.

CHAMOSITE (Chlorite Group)



Cupsuptic quadrangle - *Albee Formation, Dixville Formation; TDR2 WELS* - *Maple Mountain P; Harpswell* - *andalusite and staurolite isograds; Pembroke* - *Big Hill M; Rangeley Formation - Byron, TD; lower sillimanite zone - Standish, Windham; Paris - Hoopers Ledge Q, Whispering Pines Q; West Paris - Perham Q; Woodstock - Koskala P; T9R3 WELS* - *Hovey Mountain P; T12R8 WELS* - *Bald Mountain A*

Chamosite is the iron-dominant ($\text{Fe} > \text{Mg}$, etc.) member of the chlorite group. It is visually indistinguishable from the Mg-dominant member of the series, clinochlore.

Harwood (1966) analyzed chamosite, $\text{Fe}/\text{Fe}+\text{Mg} = 0.50 - 0.65$, from unspecified localities of the Albee and Dixville Formations, **Cupsuptic quadrangle**.

Guidotti (1974) analyzed magnesian chamosite from the upper staurolite, transition, and lower sillimanite zones of the Rangeley Formation, **Byron** and **TD**. He also described the chamosite in thin section: "In the u. st. zone, chlorite occurs as small groundmass plates except where it occurs as partial pseudomorphs after staurolite. There it is considerably coarser (as much as 4-mm plates). Interference colors and refractive indices indicate that primary chlorite has an $\text{Fe}/\text{Fe} + \text{Mg}$ ratio slightly less than 0.52... Minor chlorite, present in a few specimens from the l. s. zone has anomalous blue colors (this demonstrates low Mg/Fe , as confirmed by several probe analyses), inclusions of sagenitic rutile, and gradational relations with biotite plates, suggesting a retrograde origin for this chlorite. Only such chlorites of probably retrograde origin (all with the lowest observed Mg/Fe values) have Mg/Fe values less than that of the associated biotite."

Pavlidis and Milton (1962) noted of the chlorite from Maple Mountain prospects, **TDR2 WELS** and Hovey Mountain prospects, **T9R3 WELS**: "The absence of detectable MgO both in the chlorite and the carbonate fractions is noteworthy" and "The relatively small amount of MgO in these samples also suggests that the bulk of the chlorite in these rocks is iron rich rather than magnesian." The chemical analysis of the chlorite also indicated that it was very manganoan.

Dunn and Lang (1988) wrote of the andalusite and staurolite isograds, **Harpswell**: "In the Orrs Island - Harpswell Neck area... Another effect of retrograde metamorphism is replacement of biotite by Fe-rich chlorite in some samples."

Annite in pegmatites at the Hoopers Ledge quarry and Whispering Pines quarry, **Paris**, A. C. Perham quarry, **West Paris**, and Koskala quarry, **Woodstock** has been partly to completely altered to dark green smoky chamosite. The ruling marks

on the annite are seen to extend into the chamosite alteration zones (Neil Wintringham, personal communication, 1992).

Chamosite occurs at the Big Hill mine, **Pembroke** as dark green, tiny (1 mm and less), vermiform clusters in quartz-lined vugs (to several mm) in cherty quartz cutting chalcopyrite bearing quartz.

Thomson and Guidotti (1989) reported of the upper sillimanite zone on the southeastern shore area of Sebago Lake, **Standish**: "Chlorite, where present, is clearly a retrograde Fe-rich chlorite.." and of the lower sillimanite zone along the eastern shore of Dundee Pond, **Windham**: "Chlorite is invariably an Fe-rich variety and is believed to be present only as an alteration of biotite."

Large outcrops composed of compact foliated greenish black chamosite chlorite with crude cubic pyrite crystals (to several centimeters) are found at the Bald Mountain copper prospect, **T12R8 WELS**. Chamosite forms a thick aureole around a portion of the Bald Mountain ore deposit.

chert - a fine-grained fossiligenic variety of quartz

Jim Pond Formation - Alder Stream, Seven Ponds; Munsungun Lake Formation - Spider Lake quadrangle

Though chert is frequently ascribed to a sedimentary fossiliferous origin, chert interbedded with tuffs was reported by Hall (1970) in the Munsungun Lake Formation, Spider Lake quadrangle and elsewhere in Aroostook and Piscataquis counties.

Boudette (1991) reported chert from the *iron-formation* member of the Jim Pond Formation, **Alder Stream** and **Seven Ponds**: "Laminated jasper grading laterally to massive chert in some lenses. Blood-red, laminated, hematite- or magnetite-rich chert with some concentrations of iron minerals interlaminated with both quartz and chlorite; and reddish-gray or buff, massive chert; both types break with conchoidal fracture. As much as 20 m thick in places."

chesterlite - a wedge-shaped variety of microcline

chiastolite - see andalusite; chiastolite shows a white right-angled cross (+) in cross-section.

CHILDRENITE (Childrenite Group) - see eosphorite

$(\text{Fe}^{2+}, \text{Mn})\text{Al}(\text{PO}_4)(\text{OH})_2 \cdot \text{H}_2\text{O}$

Hebron? - Mount Rubellite Q; **Newry?** - Dunton Q; **Paris?** - Mount Mica Q; **Rumford** - Red Hill Q

Childrenite was reported from Maine (Brush, 1863a,b; Cooke, 1863a,b,c) long before eosphorite was named by Brush and Dana (1878). Brush (1862) noted the mineral as an unknown. As a result of the very limited amount of material from the first

find, there was no choice but to use the nomenclature available to name the find. Brush (1863b) stated that the material from Mount Rubellite, **Hebron**: "Gives strong reaction for manganese," but the new species status was not suspected. All of the Hebron "childrenite" consists of a dark chocolate brown to dark red-brown mineral. Crude crystals to 20 mm are in the Brush collection of Yale University. Larsen (1921) wrote: "2. Hebron, Maine. Labeled 'Childrenite' ... This mineral is no doubt eosphorite."

True (1869) further entrenched the childrenite myth: "Mt. Mica, Paris, and Mt. Rubellite, Hebron. This exceedingly rare mineral has not been found elsewhere on this continent." Though Landes (1925) stated: "Childrenite has been found at Mount Mica...," he added: "Eosphorite from Mount Mica has not heretofore been described. Specimens in the Harvard laboratories contain this mineral in small radiating needles coated by dahllite. It is embedded in massive siderite. Under the microscope the Mount Mica eosphorite is pale yellow green, whereas the Buckfield material is colorless. The color and slightly higher indices show that the Mount Mica eosphorite is higher in iron than that from Buckfield, but it is not childrenite because the axial angle for violet is greater than that for red." No other data were given. Hurlbut (1950) presented optical data and a partial quantitative analysis to base his identification that the Mount Rubellite quarry, Hebron material is eosphorite. Chemical analysis, by EDAX this study, verify that at least the Mount Rubellite quarry specimen tested is very rich in manganese and therefore eosphorite.

Holman (1935) listed childrenite from the Dunton quarry, **Newry** without substantiation. Hurlbut (1950) said of eosphorite from Newry that, "it approaches childrenite in composition." The reason for this is that he re-analyzed the eosphorite from the original lot analyzed by Palache and Shannon (1928) and found it to be richer in iron, closer to childrenite, than they found, though still very much an unambiguous eosphorite in composition.

Hurlbut (1950) noted of Red Hill, **Rumford** "eosphorite":

"The Red Hill eosphorite is in cavities in feldspar associated with amethystine quartz [= rose quartz crystals]. It is reddish brown in color. There are two generations of crystals; the earlier are the larger with a maximum length of about 1 cm. The later crystals which vary in length from 0.1 to 1.0 mm. are arranged in radial groups and as subparallel overgrowths on the earlier crystals. The habit of both generations of crystals is the same and similar to crystals from Black Mountain ... with the forms $a \{100\}$, $m \{110\}$, and $s \{121\}$ and on some crystals $b \{010\}$ poorly developed.

The indices of refraction ... indicate that the earlier deposition, as in the zoned crystals at Newry and elsewhere, is lower in iron. Moreover, the specific gravity, which for the earlier crystals is 3.14 and the later crystals 3.15, indicates a compositional difference. In the larger crystals there is 14.62% FeO and 13.86% MnO. Because of insufficient material chemical determinations were not made on the smaller crystals but the curves in Fig. 11 would indicate about 20% FeO."

The indices given by Hurlbut (1950) indicate a composition on the midpoint of the eosphorite/childrenite series. Although the data were obviously carefully collected, the graphical presentation of these data alerts the reader that a small numerical change in these data makes a dramatic difference in their significance. The actual chemical analysis given, however, indicated that both the larger and the smaller crystals from Red Hill quarry were over the midpoint of the series and, therefore, are childrenite. A chemical survey (this study) of light, medium, and dark "Red Hill" specimens revealed only manganese dominant (Mn:Fe ~ 2:1) eosphorite.

chlorargyrite?

Hampden? - *Lawrence M, Norumbega M; Sedgwick?* - *Edgemoggin M; Sullivan?* - *Sullivan M*

The presence of silver chlorides in Maine mines seems improbable and they were probably reported to improve attitudes toward stock investment and improve investor morale.

On February 6, 1880 (MMJ) it was reported of the Norumbega mine, **Hampden**: "A specimen of ore brought in yesterday is pronounced by those who have seen it to be the handsomest of anything yet found in Maine. It consists of beautiful green chlorides, charged with argentiferous galena." Barclay (September 10, 1880) might have been referring to the "beautiful green chlorides" when he reported a chemical analysis of a sample from the Lawrence mine, Hampden as a chromian mica. The analysis was unsatisfactory as it was made on a bulk sample from which chemical components were liberally subtracted to account for various other minerals in the rock. No specimens known.

It was reported of the Sullivan mine, **Sullivan** (MMJ, July 1, 1881): "The vein matter of the Sullivan lode is mostly quartz, much of which is tinted with chlorite, heavily charged with fine sulphurets of iron, and carrying, near the surface, argentiferous galena, zinc blende, sulphuret of copper and native silver. ... Ruby and native silver are found in greater quantities, minute particles of telluride of gold are occasionally visible, while the sulphurets are of finer grade and chlorides or horn silver and antimonial silver have made their appearance at the mine." A similar brief report of silver chloride was made (MMJ, June 17, 1881). On September 2, 1881 (MMJ) it was reported: "The improvements in our east and west drifts on the 4th level for the last week has been very encouraging and the ore vein is very regular and an excellent grade, carrying ruby and chloride of silver in greater quantities than usual." No specimens known. Listed by Smock (1883) as cerargyrite. No specimens known.

Perhaps as a response more than a discovery, a report of the Edgemoggin [sic] mine, **Sedgwick** (MMJ, September 23, 1881) said: "The vertical shaft of the Edgemoggin is 110 feet in depth and the ore showing is very good. Some exceedingly handsome specimens of horn silver and native silver were taken not long since from the extreme bottom." No specimens known.

chlorite group - a general name for a group of phyllosilicates with no specific chemical identification. see chamosite and clinocllore

Walker (1989) studied the distribution of chlorite polytypes in the low metamorphic grade rocks in the Fish River Lake area, Aroostook County. No species designation was given and no optical or chemical data were given to ascertain which chlorite species were observed.

CHLORITOID (Chloritoid Group)



Berwick?; **Camden** - *Camden Hills A; Carrabassett Formation - Bingham, Embden, Mayfield; Cumberland - Bates Island A, Ministerial Island A; Harpswell - Stover Point A; Kingfield - Deer Farm Road A; Monmouth - railroad cut near Wilson Pond; North Haven - North Haven Greenstone; Parkertown - Albee Formation; Portland - Great Diamond Island A, Jewell Island A; Saco Bay - Biddeford, Old Orchard Beach, Saco, Scarborough; Vassalboro - Vassalboro Formation; Wales - quartzite; Winthrop - west shore of Lake Maranacook*

Chloritoid is a nesosilicate which physically resembles a phyllosilicate. Chloritoid usually forms polyhedral porphyroblasts in fine-grained schists and phyllites. It is increasingly being recognized in Maine as petrographers have loosened their identificational grip on "biotite." No chemical analyses have been reported for Maine chloritoid and it is unknown whether some specimens represent the separate species magnesiochloritoid, though most of the reported Maine occurrences are in known iron-rich rocks. Similarly, the manganese-dominant member of the chloritoid group, ottrelite, has not been verified in Maine.

Berry (1987) found in the Camden Hills area, **Camden**: "The third metamorphic event was responsible for replacement of andalusite and sillimanite by sericitic muscovite and margarite, and replacement of biotite by chlorite. These replacements are complete in the southern and eastern parts of the area and affect the central part less intensely. A few samples from the northwest show none of these retrograde effects (Plate 2). Sample 124 contains chloritoid as well as sericite and chlorite, all of which formed during this event."

Chloritoid has been found sporadically in the Carrabassett Formation, **Bingham**, **Emden**, and **Mayfield**. Portions of this formation have been mapped by Pankiwskyj (1979) and Newell (1978). Chloritoid from a south facing ridge in Mayfield, about 3 km due west of Otter Pond, has a corrugated silvery-sheen graphitic schist with elongated rhombic chloritoid porphyroblasts (to 5 mm). Though Newell (1978) extensively reported biotite porphyroblasts, some of these were probably originally chloritoid. Pankiwskyj (1979) noted that some chloritoid was retrograde pseudomorphed to chlorite or biotite. Ludman and

Osberg (1987) noted chloritoid in the Carrabassett Formation, exposed along Route #16, west of Route #151, Mayfield.

Dunn and Lang (1988) wrote of the Stover Point area, facing Merriconeag Sound, **Harpwell**: "Chloritoid comprises 10% of samples from one outcrop within the staurolite zone..."

Boone (1970a) wrote of the Deer Farm Road area, **Kingfield**: "The pelite here reflects an intermediate grade of metamorphism, with layers 3-4 mm thick containing the assemblages biotite-staurolite-andalusite, and biotite-staurolite-chloritoid..."

Smith et al. (1907) used the word chloritoid instead of chloritic when describing the North Haven Greenstone. The species chloritoid was not intended.

Harwood (1966) wrote of **Parkertown**:

"Chloritoid was found in one thin section collected from the Albee Formation at 1900 feet elevation on the north side of the 1920 foot knob due south of Big Buck Mountain. It was distinguished from chlorite by higher refractive index and from andalusite by light green pleochroism, polysynthetic twinning, and anomalous blue interference color. A positive identification of the chloritoid was made by means of an x-ray powder photograph on a separated sample.

The chloritoid is present only in the fine-grained white mica alteration rims surrounding large andalusite crystals... The formation of the chloritoid is thus definitely retrograde after that of andalusite."

Chloritoid is found in the Jewell Formation on Jewell Island, **Portland** embedded in dark gray phyllite. The chloritoid is visible as flat, 2 - 4 mm rhombic to irregular dark grayish green plates with an oily luster. Katz (1917) first reported the mineral but called it ottrellite: "In some places crystals of ottrellite and andalusite(?) an inch in length are abundant." Hussey (1981) reported: "The Scarborough and Jewell Formations are essentially identical, consisting of rusty and non-rusty weathering dark gray, light gray, and mottled greenish and purplish gray phyllites. At appropriate grade garnet is common, and staurolite, chloritoid, and andalusite are locally abundant." The "appropriate" metamorphic grades are indicated by Hussey (1988).

Luepke and Grosz (1986) reported chloritoid was present among the heavy minerals in nearshore sediment samples from Saco Bay, **Biddeford**, **Old Orchard Beach**, **Saco**, and **Scarborough**.

Fisher (1941) reported chloritoid from several central Maine localities:

"Pyrite, chloritoid, and limonite are the chief accessories of the calcareous phase of the [Vassalboro] formation. ...

Two facies of the Winthrop phyllite are recognized. Small chloritoid plates characterize one facies, and staurolite and garnet the other. The garnet-staurolite facies has been traced southward along the strike from Winthrop into the northeastern portion of the Lewiston quadrangle. Along the Maine Central Railroad 1 1/2 miles southeast of the outlet of Wilson Pond it overlies conformably a middle-grade zone marble. The chloritoid facies has been traced northward along the strike into the Belgrade Lakes area where it gradually merges with the Waterville

slates. ... Scattered rectangular plates of nearly opaque chloritoid and elongated staurolites are not oriented. ...

In the railroad cut of the Maine Central Railroad, weathered and gray streaked thin-bedded sandstones, quartzites, and chloritoid phyllites crop out. ...

Chloritoid occurs in the phyllites north of Winthrop, where it is associated with biotite, garnet, and staurolite, and in the phyllite east of Brunswick. Pleochroism from colorless to pale greenish yellow has led the writer to identify the mineral as chloritoid instead of ottrellite. ...

Scattered outcrops northwest of Berwick have been studied by the writer. Thin sections from these outcrops show a quartz-muscovite ground mass with subordinate amounts of albite-oligoclase. Large plates of unchloritized yellow-green biotite are associated with chloritoid and staurolite (1.5 mm. long) and lesser amounts of kyanite. ...

The Jewell phyllite of the Casco Bay group is characterized by its silky sheen and its metacrysts of ottrellite, garnet, and staurolite."

Fisher (1941) also reported limonite pseudomorphs after chloritoid from "Interbedded quartzite and biotite schist from East Wales" and from "Quartz-biotite-garnet-chloritoid phyllite (Winthrop formation) from west shore of Lake Maranacook, north of Winthrop." Charles Guidotti (personal communication, 1990) has suggested that Fisher's (1941) report of chloritoid requires further investigation and verification.

chlorophaneite? = chlorophaeite = a volcanic glass

Cutler

Chlorophaneite as used by Gates (1961) is not a variety of fluorite (usually called chlorophane, but also called chlorophaeite): "Some of the Cutler diabase originally contained interstitial glass or chlorophaneite that has since been altered to chlorite." The spelling should have been chlorophaeite.

chlorophyllite = clinochlore

Beaver Cove - Burnt Jacket Mountain A; Unity?

Philbrick (1940) tentatively reported the chlorophyllite variety of clinochlore from injection hornfels on Burnt Jacket Mountain, **Beaver Cove**: "Alteration of the cordierite to chlorophyllite (?) is also to be noted."

Blocky masses of cordierite (to 8 cm) with parting planes (separated about 1 cm) coated with a chlorite are labeled chlorophyllite from Unity, Maine (AMNH #10423). The actual locality may be Unity, New Hampshire.

chlorospinel = ferrian spinel (q.v.)

Union - Harriman P

CHROMITE (Spinel Group)



Alder Stream - *serpentine*; **Black Narrows A** - **East Moxie, The Forks**; **Deer Isle** - *Little Deer Isle A, Pine Hill A*; **TDR2 WELS** - *Porcupine Mountain A*; **Elephants Head A** - **Alder Stream, Tim Pond**; **Jim Pond** - *unnamed gravel pit, unnamed hill*; **Kennebago allochthon** - **Davis, Eustis, Lang, Stetsontown, Tim Pond**

Chromite is found in a number of rock types in Maine. It is a mineral which is usually in no more than "accessory" abundance (e.g. <5%) in a rock. No chemical analyses of Maine chromite known. Some specimens could be magnesiochromite.

The serpentine found at **Alder Stream** and **Jim Pond** has black, subhedral chromite grains (1-2 mm) embedded in its matrix. Sparse chromite grains (1 mm or less) are found in the fuchsite-bearing dolomite (arnoldite) of **Jim Pond** and **Alder Stream**, as well. (Though chromite is ideally octahedral, chromite is frequently irregular in shape with only occasionally a few developed faces.) Black chromite grains (to 3 mm) in arnoldite from an outcrop on an unnamed hill about halfway between **Shallow Pond** and **Little Greenbush Pond** are much fractured. Arnoldite boulders containing sparse chromite are also found in an unnamed gravel pit southeast of **Jim Pond**, **Jim Pond Township**. The occurrence was described by Thompson (1968).

Nowlan et al. (1987) reported of **Tim Pond** and **Alder Stream**: "At least one minor chromite deposit is located along the southeasterly Cr trend, in the vicinity of **Alder Stream** - **Elephants Head**..."

Merrill (1888) wrote of a peridotite exposed on **Little Deer Isle, Deer Isle**: "The rock consists essentially of olivine and augite, with accessory magnetite, chromite, apatite, and rarely a plagioclase feldspar (?)" Of peridotite exposed on **Pine Hill, Little Deer Isle**, Merrill (1889) wrote: "Magnetite occurs in abundance both as original and as a secondary constituent from the serpentized olivine. Chromic iron is also present in beautiful minute octahedra with a brilliant luster. It is not in all cases possible to distinguish between the two ores by the microscope, and as both were attracted by the magnet the presence of chromium was determined by testing the separated ores in the borax bead."

Pavlidis et al. (1965) wrote of the **Porcupine Hill** area and the stream area draining **Ketchum Lake, TDR2 WELS**: "A minor amount of euhedral to subhedral chromite is found in the antigoritic groundmass [of the serpentinite]."

Houston (1956) said of the pyrrhotite body exposed at **Black Narrows** area of the shore of **Moxie Pond, East Moxie and The Forks**:

"Chromite is present only in the peridotite at **Black Narrows**. ... The peridotite is almost identical with that at **Union, Maine**. It is composed dominantly of olivine (Fe_{75}) [sic], with minor amounts of plagioclase (An_{70}) and orthopyroxene (En_{70-75}). Biotite makes up about

3% of the rock and occurs as interstitial masses between plagioclase and olivine. This is the only peridotite examined which contained chromite. Small euhedral chromite crystals are scattered through the rock; these crystals are cut by late magnetite and pyrrhotite. The rock is highly altered. Serpentine, talc, and magnetite replace the olivine, and chlorite is a common alteration product of the pyroxene. Phases of the rock, ... contain as much as 20% pyrrhotite."

CHRYSOBERYL



Auburn? - *road cut*; **Bowdoinham** - *Booker Q*; **Brunswick** - *road cut*; **Buckfield** - *Bennett Q?*, *Perien Dudley farm A, Westing-house Q (=Dudley Ledge Q)*; **Canton** - *"across from cemetery," Wentworth Q (=Reynolds Q)*; **Edgecomb**; **Georgetown** - *Consolidated Q*; **Gilead** - *Wheeler #2 Q*; **Grafton** - *Mother Walker Falls road cut*; **Greenwood** - *Harvard Q, Locke Mills A, Nubble Q, Witt Hill L*; **Hartford** - *Ragged Jack Mountain L*; **Hebron** - *railroad cut*; **Litchfield** - *Dennis Hill albitite*; **Lovell** - *Sabattus Mountain A*; **Mechanic Falls** [=Minot?] - *Conroy Q*; **Mexico** - *U.S. Route #2 road cut*; **Minot** - *McHugh Q, Roy Farm P*; **Newry** - *Beryllium Corporation Q, Double Cross Q, Dunton Q, Nevel Q*; **Norway** - *Cobble Hill Q, Pikes Hill A, Speckled Mountain A, Tubbs Ledge Q, Witt Hill A*; **Paris** - *Hoopers Ledge chrysoberyl P, Mount Mica Q?, Slattery Q, Whispering Pines Q*; **Peru** - *Hedgehog Hill Q, Joyner P*; **Rumford** - *east side of Whitecap Mountain, Black Mountain A*; **Standish** - *road cut*; **Stoneham**; **Stow** - *Pine Hill A*; **Sumner?** - *Ragged Jack Mountain?*; **Topsham** - *Fisher Q, Porcupine Hill Q, Railroad Q (=Burbank L)*; **West Paris** - *Newt Brook A, Perham Q*; **Woodstock** - *Bryant Pond pegmatite Q, southern Mollycokett Mountain A, Newt Brook A, Old Spar Q*

Chrysoberyl is known from a large number of localities in Maine. The variety of occurrences include mica schist, pegmatitic quartz veins, and sillimanite-bearing, quartz-poor pegmatites. It occurs completely embedded in feldspar, quartz, or mica or may be found adhering to beryl crystal faces also embedded in matrix. It is frequently twinned in "V"-shaped or "sixling" plates. Striations are common and follow the length of the individual crystals. The color is generally light to dark sea-green grading into grays, tans and browns. Chrysoberyl is frequently confused with massive green fluorapatite and beryl. In particular, golden beryl in facetable grades has been confounded with gem chrysoberyl. Chrysoberyl is much harder than fluorapatite and is non-fluorescent, and it can be told, sometimes with difficulty, from beryl by its square cross-section or V-twinning, by the presence of longitudinal striations, or by its lack of cleavage. Chrysoberyl crystals are usually thin platelets, while beryl usually forms long prismatic crystals. Pocket-formed chrysoberyl crystals are unknown in Maine. A discussion of the worldwide modes of chrysoberyl occurrences is given by Heinrich and Buchi (1969). Discoveries of numerous chrysoberyl localities around the world

have greatly diminished the significance of Maine chrysoberyl, but the interest is still more than historical only. Chrysoberyl localities in Maine have been summarized by Petar (1929), King (1975a), and Jacobson (1982). Chayes (1944) cursorily researched the Maine chrysoberyl localities and amazingly concluded: "Thus, the imposing total of 12 Maine occurrences is reduced to 2, Hartford and Norway, which have been studied adequately." The suggestion was that chrysoberyl was probably found at no other localities than those two and that the known samples were incorrectly labeled: his experience may have justified the comments at the time, however. It remains a mystery why so few Maine specimens, of any mineral, are adequately labeled.

Chayes (1944) cited a personal communication concerning **Buckfield** chrysoberyl from Charles Palache, who felt that the locality "is questioned." No specimens are known to represent the occurrences listed in this town by Morrill et al. (1958).

Some **Canton** chrysoberyl specimens are gray to gray green prisms with some striations and a sub-parallel divergent to overlapping intergrowth. Kunz (1883c) reported: "Mr. G. F. N. Kunz exhibited specimens of chrysoberyl, of remarkable size (one, five by three inches), and crystalline marking, from Canton and Stowe [sic], Me. ..." Though the Canton locality of the early reports was reported to be unknown (Putnam and Perham, 1968), Anonymous (1945) suggested that the Wentworth quarry (= Reynolds Q) is the locality of fame. Very large uninterminated chrysoberyl "plates" (to 8 x 11.5 x 3.5 cm, AMNH 67080) have been found in Canton.

Morong (1990) made the only observation of chrysoberyl from the Consolidated quarry, **Georgetown**: "rarely found, this was translucent yellow, fan-shaped, flat and striated, small specimens in dark quartz."

A few small pieces of golden yellow-green chrysoberyl suitable for faceting gems were found at the Wheeler #2 quarry, **Gilead** (Thomas Michalski and Jim Mann, personal communications, 1990). The chrysoberyl was found in smoky quartz. The Wheeler #2 quarry has produced triangular chrysoberyl crystals (to 1.5 cm) with "V" twinning striations in a granular light gray quartz above the quarry portal area (Neil Wintringham, personal communication, 1992).

Mother Walker Falls area road cut (Route 26), **Grafton** produced some triangular "sea-green" chrysoberyl crystals (to 4.5 cm) frozen in granite pegmatite (Sid Howe, personal communication, 1964).

Nubble quarry, **Greenwood** chrysoberyl sometimes forms excellent pseudohexagonal sixling twins to 3.5 cm, and V-twin crystals to 2.5 cm are also known in quartz-beryl-microcline matrix as well as tightly intergrown tannish green crystals (to 3 cm) and plates in muscovite-almandine-albite matrix.

The tiny Witt Hill prospects, Greenwood/Norway have been variously located in guidebooks, sometimes in the wrong place, and much confusion has arisen because of the mistakes. Some of the USGS topographic maps have mislabeled the hill entirely (e.g. USGS 15' Bryant Pond quadrangle map, 1911).

Thompson et al. (1988, 1991) show proper directions for the Greenwood area. Jacobson (1987) gives directions to the Norway portion of Witt Hill. The prospects indicated may be several of many, however, as specimens from the locality have been commercially available since the 1890's. The chrysoberyl forms thin, occasionally with a 20:1 ratio of width to thickness, pseudo-hexagonal plates frozen in microcline-quartz-almandine-sillimanite-zircon pegmatite. V-twins which have in-filled re-entry angles are triangular in habit, frequently showing multiple growth with other V-twin plates. Individual crystals of differing sizes are also common. The platelets are frequently slightly wavy or undulatory. Foote (1897) wrote: "*Chrysoberyl*, Greenwood, Me. The accompanying engraving fails to do justice to the perfection and symmetrical outline of these neat crystals. They are orthorhombic twins (pseudo-hexagonal), green in color, of thin, tabular habit, and show radial, feather-like striations. (See Dana [1892], p. 229, Fig. 5) No such Chrysoberyls as these have been known in America or Europe for years, and similar ones, when found brought high prices. Crystals in white feldspar matrix. 50¢ to \$2.50."

The locality in **Hartford** which is famous for its specimens has been known locally as Ragged-Ass Jack Mountain. The U.S. Geological Survey shortened the name to Ragged Jack mountain on its topographic maps (Ralph Spencer, personal communication, 1974). Collectors have long tried to scale the cliff of the pegmatite vein to get specimens. Extension ladders have been brought to the face and mountaineers have come down from the top of the mountain on ropes in order to prospect the upper portions of the deposit. A scaffolding was also built against the cliff face. (The hill face is a miniature *El Capitan*.) The chrysoberyl from this locality has been known for a long time and has been variously placed in Sumner, Peru, and Hartford (Palache, 1924). "The deposit is about half way up on the face of a vertical cliff about 150 feet high and the talus at the bottom is very steep and rough. Some of the masses that have split off are as large as a small house" (Marble, 1928). Palache (1924) reported:

"The pegmatite dike which is the source of the chrysoberyl traverses the face of the cliff in a diagonal direction and is well exposed in section. It is from 3 to 5 feet wide in its main extent and is 2 feet wide at the top of the cliff, but at the base it narrows to a few inches. Segments of the dike are seen in many of the fallen blocks and from these alone has the chrysoberyl been collected, the cliff face being too abrupt for foothold or attack.

The dike is largely composed of gray or milky quartz. Along the walls, however, some feldspar is developed in well formed and occasionally large individuals of unusual habit. Muscovite, black tourmaline, occasional garnet crystals, and chrysoberyl are the minor mineral constituents. They are very irregularly distributed in the dike and 'like chrysoberyl' are found embedded both in quartz and feldspar. The quartz is unusually brittle, being apparently under pressure strain; and some chrysoberyl crystals show cracks and offsets with quartz infilling. The friable nature of the quartz is favorable to the collector; it generally breaks away readily and cleanly from the crystals of the other minerals.

... Several hundreds of crystals are represented in the collections and they vary in size from plates up to two inches in diameter by a sixteenth of an inch in thickness to tiny scale-like crystals of extreme thinness. The vast majority of the crystals are twins consisting of two individuals in contact, generally very symmetrically developed. Very exceptional trilling crystals were observed and only two untwinned individuals were discovered in the whole collection. In these simple crystals the habit is prismatic with an almost square section determined by the front and side pinacoids."

The best crystals are frozen in quartz and form V-twins, sixlings, and triangles to 5 cm. Silvery white muscovite frequently wraps around the chrysoberyl from this and other locations. Prismatic zircon crystals (to 2 mm) can be found embedded in the surface of some of the Hartford chrysoberyl. Fisher (1933) added to the locality description. In recent years, very little pegmatite has been available to collect in, in the talus. A small prospect pit is located at the top of the cliff face (Ray Woodman, personal communication, 1992).

Barker (1965) reported chrysoberyl from an albititic pegmatite on the southwest foot of Dennis Hill near Routes #126 and #9 near Dennis Brook, **Litchfield**: "Fluorite, apatite, garnet, chrysoberyl, allanite, zircon, pyrite, and arsenopyrite are scattered through the pegmatite." Based on the minimal attention given to its description, it can be surmised that no crystals of consequence were found and the mineral may have been nothing more than gray green "dots" in the rock as well as being relatively scarce.

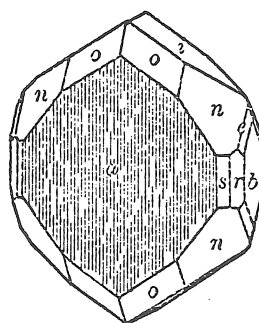
Very fine gray green chrysoberyl V-twinned crystals (to 7 cm, HU collection) are found in quartz at the now "lost" Conroy quarry, **Mechanic Falls**.

Dunton quarry, **Newry** chrysoberyl is quite rare. It has been found as yellow-green incomplete crystal plates (to 3 x 5 cm) embedded in smoky quartz (Robert Whitmore, personal communication, 1990).

Pseudohexagonal yellow-green chrysoberyl plates (to 1.5 cm) were found at the contact with microcline and smoky quartz at an unspecified locality in Newry. Chrysoberyl of a gray-green color is found in pegmatite at the Three Ledges prospect, Newry (Norman Davis, personal communication, 1972).

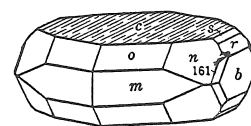
Verrill (1861) wrote of **Norway**: "A third [specimen exhibited] was a crystal of chrysoberyl, found on a hill near Norway village, Me., in granite associated with large garnets and rose quartz; it was of unusually large size." True (1869) revealed the location: "Pike's Hill, Norway. A single crystal of this rare mineral was discovered, and is in possession of Prof. A. S. Verrill. It is a flat prism about one and a quarter inch in length, and three-quarters inch wide, and one-quarter inch thick, with angles highly modified and partially transparent." Putnam and Perham (1968) wrote: "The old chrysoberyl find in Milletville above Norway is difficult to locate these days. ... The land is presently owned by Norman Mills, West Paris."

Norway proved to have several good localities, formerly (Kunz, 1885): "Mr. N. H. Perry found one small, very perfect



Norway

(from Goldschmidt, 1913)

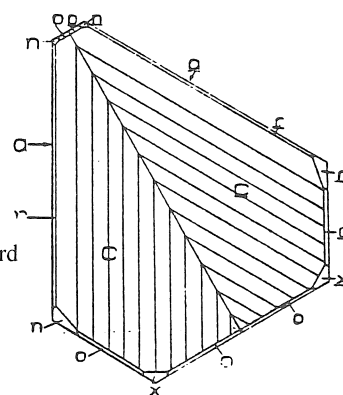


Newry

(from Palache et al., 1944)

Ragged Jack Mountain L, Hartford

(from Palache, 1924)



Chrysoberyl

crystal at Tubbs' Ledge, Maine, and it has also been observed at Speckled Mountain [Norway], and at Stoneham, Oxford county, Maine, near the Stow line, by Prof. Verrill ..." A drawing of an excellent chrysoberyl crystal labeled "Norway" was illustrated by Dana (1892) and was re-figured in a new orientation and relabeled "Newry" by Palache et al. (1944), but Newry was not listed in the localities section which suggests a misprint. No Norway chrysoberyls have been observed in recent times, and none are preserved in collections.

A small prospect associated with the Hoopers Ledge quarry, **Paris** has yielded large masses of chrysoberyl to 5 kg (Morrill, 1943). Knots of intergrown and indistinct crystals are the norm, but striated V-twins and twin segments can reach 5 cm. Occasional small pieces of transparent chrysoberyl suitable for gemstones have been located. Perham (1987a) suggested: "The largest of the chrysoberyl specimens which have been found here is a massive crystal which weighed about one hundred pounds. Unfortunately, this remarkable specimen was broken during blasting but chunks of this chrysoberyl weighing several pounds were recovered along with many smaller specimens." The color varies from sea green through gray green to gray. Crystal faces, as well as broken surfaces, have an oily luster and variously show wedge shaped sectors which show vague V-shaped striations. The largest Maine chrysoberyl that has been preserved came from the Hoopers Ledge quarry. One twinned crystal (17 cm across with a main crystal 12 x 9.1 cm) free of matrix (HU 97582)

is known. Though Eckel (1961) felt that a Colorado chrysoberyl (12.5 x 12.5 x 6.5 cm) was "among the world's largest," a smooth-faced, lustrous symmetrical V-twin chrysoberyl (about 18 x 25 x 10 cm) is now known from Pancas, Espirito Santo, Brazil (Robinson and King, 1990).

Kunz (1887a) indicated a 7.5 carat cut chrysoberyl and suggested Mount Mica quarry, Paris as the source, but the reference should have read: "chrysoberyl-green tourmaline" (Conklin, 1986).

Terminated prismatic gray-green chrysoberyl crystals (to 4 cm) are found with schorl and almandine at the Whispering Pines quarry, Paris.

Large chunks (to 7 cm) of chrysoberyl, generally without crystal form, were found at a previously unnamed prospect, Peru which has recently been called the Joyner prospect. The chrysoberyl is dark sea-green and frequently has silvery muscovite flakes, and occasional torbernite, attached to the outside of very crude chrysoberyl crystal faces.

Marble (1927) wrote of the Hedgehog Hill quarry, Peru: "The writer knows of at least one crystal of chrysoberyl found here. It was rather shattered, but originally must have been about 1/2 inch thick and 2 inches in diameter. From this crystal a perfect stone of about 1 carat was cut that was very brilliant, the color being greenish straw yellow."

An unspecified road cut in Standish has yielded exceptional yellow-green transparent, vitreous V-twin chrysoberyl crystals (to 1 cm) in coarse brown mica schist.

Perry (1885) reported chrysoberyl: "... at Stoneham, also at Canton, Peru, Norway, and Stow, but thus far not in fine specimens. Some of the small dark colored crystals in the fibrolite at Stoneham are however, quite perfect in form. The small crystals occur at Canton and Stow with large coarse crystals." Chrysoberyl in fibrolite in Stoneham is analogous to the Witt Hill occurrence. The Stoneham locality is currently lost, but one specimen is preserved (USNM 131499).

Kunz (1885) further reported on Stow chrysoberyl (probably based on specimens and information from Perry): "... recently, perfect, small, and very distinct crystals of no gem value have been found in fibrolite at a new locality in Stow, Maine. ... it has been found in masses weighing about 5 pounds each, and also in single distorted crystals 3 by 5 by 1 inches, of an opaque color; these may in part furnish very poor chrysoberyl cat's-eyes." Putnam and Perham (1968) queried: "Chrysoberyl has been reported eighty years ago from Stow. Where?"

An early chrysoberyl from Topsham was reported by Kunz (1892a): "A crystal 3 1/2 inches long by 1 inch wide, from Topsham, Me" One exceptional crystal from the Porcupine Hill quarry, Topsham is about 6 x 6 cm (HU collection).

The Railroad quarry (= Burbank locality), Topsham, near Interstate Route 95 has produced yellow-green V-twin chrysoberyl crystals (to 4.5 x 5.5 cm).

Putnam and Perham (1968) wrote of West Paris: "Chrysoberyl in small one-fourth-inch crystals were found by Stanley

Perham on Newt Brook in 1942 not too far up the brook along a logging road that went over bare ledge."

CHRYSOCOLLA



Beddington? - Chalk Pond A; **Blue Hill** - Douglass M, Twin Lead M; **Brooksville** - Callahan M, Cape Rosier M; **Penobscot?** - Hercules M; **Woolwich** - U. S. Route #1 road cut; **T22MD?** - Chalk Pond A

Because chrysocolla is usually an indistinct blue-green to green coating in Maine, it has usually been dismissed as one of the copper stains at a mine and ignored.

Stewart (April 16, 1880) wrote of the Twin Lead (pronounced "Leed") mine, **Blue Hill**: "The true ore-channel of the lode is a massive, well-defined quartz vein, which is permeated throughout by a variety of metallic elements such as Magnetic Iron, Zinc blende, Mispickel, Arsenical Nickel, Iron Pyrites, Yellow Copper, Native Copper - in thin sheets - chrysocolla, Antimonial Silver, Argentiferous Galena, and other undetermined substances." (The name Twin Lead suggested two veins or leads to follow.) No specimens known.

Veinlets up to 5 mm thick of chrysocolla have been found at the Callahan open pit mine, **Brooksville** in pyrite crystal-bearing talcose quartz matrix. Thin pale blue earthy chrysocolla coatings are frequently found, as well.

Bartlett (October 15, 1880) reported of the Hercules mine, **Penobscot**: "For example, at the Hercules mine the following varieties of ores may be seen: - galena, zinc blende, copper pyrites, iron pyrites, gray copper, native copper, silicate of copper, arsenical pyrites, native silver, together with other various kinds of silver and gold ores..." No specimens of the "copper silicate" known.

chrysolite = forsterite (Olivine Group)

chrysotile - see clinochrysotile

cimolite - clayey alteration

Greenwood - Harvard Q; **Norway** - Tubbs Ledge Q?

Cimolite from the Harvard quarry, **Greenwood** appears to be a mixture of minerals: "I have a sample 1 1/2" x 2" labeled 'Kimolite' from Harvard Q. It is fine-grained, buff in color, talcose in feel but too hard to scratch with a fingernail. Its structure indicates a complete replacement of spodumene with no trace of other minerals except for some Mn-dendrites on what appears to have been the external surface of the spodumene" (Neil Wintringham, personal communication, 1992).

Clarke (1884c) reported of **Norway**:

"Among a collection of Maine minerals received from N. H. Perry, of South Paris, were several specimens of tourmaline and albite encrusted with a pink to rose-purple, earthy alteration product. The color was found to be due to a little manganese, which was not, however, separately estimated. The analysis (Clarke) gave results approaching to those required by the formula $\text{AlH}_3(\text{SiO}_3)_3$...

It will be observed at once that these results do not agree exactly with those commonly obtained for cimolite. They are too high in silica, and too low in water, and the formula deduced from them is somewhat novel. We are inclined to place the mineral, however, under cimolite, as being nearer to that species than to any other. Possibly the new formula represents the final outcome of an alteration process which ordinary cimolite has only partially undergone. Somewhat similar pink alteration products are not uncommon in the albitic granite veins of Maine and New Hampshire, and some, without analysis, have been supposed to be montmorillonite, like that of Branchville, Connecticut."

Clarke (1887a) further wrote of the Norway cimolite: "With the lepidolite are associated, as usual, quartz, the feldspars, the micas, cassiterite, lithiophilite, beryl, &c., and also a peculiar rose red clay, derived from some other species by alteration. ... Of the rose-red clay, previously mentioned a partial analysis was published by Mr. Riggs... The following complete analysis by Mr. Riggs is better, and shows, in spite of some little non-uniformity of composition in the mineral, that it is to be classed most definitely as cimolite... It is not easy to determine, from the specimens at hand, from what species this clay has been derived." Clarke (1886b) also reported on this cimolite. The analysis could be that of a montmorillonite mixed with quartz and/or kaolinite. Schaller (1905a), however, accepted the cimolite interpretation and discussed halloysite clay from California. Larsen (1921) described cimolite (USNM 16177) from Norway, Maine: "Rather clear, isotropic grains. $n = 1.564$. Considerable admixed quartz occurs in small well-formed crystals." Larsen's (1921) description was made using a petrographic microscope.

cirrotite - name of unknown significance

Greenwood

The name cirrotite appeared in a list of Maine mineral names September 22, 1905 in the *Lewiston Evening Journal*. The name could be a typographical error for cimolite.

clarkeite?

Newry? - Dunton Q; **Stoneham?** - Lord Hill Q

Clarkeite is a simple sodium uranium oxide alteration ($\text{Na}_2\text{U}_2\text{O}_7$, but frequently highly substituted) of uraninite. However, clarkeite is not nearly as widely distributed as uraninite and visible, brown resinous rinds of clarkeite are usually seen only from pegmatite localities which have fairly large uraninite grains or patches of uraninite (to several cm). While clarkeite is not

restricted to pegmatites, neither is it required that pegmatite uraninite be replaced by clarkeite. Brown iron stains and brown radiation halos around uraninite have been casually identified as clarkeite by collectors. No Maine clarkeite verified.

Much of the uraninite at the Dunton quarry, Newry has been altered to sooty pitchblende. In addition to the various yellow to orange alteration products of the uraninite, chocolate-brown clarkeite? sometimes forms a thin rind about a core (1-2 mm) of pitchblende. The "clarkeite" is found as waxy, chocolate-brown rims in the cavities where uraninite was embedded in cleavelandite. (Care should be exercised in identifying the material as waxy, chocolate-brown zircon crystals are found in the same association and earthy, brown iron and silicate-rich material sometime rim the uraninite. Frondel (1956, 1958c) does not mention Newry material, but says that, in general: "Clarkeite is formed by the alteration of uraninite. It occurs as the central core in zoned pseudomorphs after uraninite, or immediately surrounds unaltered residuals of uraninite, and is surrounded in turn by an orange-red zone of gummite (usually composed of fourmarierite, vandendriesscheite ...) and an outer zone of uranium silicate.") An earthy alteration rim on Dunton quarry uraninite was chemically analyzed in order to confirm the species (this study) and found to contain only iron and silicon, and therefore is not clarkeite.

Clarkeite was reported from Lord Hill quarry, Stoneham (Seaman, 1975b): "It also undoubtedly forms part of the alteration products formed around cubic crystals of uraninite which have been found in the pegmatite at Lord's Hill at Stoneham in recent years. Its color is dark brown to chocolate brown." No specimens known.

clay - a general term covering a wide variety of fine-grained minerals including muscovite, chlorite, kaolinite, etc.

Many clay reports are known including those of: Katz (1913); Trefethen et al. (1947); Goldthwait (1949); Fuller (1949); and Kelley (1989).

cleavelandite (Feldspar Group) = platy albite; see discussion under plagioclase series

CLINOCHLORE (Chlorite Group)

$(\text{Mg,Fe})_5\text{Al}(\text{Si}_3\text{Al})\text{O}_{10}(\text{OH})_8$

Albany; **Alfred**; **Biddeford**; **Blue Hill** - Douglass M, Granger M, Stewart M, Twin Lead M; **Brooksville** - Tapley M; **Calais** - U.S. Route #1 road cut; **Cape Elizabeth**; **Castine**; **Castle Hill** - Castle Hill A; **Concord** - Robinson M; **Cornish**; **Cutler** - Cross Island, Cutler Diabase, Little River basalts; **Dedham** - 900 Foot Hill; **Deer Isle** - Deer Isle M; **TE** - Smalls Falls A; **Eastport**; Ellsworth Schist; **Frankfort** - Mosquito Mountain; **Franklin** - Blaisdell Q, Bradbury and Son Q; **Gouldsboro** - Gouldsboro M; **Greenville** - Routes

#6 & #15 road cut; **Hanover**; **Harpwell** - east shore Hen Cove; **Hermon** - *Hermon Q*; **Jonesboro** - *Bodwell-Jonesboro Q*; **Katahdin Iron Works** - *Katahdin Iron Works M*; **Lincolntonville** - *Heal Q*; **Lubec** - *Lubec M*; **Marshfield** - *Machias Granite Q*, *Marshfield Granite Q*; **Milbridge** - *Cherryfield M*; **Minot**; **Monticello** - *dacite/diorite dike south of Sugar Loaf Mountain*; **Muscle Ridge Plantation** - *High Island Granite Q*; **Newburgh** - *U.S. Route #95 quarry*; **Newry** - *Dunton Q*, *Nevel Q*; **North Haven**; **Noyes Mountain Formation and Sangerville Formation** - **Greenwood, Norway**; **Orono** - *glacial rock*; **Oxbow** - *Cupsuptic River Q*; **Perry** - *Gin Cove A*, *Loring Cove A*; **Portland**; **Rumford**; **Saint George** - *Clarke Q*; **Sanford**; **Searsport** - *Bog Hill Q*; **Stonington**; **Stow**; **Sullivan** - *Sullivan M*; **Tremont**; **Union** - *Harriman P*; **Unity**; **Vinalhaven**; **Warren** - *Warren Nickel P*; **Waterford**; **Waterville Formation** - **Benton**, **Fairfield**, **Waterville**, **Winslow**; **Woodstock**; **T9R3 WELS** - *Hovey Mountain P*; **T10SD** - *Catherine Hill Q*

Clinochlore is a member of the chlorite group of micas and forms a series with the less common iron-rich mineral, chamosite. Clinochlore has a great number of varietal names, some of which are actually only synonyms. Penninite is a sometimes used term in Maine for chlorites which exhibit a peculiar "Berlin blue" color when microscopically viewed in a thin section of rock. Ripidolite seems to be used synonymously with clinochlore. Clinochlore is generally green and is frequently a component of schists and gneisses. Well-formed crystals are scarce in Maine. Ferry (1976), Guidotti (1965a), Guidotti and Cheney (1976), Pavlides (1962), Pavlides et al. (1965), Rainville and Park (1976), to name only a few, have mapped chlorite-bearing units in Maine. Generally, clinochlore is a fine-grained component in schists, a replacement mineral in altered rocks, or an alteration mineral in an aureole near metallic mineral-bearing veins, etc. The low grade regionally metamorphosed rocks of the northern parts of the state, generally unaffected by contact metamorphism associated with plutonic events, are at chlorite grade.

The rock in the road cut which produced the exceptional prehnite crystals in U.S. Route #1, **Calais** has produced only a few sharp pseudo-hexagonal vermiform clusters (to 3 mm) of green clinochlore.

Gates (1961) reported on the Little River basalts and the Cutler diabase, **Cutler**: "The very pale interstitial ripidolite found in the least altered diabases commonly, on metamorphism, turns a slightly darker green, assumes the anomalous blue interference colors of penninite (although the optic angle and N_0 index remain the same as in the ripidolite), and becomes indistinguishable from the chlorite replacing plagioclase and pyroxene. In most of the altered rocks chlorite is ubiquitous, occurring as vesicle fillings, as massive replacements of pyroxene and albite, following shears and cracks in mineral grains, and ramifying through the rocks in branching irregular veinlets. In those rocks, however, in which augite has altered to hornblende, needles of actinolite have grown in the chlorite and both may be replaced by hornblende."

The best groups of clinochlore in Maine were found in quartz veins in a road cut along Routes #6 & #15, **Greenville**. The vermiform to radial clinochlore clusters (to 3 mm) are dark green and are implanted on microcline crystals (to 6 mm) and are associated with exceptional, sometimes twinned muscovite (Ray Woodman, personal communication, 1992).

The road metal quarry next to U.S. Route #95, **Newburgh** has typical vermiform aggregates (to 3 mm) of pseudo-hexagonal clinochlore in milky quartz vugs.

A glacial rock, though not a "proper" locality, in **Orono** has provided some of the best clinochlore crystals (to 4 mm) in Maine. The *in situ* locality might, statistically, be approximately 10-20 km away. The triangular plates (1 mm) can be individually placed on small microcline crystals (1-2 mm) or grouped in sub-parallel triangular and pseudo-hexagonal crystal aggregates (to 5 mm).

Guidotti (1965a) wrote of the Patch Mountain Member of the Sangerville Formation, **Greenwood** and **Norway**: "Chlorite is present in small amounts in some specimens but is a retrograde mineral after hornblende or diopside," while in the Noyes Mountain Formation: "The chlorite shown in the modes is always a retrograde product of biotite."

Clinochlore in fine-grained mignonette-green (a light gray-green, RHS 192a) amygdule-filling masses are conspicuous in the volcanic rocks exposed in Loring and Gin Coves, **Perry**. Particularly light colored masses of clinochlore have been erroneously called saponite (q.v.).

At the Sullivan Mine, **Sullivan**, intricately branching vermiform deep green clinochlore clusters (to several mm) are found in quartz crystal veins which have the interstitial calcite etched away. Light cream yellow radial muscovite clusters (to 1 mm) can be associated.

Small (1-2 mm) vermiform aggregates of clinochlore crystals are found in vugs of iron-stained microcline crystals (1-3 mm) at Catherine Hill, **T10SD**.

CLINOCHRYSOTILE (Serpentine Group)

$Mg_3Si_2O_5(OH)_4$

Addison; **Alder Stream** - *Alder Stream Falls, Elephants Head A, outcrop near southwestern Tea Pond road*; **Bethel?**; **Black Narrows A** - **East Moxie, The Forks**; **Boil Mountain Complex serpentinite** - **Alder Stream, Oxbow, Seven Ponds**; **Bristol**; **Brooksville**; **Cherryfield** - *community spring area*; **Columbia**; **Cupsuptic quadrangle** - *Hill 2720 A*; **Deer Isle** - *Little Deer traprock Q, North Deer Isle A, Terrys Pond A, Verde Antique Q*; **Dixfield?**; **TDR2 WELS** - *Porcupine Mountain A*; **TE?** - *School lot A*; **Hampden**; **Harpwell**; **Island Falls**; **Jim Pond** - *Arnold Trail A?*, *ledges south of Shallow Pond*; **Kennebago Lake quadrangle** - **Alder Stream, Jim Pond, Seven Ponds**; **Lower Enchanted** - *Stony Brook Mountain A*; **Mapleton** - *diabase*; **Mount Chase** - *Mount Chase A*; **North Haven**; **Parmachenee?**; **Presque Isle**; **Richardson** - *Pine Island A*; **Sidney**; **Trescott** -

Moose River, Moose River school; Union - outcrops; Whiting; T3R5 BKP WKR - Little Spencer Stream-Parker Pond Brook A; T5R6 BKP WKR - Three Slide Mountain A

Clinochrysotile is a member of the serpentine group and comprises most commercial asbestos. It frequently forms grayish white to pale mottled green, thin fibrous veinlets cutting across antigorite. Chrysotile is a general name which can include, not only the very common clinochrysotile, but also orthochrysotile and parachrysotile. (The polytypes orthochrysotile and parachrysotile are yet to be verified in Maine.) Burr (undated a), Ekren and Frischknecht (1967), and Pavlides et al. (1965) listed some Maine asbestos localities. Wing and Dawson (1949) looked for and did not find asbestos in **Parmachenee**, but Harwood (1966) noted slip fiber asbestos "in the vicinity of the south knob of the 2720 foot hill east of the Kennebago River," **Cupsuptic quadrangle**.

Small veinlets (to several millimeters) of clinochrysotile cut some of the serpentine at **Alder Stream** (Alder Stream Falls and southwestern Tea Pond A) and **Jim Pond** (ledges in the Dead River, and ledges south of Shallow Pond). The clinochrysotile is light grayish green and the fibers form at an oblique angle to the veinlet walls. Additional clinochrysotile fibers are also found along slickenside surfaces and between antigorite lamellae, but the thickness of the clinochrysotile layers is so thin that it is just a few fiber thicknesses. (The picrolite variety of antigorite can resemble clinochrysotile superficially, but the color of the picrolite is usually yellow-green to dark green and, more importantly, is not weavable.) Wing and Dawson (1949) mapped, sometimes with ambiguous symbols, the occurrence of serpentine and greenstone which contain small veinlets of asbestos. (Outcrop exposure is minimal in all of the areas reported on by Wing and Dawson (1949).) Boone et al. (1970) did not specify which located serpentinites were clinochrysotile-bearing.

Boudette (1991) reported clinochrysotile from "allochthonous serpentinite" in the **Kennebago Lake quadrangle**.

Asbestos in small veinlets was found in a serpentine body which extends from Parker Pond Brook and crosses over Little Spencer Stream, **T3R5 BKP WKR**. Wing and Dawson (1949) reported: "The fiber of the Spencer Area occurs as two different types. The least common occurrence is as cross fiber in which the asbestos fiber is found as a vein filling at high angles to the walls of the vein. This occurrence is found in many places in several different bodies, but the fiber is not long enough to have any great commercial value. The more common occurrence, and the one that merits consideration from an economic viewpoint, is that referred to in the asbestos industry as shear fiber. In the Spencer Area this is believed to have been formed by shearing of the original veins of cross fiber. Hand samples give the appearance of a smear or coating on the fracture or planes of movement. The shear fiber generally is of uniform length and quality." An area "a little less than one-half mile north of Eagle Pond" also afforded an exposure with poor quality asbestos (Wing and Dawson, 1949).

Wing and Dawson (1949) reported of the Stony Brook Mountain area, **Lower Enchanted**: "Another concentration of fiber is seen close to the top of the eastern slope of the mountain. ... One vein one-half inch wide was seen but the fiber was somewhat distorted and broken by a medial parting containing flecks of serpentine and magnetite."

Boucot et al. (1964) wrote of a diabase exposed in **Mapleton**: "The diabase east of Mapleton and on Haines Hill is olivine-bearing, and some of the olivine has been replaced by plates of antigorite and veinlets of chrysotile."

clinopyroxene - usually a member of the diopside/hedenbergite series or augite, but sometimes including pigeonite and/or the clinoenstatite/clinoferrosilite series.

Boudette (1991) provided the most interesting report of Maine clinopyroxene, **Tim Pond**: "Elephants Head pluton - Contains three types of interlayered gabbroic rocks: (1) medium- to dark-gray, medium- to coarse-grained, extensively altered gabbro, comparable to Flagstaff Lake pluton and sill and dike rocks composed originally of about 50 percent plagioclase, 45 percent pink clinopyroxene (partly transformed to brown hornblende), and 5 percent combined magnetite-ilmenite, biotite, and quartz; (2) ..."

CLINOZOISITE (Epidote Group)



Augusta?; **Brooksville** - basalt west of Callahan M; **Casco** - Chute P; Casco Bay Group; **Flagstaff**; hornblende diorite dikes - **Forsythe, Sandy Bay**; **Lewiston** - City Q; **Minot** - Pitts-Tenney P; **Oxbow** - Hill 3100 A; **Phippsburg** - The Basin L, Basin Limestone Q; **Quimby Formation/Greenvale Cove Formation** - **Dallas, Rangeley, Rangeley Plantation, Redington, Sandy River**; **Rangeley Formation** - **Davis, Lang**; **Raymond** - Camp Hinds L; **Sanford** - Webster P, 200 meter L, 600 meter L; **Sangerville Formation** - **Buckfield and Bryant Pond quadrangles, Farmington, New Sharon**; **South Thomaston** - Deans Hill A; unnamed Ordovician volcanic rocks - **T2R7 WELS, T4R7 WELS, T4R8 WELS, T3R7 WELS**; **Vassalboro Formation** - **Vassalboro**

Clinozoisite is an abundant accessory mineral in Maine metamorphic rocks, but is usually in small grains, not easily recognized by the naked eye. Clinozoisite is the aluminum-rich member of the epidote/clinozoisite series. There are two independent sites in the clinozoisite structure which can accept aluminum, but only one of the sites can contain appreciable iron. When the aluminum + iron site becomes more than half substituted by iron, the species becomes epidote.

Boone (1955) listed clinozoisite from a unit now apparently called the Anasagunticook Member of the Sangerville Formation, **Farmington** - **New Sharon**. Neuman (1967) listed clino-

zoisite from unnamed Ordovician volcanic rocks, **T2R7 WELS**, **T4R7 WELS**, **T4R8 WELS**, **T3R7 WELS**. Moench (1969) reported clinozoisite and grossular from the Quimby Formation and the Greenvale Cove Formation, **Dallas**, **Rangeley**, **Rangeley Plantation**, **Redington**, and **Sandy River**. Osberg (1968) noted clinozoisite in the Vassalboro Formation, near Spectacle Pond, **Vassalboro**. Clinozoisite is a common constituent of the extensive Patch Mountain Member of the Sangerville Formation, **Buckfield** and **Bryant Pond quadrangles** (Guidotti, 1965a; Warner, 1967). Boudette (1991) noted clinozoisite in a "thinly laminated to vividly banded calc-silicate rock" of the Rangeley Formation. Arthur Hussey (personal communication, 1992) reported: "Clinozoisite is abundant in calc-silicate lithologies throughout the Casco Bay Group."

Clinozoisite has been found (AMNH #78856) as light gray to medium gray-green striated curved uninterminated blades (to 5 x 1 x 0.4 cm) in open vugs in interlocking clinozoisite as part of a 9 cm wide "vein" section from the Lake Cobbosseecontee area near "**Augusta**" (Manchester?).

Bouley and Hodder (1984) reported a basalt just west of the Callahan mine area, **Brooksville**: "Clear clinozoisite occurs within albite as minute kernels and also as euhedral prisms dispersed in chloritic groundmass."

The Chute prospect, **Casco** clinozoisite usually consists of irregular uninterminated blades of brown to gray-brown crystals (to 5 cm) on diopside crystals (1-4 mm) embedded in calcite.

Clinozoisite, along with albite and "white mica," is found replacing plagioclase grains (1-2 mm) from large hornblende diorite dikes exposed in **Forsythe** and **Sandy Bay** (Albee and Boudette, 1972).

Fisher (1941) wrote of the City quarry, **Lewiston**:

"Scattered tourmaline, abundant vesuvianite, graphite, and pyrrhotite are found in the marble at or near the contacts with the basic dikes. Zones of biotite, succeeded with distance from the contact by zones of quartz, clinozoisite, and anorthitic feldspar, are common.

Calcite-rich portions of some slides carry metacrysts of diopside, needles of actinolite, and shreds of graphite. They are sharply separated from beds rich in clinozoisite. Diopside and hornblende are more common at a distance from the dike contacts. Common accessory minerals of the marble are vesuvianite, scapolite, zircon, and sphene..."

Clinozoisite forms columnar bundles of gray needles and blades (to 3 cm) in calcite and cavities in between grossular crystals at the Pitts-Tenney prospect, **Minot**. The crystals rarely show definable terminations.

Clarke (1894) reported on an "epidote" specimen from The Basin locality, **Phippsburg**. Though Clarke (1894) said that the chemical analysis was epidote, the analysis actually calculates to be the aluminum-rich member of the series, clinozoisite. Of the material he says: "The mass of the material consists of cinnamon garnet, with occasional green pyroxene, similar to the well-known occurrences at Raymond, Maine, and elsewhere, the rock itself being evidently a highly metamorphosed contact lime-

stone. Occasionally, there is imbedded in the masses of garnet a dark gray mineral, nearly black, in brilliant plates, in nowise suggesting epidote. ... On first inspection I supposed the epidote to be axinite, which is said to occur at the Phippsburg locality, and which in this case it somewhat resembles." Hillebrand (1900) repeated nearly *verbatim* the report of Clarke (1894) and added: "Is the supposed axinite really epidote?" The gray to black clinozoisite forms interstitial, sometimes triangular, plates (to 7 x 7 cm) in the orange-brown grossular and occasionally forms obliquely terminated crystals, sometimes with multiple growth. This clinozoisite could be mistaken as dark smoky quartz with a tabular aspect. The well-known "axinite" from this locality is actually misidentified clinozoisite.

Gray clinozoisite crystals (to 4 x 1 cm) are found with white meionite crystals (to 2 cm), green diopside crystals (to 3 mm), white calcite masses, and vesuvianite crystals and masses at the small satellite prospect pits associated with the Webster prospect in the Goodall Farm area, **Sanford**. The clinozoisite crystals form tapering to wedge-shaped blades with "asymmetrical" terminations. Most of the clinozoisite crystals which have been found at the Webster prospects have been etched from calcite and occur in exposed vugs in large chunks of vesuvianite. Webster (1848) first called the mineral epidote. Some of the Sanford clinozoisite crystals are among the best found in the United States and approximate those from Eden Mills, Vermont and Cornog, Pennsylvania.

Deans Hill area, **South Thomaston** has produced gray clinozoisite plates embedded in grossular and calcite matrix.

cobalt-silver-arsenide?

Castine? - Emerson M

Morrill and Hinckley (1959) reported cobalt-silver-arsenide from the Emerson mine, **Castine** without description or citation of the source report. No specimens known.

cobalt sulfide?

Union?

Burr (1930) listed "Cobalt (probably a sulphide)" from **Union**. No specimens known.

coccolite = a granular diopside

Woodstock

A granular diopside labeled coccolite (USNM# 0028507) is known from **Woodstock**. The coccolite was collected by George P. Merrill and consists of rounded grayish green diopside grains (to several mm) in calc-silicate rock (Paul Powat, personal communication, 1994).

coeruleolactite?

Greenwood - Tamminen Q

Wintringham (1962) wrote: "A pink-purple massive material found at the Tamminen Pits (Greenwood) has been reported as 'possibly coeruleolactite'. This is not unlikely, since turquoise has been reported (Montebras, France) as an alteration product of amblygonite, but further study will probably show this material to be morinite or, less probably, wavellite." No specimens known, but the color of coeruleolactite is usually pale blue-green. Research by one of us (EEF) has failed to reveal the existence of coeruleolactite in any specimen from anywhere in the world. Coeruleolactite might not be a valid species. Research is pending.

collinsite? (Fairfieldite Group)

Newry - Dunton Q

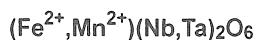
Collinsite has been proposed (various personal communications, 1986, 1991) as the identity of some Dunton quarry, Newry fairfieldite, but chemical analysis of six specimens (this study) collected at different times revealed a generally magnesium-poor composition with dominant manganese. Fairfieldite is difficult to distinguish from collinsite based only on X-ray diffraction.

collophanite = massive unspecified apatites (fluorapatite or hydroxylapatite)

TDR2 WELS - Maple Mountain P; T3R9 WELS - Hovey Mountain Prospect

White (1943) and Miller (1947) reported collophanite from the Hovey Mountain prospect, T3R9 WELS and the Maple Mountain prospect, TDR2 WELS. Pavlides and Milton (1962) preferred to describe it: "Cryptocrystalline apatite is an important accessory in the manganiferous rocks of the Maple and Hovey Mountain deposits. In the banded hematite ironstone of the Maple-Hovey deposit, it is concentrated in the light-colored laminae. It also occurs as tiny irregular patches or blebs embedded in the carbonate-rich laminae of the ironstone."

COLUMBITE (Columbite Group)



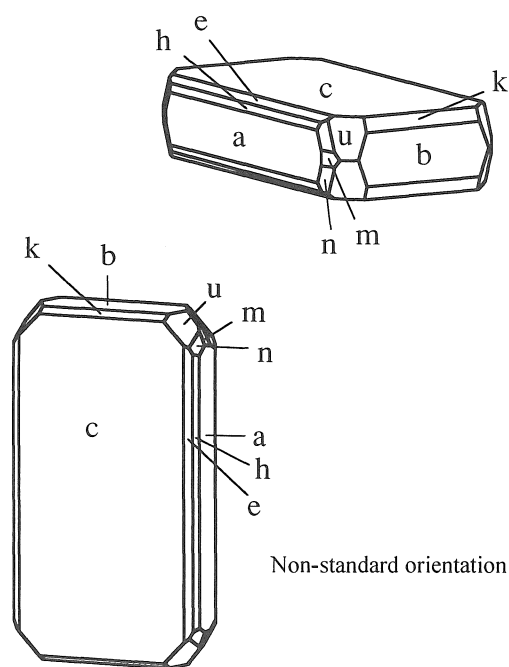
Albany - Bumpus Q, Johnson Q, Pingree Ledge Q, Scribner Q, Songo Pond Q, Stearns P, Wentworth Q; **Auburn** - Keith Q?, Maine Feldspar Q, Pulsifer Q?; **Bowdoin** - Coombs Q; **Bowdoinham** - Booker Q, West Booker Q; **Brunswick** - LaChance Q; **Buckfield** - Bennett Q?, General Electric Q; **Byron?**; **Canton** - Daggett Q; **TD?** - Bemis Stream P; **TE** - Harden P; **Georgetown** -

Consolidated Q; **Gilead** - Wheeler Q; **Greenwood** - Emmons Q?, Harvard Q?, Heikkinen Q, Tamminen Q?, Waisanen Q; **Hebron** - Hibbs Q; **Lakeville** - Getchell Mountain P; **Newfield?** - Straw Hill A; **Newry** - Bell Pit, Crooker Q, Dunton Q?, Kinglet Q, Nevel Q, Rose Quartz Crystal A?, Three Ledges Q; **Norway** - Ordway Farm A; **Paris** - Hoopers Ledge Q, Mount Marie Q, Mount Mica Q?, Ryerson Hill Q, Singepole Mountain Q, Twitchells Ledge Q; **Peru** - Perry Q; **Phippsburg?**; **Poland?** - Berry-Havey Q; **Pownal** - Hinkley Q, Tash Ledge L, Upper Tryon Mountain Q; **Rumford** - Black Mountain Q, Goddards Ledge Q, Red Hill Q; **Southwest Harbor?**; **Standish** - Oak Hill P?; **Stoneham** - Cole Q, Lord Hill Q, McKean Mountain P, McAllister farm Q; **Stow** - Deer Hill Q, Shell Pond A; **Topsham** - Consolidated #1 Q, Fisher Q, Mount Ararat A, Railroad Q (= Burbank L), Porcupine Hill Q, Russell Brothers Q, Standpipe Hill Q, Staples Q, Swamp #1 Q, Trenton Q, William Willes #1 Q; **Warren** - Starrett Q; **Waterford** - Knight Q; **West Paris** - Cobble Hill Q

Columbite is a mineral characteristic of granite pegmatites, but is found only in special examples. On occasion, columbite has been common enough at a particular Maine pegmatite quarry to warrant its being stockpiled for sale. Columbite is part of a group of very similar minerals, but is by far the most common member of that group. Tantalite (q.v.) has only once been reported scientifically in Maine, and even that identification seems to be in error. The manganese-rich members of the series, manganocolumbite (q.v.) and manganotantalite (q.v.) are found in several localities in Maine.

Columbite is black, generally with no red internal reflections. As the members of the columbite series have higher manganese contents, the color of the streak begins to show subtle shades of brownish black and occasional red internal reflections can be seen in the massive material, but these color changes are usually evident only well into the manganese-rich ends of the series in question. The question mark after quarry names suggests not only is columbite probably not found there, but specimens which formerly were thought to be columbite proper are actually manganocolumbite or manganotantalite. Burr (1942), Hess et al. (1943), Sanford and Stone (1914), and Schrader et al. (1917) listed Maine locations for members of the group. Taylor (1940) studied columbite crystal shape from worldwide localities including Paris, Rumford, and Standish. Numerous chemical analyses (this study; Shainin and Dellwig, 1955; and Wise and Francis, 1992) have been used to try to sort out the variety of species reports in Maine.

It is not inconsistent that columbite and manganotantalite would occur at the same locality. The two species could be separated in time of formation with the iron- and niobium-rich columbite formed early and the manganese- and tantalum-rich manganotantalite formed after significant enrichment of these elements, accomplished through late-stage crystallization processes. Three members of the series, columbite, manganocolumbite, and manganotantalite have been found at one locality - Black Mountain quarry, Rumford (analyses, this study).



Columbite, Johnson Q, Albany

The name ferrocolumbite has been applied to columbite as a specific name, but ferrocolumbite (q.v.) is discredited (Shepard, 1852). It is more appropriate to label unanalyzed Maine specimens "columbite/manganocolumbite" than "columbite/tantalite."

Excellent bladed columbite crystals (to 5 mm) are found free standing in albite crystal (to 8 mm) vugs at the Guy Johnson quarry, **Albany**. The crystals can be deeply striated. Small crystals can grow out of the side of the crystals and some "jackstraw" clusters are known. A "gunmetal blue" tarnish is sometimes found on the crystals. Faulkner (1953a) noted of Pingree Ledge quarry, Albany: "Columbite occurs in feldspar as thin crystals like the quartz in graphic granite."

Pulsifer quarry, **Auburn** "columbite" is scarce and crystals are generally poor. Brownish-red internal reflections indicate a manganocolumbite character (see results of study in second volume of this work). Schaller (1907) reported on some crystallographically interesting manganotantalite crystals (q.v.) from "Mount Apatite" which may have come from the Pulsifer quarry.

Rectangular-bladed to chisel-pointed prismatic columbite crystals (to 4 mm) occur in albite at the West Booker quarry, **Bow-doinham**, and the columbite sometimes occurs as surface inclusions in golden beryl.

Columbite with a small titanium component (this study) is found at the LaChance quarry, **Brunswick**. It can be found as bladed, multiply terminated crystals (to 1+ cm), sometimes with a blue iridescent tarnish, in smoky quartz associated with microcline. An unusual association includes single columbite crystals (to 3 mm), as well as sprays, grown on golden beryl crystal faces,

occasionally as inclusions in the beryl. Minute masses (1-2 mm) of red microlite can be associated in albite matrix.

Bladed, rectangular columbite crystals (to 3 x 1 x 0.2 cm) were found at the Consolidated quarry, **Georgetown** embedded in compact cleavelandite, sometimes extending into smoky quartz and muscovite, and sometimes associated with zircon (to 6 mm).

The Wheeler quarry, **Gilead** has provided 2-3 cm terminated crystals of columbite frozen in matrix.

Thin rectangular, bladed manganocolumbite crystals, as well as prismatic crystals, are found in the cleavelandite and green elbaite matrix at the Harvard quarry, **Greenwood**. Heikkinen quarry columbite has tan zircon crystals (to 2 mm) attached to the crystal blades.

Columbite in sunstone was listed from an unspecified rock type, Straw Hill area, **Newfield** by Carpenter (1953), but a chemical analysis and XRD (this study) showed that Carpenter's original specimen is pyrophanite (q.v.).

A particularly fine bright, tabular columbite crystal (to 17 cm; HU 119313) came from the Bell pit, **Newry**; this crystal is one of the finest columbite crystals in the world. Abundant low grade specimens were also recovered during the brief mining periods at the Bell pit. Both the Bell Pit and the Nevel quarry, **Newry** produced some unusually lustrous thin bladed to platy columbite crystals (to 5⁺ x 5⁺ cm). Frank Perham (1964) reported of the Nevel quarry, **Newry**: "Columbite crystals over a foot long were seen in the walls during mining operations."

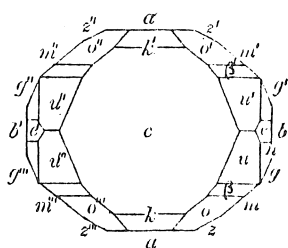
Fraser (1930) noted of the Dunton quarry, **Newry**: "Columbite is present in two distinct generations. The first generation occurs in excellent crystals and is definitely earlier than the cleavelandite. Some of these crystals reach a maximum of four inches in length. The second generation, chiefly manganocolumbite, is formed as platy masses, intergrown with or replacing cleavelandite or intersecting tourmaline. Sometimes the columbite [which?] is seen as flat thin crystals formed between the lepidolite 'books'." Columbite probably does not occur at the Dunton quarry. Only manganocolumbite members of the columbite series have been quantitatively analyzed from there (Shainin and Dellwig, 1955; also data for this study).

The Three Ledges quarry, **Newry** has produced large columbite plates (to 7 cm) with brown zircon crystals (to 4 mm) attached.

Platy "columbite" crystals frozen in albite and quartz from the Mount Mica quarries, **Paris** have a reddish brown internal reflection in them and are manganocolumbite (q.v.).

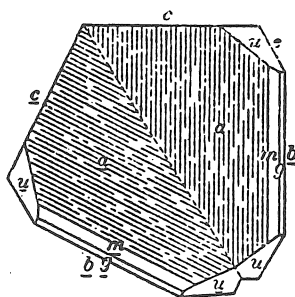
Much of the platy mineral frozen in cleavelandite at the Black Mountain quarry, **Rumford** is actually manganocolumbite. However, some free-standing crystals in cleavelandite have a rhombic cross-section, horizontal striations, and a four-faced termination. The latter have a composition in the columbite field, but are very manganocolumbite and tantalite (this study).

Columbites from an unspecified locality in **Standish** were at one time regarded to be the best small crystals of the species in the world: "The crystals of columbite obtained a few years



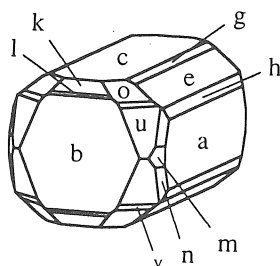
Standish

(from Dana, 1886)



Standish

(from Goldschmidt, 1913)



Standish

(data from Dana, 1886)

Columbite

since from Standish, Maine, largely through the active efforts of Professor O. D. Allen, are well known for their brilliant luster and perfection of form. In these respects they are far superior to those from any other known locality" (Dana, 1886). The report of Morrill et al. (1958) that the crystals came from a feldspar quarry in Steep Falls village, Standish, have failed to direct collectors to any columbite. A quarry on Oak Hill, near Standish village, has yielded poor fragmental columbite, but nothing resembling the exceptional old-time crystals (Terry Szenics, personal communication, 1990). The locality has to be regarded as the most significant "lost" locality in Maine. Dolloff (1936) unconvincingly suggested that the Oak Hill prospect is the same as the columbite locality of Dana (1886): "Columbite was found as plates several millimeters in diameter piercing plates of muscovite." The mirror-faced columbite crystals were generally less than 6 cm. Two Standish columbite specimens (AMNH 14426, 14428) consist of sharp, mirror-faced black crystals (1.4 x 0.9 x 0.8 and 1.2 x 0.7 x 0.9 cm, respectively) embedded in light smoky quartz and cream to tan microcline matrix. (Some of the microcline grains show crystal faces to 1.5 cm.) Minor black dendritic to sooty coatings as well as muscovite flakes are associated. The latter specimen was obtained by Clarence Bement from Oscar Allen in 1877. The former specimen was purchased from Louis Stadtmueller for the princely sum of \$75.00 (then two to three months salary for a common laborer).

Symmetrical rectangular and blocky columbite crystals (to 1 cm) are abundant at the Lord Hill quarry, **Stoneham**. The matrix includes massive albite and quartz, as well as vugs in coarse cleavelandite with late stage minerals such as eosphorite crystals (to 3 mm), montmorillonite, hydroxyl-herderite crystals

(to 2 mm), quartz crystals (to 6 mm), fragmental beryllonite crystals (to 7 mm), and an orange-brown resinous mineral with a rod-like shape (to 4 mm). Kunz (1883a) wrote of the Lord Hill quarry: "... columbite, one mass of the latter weighing over seventeen pounds..." Kunz (1884a₂) noted: "Columbite was scattered through the cleavelandite in crystals from 1mm. to 10mm. in length. A number of acicular crystals bunched together resembled a fibrous structure." Woodard (1951) reported on the crystallography and composition of Lord Hill quarry columbite.

Putnam and Perham (1968) wrote of **Stow**: "Columbite and cleavelandite have been reported from a brook near Shell Pond in the Stow, Maine, area. Has anyone seen any lately?"

Large columbite crystals have been found at the Fisher and Trenton quarries, **Topsham**. Crystals weighing over 8 kg are spoken about in the folklore of the area (Seaman, 1975b). Large crystals from unspecified localities in Topsham show typical tabular development of columbite with edge modifying faces. Some of the columbite of the Trenton quarry, Topsham can be found embedded in microcline with chisel point terminations. Wheeler and Wheeler (1878) noted of columbite in Topsham: "Large and perfect crystals have been found at Fisher's quarry. One specimen weighed upwards of two pounds. It is found also at the railroad cut near the upper bridge." One unusual columbite crystal (2 x 1 cm) from the Fisher quarry is enclosed in a well-formed almandine crystal (5x5 cm).

The William Willes #1 quarry, Topsham has produced some very large columbite crystals (to 15 x 15 x 5 cm).

Sharp prismatic columbite crystals (to 4 mm) are found with an orange-brown resinous mineral frozen in pale salmon orange microcline at the Russell Brothers quarries, Topsham.

Small (2-3 mm) bladed columbite has been found in albite at the Swamp #1 quarry, Topsham.

Columbite has been found at the Starrett quarry, **Warren** in lustrous, well-formed flat rectangular black crystals (to 3 cm) in orange to brown stained muscovite - quartz - albite pegmatite.

***COOKEITE (Chlorite Group)**

Albany? - Bumpus Q; **Auburn** - Greenlaw Q, Hatch Farm Q, Maine Feldspar Q, Pulsifer Q; **Buckfield** - Bennett Q, Westinghouse Q; **Cape Elizabeth?**; **Georgetown** - Tourmaline P; **Greenwood** - Emmons Q, Harvard Q, Tamminen Q, Waisanen Q; **Hebron** - Mount Rubellite Q; **Hollis** - Hollis Center road cut; **Newry** - Dunton Q, Nevel Q; **Norway** - BB# 7 Q; **Paris** - Mount Marie Q, Mount Mica Q; **Poland** - Berry-Havey Q; **Rumford?** - Black Mountain Q; **Standish?** - Oak Hill road cut; **Stoneham?** - Lord Hill Q; **Topsham** - Fisher Q; **West Paris?**

Maine has the type localities for cookeite. Cookeite was first observed by Shepard (1830) at Mount Mica, Paris, but he misidentified it as talc. George Brush (1866) examined speci-

mens from both Mount Mica and Mount Rubellite, Hebron and determined that the material was unique and named the species:

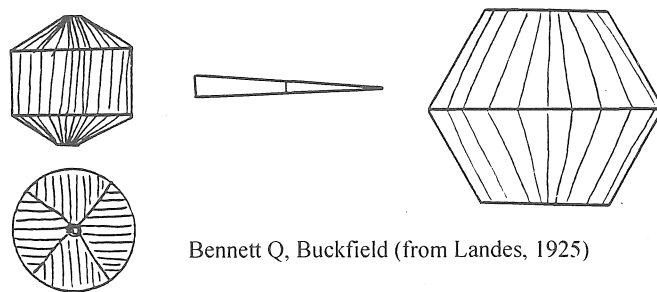
"Associated with the tourmaline and lepidolite of Hebron and Paris, Maine, there occurs a pearly micaceous mineral somewhat resembling *nacrite*. In searching for amblygonite on the Hebron specimens of lepidolite, Professor Cooke of Cambridge, some three or four years since, discovered that this substance had very remarkable pyrognostic characters. Before the blowpipe it exfoliates like vermiculite or foliated pyrophyllite, at the same time imparting an intense lithia-red color to the flame. Professor Cooke called my attention to this mineral at the time of his observation of its properties, but it was not until I visited the locality in 1863, that I obtained the mineral in sufficient quantity and purity to make further investigations in regard to it.

It is found coating crystals of rubellite, and appears to be a product of alteration of this variety of tourmaline; in many instances cavities in the rubellite are filled with the nacreous substance. It is also intimately associated with lepidolite, sometimes in extremely minute scales, and not infrequently in hemispherical aggregations; more rarely it is found in distinct six-sided prisms, which are bent into a vermiform like some varieties of chlorite. In most cases it occurs so mixed with the tourmaline and lepidolite as to preclude the possibility of its being selected free from these minerals."

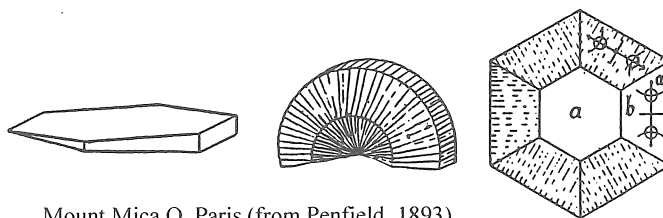
True (1869) expressed his opinion: "This new species named by Prof. Brush, of Yale College, for Prof. Cooke, of Harvard University, is found at Mt. Mica, associated with the colored tourmalines. It is doubtful if it maintains the character of a distinct species."

Cookeite is present in many of the gem pocket assemblages in Maine pegmatite as well as gem pegmatites in Brazil and elsewhere. Quensel (1937b) noted cookeite from Varuträsk, Sweden; Wait-a-bit Creek, British Columbia, Canada; Padar, Kashmir, Pakistan; and Catelnaud-de-Brassac, Tarn, France. Cookeite is becoming increasingly widespread in its discovery and is found in a variety of environments other than late stage pegmatite formations. (Note: Cookeite was named for Josiah Cooke and is pronounced cook - ite {the e's are silent}. It is not pronounced cook - ie - ite.)

Cookeite is abundant at several of the gem pegmatites in **Auburn**. The Pulsifer quarry has a variety of slightly different kinds of cookeite. In one instance, cookeite botryoids (to 3 mm) are spherical rosettes with a few individual platelets jutting out of the cluster and the edges of the clusters sparkle with the extra reflection provided, in addition to sharp, pseudohexagonal micaceous vermiform aggregates typical of chlorite group minerals. The color varies from tan to gray-green and dark rosy purple. Associated species include fluorapatite (lilac to purple and clear), quartz (milky to clear), valencianite or zygadite varieties of albite, and transparent hydroxyl-herderite. The Pulsifer quarry, Auburn (as well as the Tamminen quarry, Greenwood) has produced some of the prettiest cookeite known, despite the discovery of the gray-green to gray-blue Saline county, Arkansas specimens which occur as rounded botryoidal groupings with



Bennett Q, Buckfield (from Landes, 1925)



Mount Mica Q, Paris (from Penfield, 1893)

Cookeite

individual spheres to 7 mm (Wilson, 1986). On a few occasions, very deep raspberry-purple clusters from the Pulsifer quarry have been found on a backdrop of tan microcline. These clusters reach 2-3 mm.

Bennett quarry, **Buckfield** cookeite is similar in its crystal aggregates to the Auburn specimens. The radial rosettes have micaceous edges projecting out of the clusters and the edges add a sparkle to the specimens when viewed with magnification. The cookeite coats cleavelandite surfaces or forms cavernous coatings on all surfaces of large flat crystal shards which have been partly replaced by cookeite or lepidolite. The "walls" of the caverns are constructed of thin "shells" of cookeite which intersect in a distorted "house-of-cards" fashion. Quartz crystals (to 1 cm) are sprinkled over the cookeite. Associated species include hydroxyl-herderite (to 1 cm), green elbaite (to 1 cm), and albite crystals (to 8 mm). The color of the cookeite is usually orange-tan, but yellow-green and even rare bright pink colors are also found. Large pure clumps composed of small aggregates can weigh several kilograms. Frequently, cookeite occurs as hollow epimorphs (to several cm) whose interior can be wedge-shaped to rectangular.

Cookeite botryoids (to 2 mm) are found in cleavelandite at the Harvard quarry, **Greenwood**. The cookeite glistens on the projecting crystal edges and varies in color from white and tan through yellow-green with occasional specimens being pink or orange. The cookeite is found lining healed fractures in green corroded elbaite and is abundantly found through the cleavelandite vugs. Sometimes the cookeite occurs in cellular aggregates with a banding suggesting that the cookeite was crystallized along cleavage traces of a pre-existing mineral. Small well-formed, parallel growth, quartz crystals (to 1 x 0.3 cm) are usually found in the cellular openings. (Similar specimens have been found at the Tamminen quarry, Greenwood and

the Mount Marie quarries, **Paris** [much of the Mount Marie quarry cookeite is bright rose pink.] Associated species include blue and lilac colored fluorapatite, bertrandite, cassiterite, and quartz - all in crystals. Some Harvard quarry elbaite crystals have been replaced by cookeite (fine-grained and generally a light creamy to very pale yellow-green color) or at least have their etched cores infilled by fine-grained cookeite. Such combinations have erroneously been called "cucumber" tourmaline, but as the specimens consist of two species, this varietal name usage is improper.

Tamminen quarry, Greenwood cookeite forms silvery to gray-green rosettes (to 3 mm) which form large masses (10+ cm). Fine-grained pink cookeite with lepidolite flake inclusions (to 13 mm) with quartz has been observed replacing some petalite. Some very beautiful purple cookeite (to 2 mm) is found at the Tamminen quarry in etched vugs in quartz, etc.

Waisanen quarry, Greenwood cookeite forms tan to yellow-gray to gray-green botryoids (to 2 mm) with quartz crystals (to many centimeters), bertrandite crystals (generally 3 mm or less), and hydroxyl-herderite crystals (to 5 cm). Additional associated minerals include muscovite (to 3 mm), goethite pseudomorphs of pyrite (to 1 mm), and fluorapatite crystals (q.v.). The cookeite constitutes perhaps less than half of the mica present. The cookeite forms glistening rounded botryoidal clusters while the muscovite forms loose scales or flat stacks of varying-sized discs.

Mount Rubellite quarry, **Hebron** is the co-type locality along with Mount Mica quarry. At the Mount Rubellite quarry, cookeite can form pink through tan or green ribbed botryoidal clusters which have an oily luster. Fine-grained light gray-green cookeite casts after tourmaline and other minerals are frequently studded with clear quartz crystals (generally several mm, but to several cm). The cookeite is unctuous and shows typical clusters (to several mm) belying its chlorite relationships. Penfield (1893) wrote a composite description of cookeite based on recently collected specimens from Paris and Hebron: "Cookeite is related to the chlorites and micas, having a distinct basal cleavage and crystallizing like them in the monoclinic system. The largest crystals that the author has observed are not over 3^{mm}, in diameter and are hexagonal in habit. Distinct six-sided prisms are rarely found; the crystals are usually radial as if made from a series of wedge-shaped hexagonal plates ... grouped with their thin edges together... The form is something like that of prochlorite, figured on page 653 of the sixth edition of Dana's Mineralogy, only more bent. The exterior of the crystals is rather rough, so that they look almost hemispherical or globular."

Dolloff (1930) listed cookeite from a road cut in Hollis Center, **Hollis**, but the optical data given could fit many different micas. No specimens known.

The Dunton quarry, Newry cookeite is scarce. It can be found as 2 mm pseudo-hexagonal clusters, sometimes haphazardly grouped as well as occasionally vermiform, which have a snow-white color. It is associated with the cleavelandite - and beryllonite - bearing associations of the gem pocket assemblage.

Cookeite from this location can resemble white perhamite. Fraser (1930) listed cookeite among "Group 3" minerals and observed: "In places it appears as an alteration product after cleavelandite."

Tan to white cookeite crystals (to 2 mm) of typical vermiform shape are found intersprinkled between free-standing muscovite crystals (to 1+ cm) on albite, occasionally with rose quartz crystals, at the Nevel quarry, Newry.

Shepard's (1830) description of the Mount Mica quarry, **Paris** cookeite is still useful: "The *Crystallized Talc* is found in quartzose cavities among the lepidolite, and coating the larger crystals of green Tourmaline, that occur imbedded in the Mica. To the naked eye, the crystals appear to consist of globular masses; but under the microscope, they present the aspect of the frustra of two cones, applied base to base, the curved superficies of which are channeled lengthwise. It is so minute a mineral as scarcely to attract attention." The description could also be applied to other members of the mica subgroup it belongs to: chlorite. The Mount Mica quarry cookeite is usually colored various shades of yellow, yellow-green, orange, and tan. The mineral is actually pseudo-hexagonal and platy. The crystal plates (1-2 mm in cross-section maximum) are further stacked with continuous offsets forming an aggregate which forms the vermiform or "worm-like" cluster for which all chlorites are known. Clusters can close in on themselves (to 3-4 mm) or wind across the matrix for several centimeters. Single, ungrouped crystals are very scarce. Occasionally, thin crystal scales are sufficiently offset from the main cluster to show the edges of the hexagonal plates. The mineral is very common at the Mount Mica quarry and is found in the gem pocket assemblage fortuitously associated with these species rather than systematically. In many cases, the cookeite appears to be "cementing" broken fragments of tourmaline and quartz and thus represents a late mineral in gem pocket formation. Large clumps composed of these small aggregates can weigh several kilograms. Quartz crystals from Mount Mica quarry frequently have cookeite in-filled seams, "worm trails", or sinuous etched crevices where the later mineral "attacked" the former. The cookeite usually forms continuous mats and masses, but the pattern is apparent when the quartz crystals are separated from matrix.

Large cellular masses (to 20 cm) of cookeite crystals from the Mount Mica quarry can coat variously colored elbaite crystals (to 5 cm), but may actually be hollow epimorphs with internal striations indicating the former contact with elbaite. The internal surfaces of the epimorphs occasionally have quartz crystals (to 4 mm) on them.

Verrow (1941) did not list cookeite from the Black Mountain quarry, **Rumford**, but Morrill et al. (1958) did. No specimens have been available for examination. Francis et al. (1993) continued the earlier report.

Dolloff (1936) wrote of a mineral he called cookeite from the, now graded, Oak Hill road cut, **Standish**: "The mica mentioned as occurring in cavities of albite is yellow, occurs as tiny plates in masses, and gives a slight test for lithia in the flame. Its appearance is much like that of cookeite found in York County,

and at Buckfield, Maine." The mineral was probably lithian muscovite. No specimens known.

Cookeite is a scarce mineral at the Lord Hill quarry, **Stoneham** and may be, in fact, misidentified. A micaceous to globular mineral forms tan to pale yellow green granular clusters (to 1 mm) between cleavelandite blades. Specimens so far observed, previously identified by folklore methods, have been re-identified as muscovite. The muscovite granules show some radial lamination, but the texture is unlike cookeite's very organized appearance.

The Fisher quarry, **Topsham** has pale yellow to golden or tan to white cookeite crystals (to 2 mm) in vermiform clusters coating cleavelandite. A single specimen, in a private collection, was shown to us which contained a group of typical vermiform cookeite in cleavelandite, but the specimen is untested. Stewart (1938) said of the Fisher quarry "cookeite": "It is most abundant near the muscovite and appears to have been active in replacing it." The fine scaly pale yellow mica, which frequently has cloudy rims, described by Stewart (1938), is muscovite. The majority of the fine-grained mica coating the pocket minerals is also muscovite.

copiapite? - appears to be a post-mine growth

Acton - Boston-Acton M; **Katahdin Iron Works** - Katahdin Iron Works M; **Waterville**; **Winthrop** - Copperas M

COPPER

Cu

Acton? - Dirigo M; **Appleton?** - Appleton Mining and Smelting M; **Blue Hill** - Douglass M, Mammoth M, Owen M, Stewart M, Twin Lead M; **Brooksville** - Callahan M, Manhattan M; **Buck-sport?** - Coombs P; **Camden?**; **Carroll?** (=Kossuth); **Cherry-field?** - Narraguagus M; **Dixfield?**; **Ellsworth?**; **Hancock?** - Copperopolis M, Emmet M; **Kossuth?**; **Newry?** - Nevel Q; **Penobscot** - Hercules M; **Perry** - Loring Cove A; **Sorrento?** - Boss of the Bay M; **Stoneham?** - Speckled Mountain A; **Sullivan?** - Salem-Sullivan M; **Whiting?** - Cooper M

Copper has been reported from many Maine localities, but specimens are virtually unknown. Most reports might be general statements that "copper" was present to signify copper ore, or were fraudulent reports to signify a rich copper deposit in order to attract investors. Miners and speculators frequently used mine names suggesting a close association with famous mines and mining districts - Hercules, Bisbee, Hecla, Copperopolis, etc. Copper from unspecified locations in Maine (AMNH 50546, 50637) forms irregular masses (to 2 x 0.3 cm) in coppery brown rusty indurated matrix.

Phillips (July 16, 1880) wrote of the Appleton Mining and Smelting Company mine, **Appleton**: "Free copper occurs in small quantities." No specimens known.

Earl (1950b) tentatively reported native copper in small specks on drill core surfaces collected near the Douglass mine, **Blue Hill**: "Abundant native copper (?) in very small flakes on freshly broken face of core. ... Native copper(?) occurs as discontinuous film on fracture surface. Also found as tiny specks imbedded in the rock on freshly broken surface. ... Thin vein of pyrrhotite and chalcopyrite. A few tiny flakes of native copper (?)." Emmons (1910) wrote of the Owen mine, **Blue Hill**: "According to Mr. Arthur Owen thin sheets of native copper have been found in joint planes of the rock."

Stewart (April 16, 1880) wrote of the Twin Lead mine, **Blue Hill**: "The true ore-channel of the lode is a massive, well-defined quartz vein, which is permeated throughout by a variety of metallic elements such as Magnetic Iron, Zinc blende, Mispickel, Arsenical Nickel, Iron Pyrites, Yellow Copper, Native Copper - in thin sheets - chrysocolla, Antimonial Silver, Argentiferous Galena, and other undetermined substances." No specimens known.

On July 29, 1881 (MMJ), it was reported of the Mammoth mine, **Blue Hill**: "Yesterday we broke into considerable *native copper*." No specimens known.

Stewart Mine, the reorganized Atlantic mine, **Blue Hill** had copper reported from it (MMJ, June 17, 1881): "Some very good ore has been encountered. Specimens of which may be seen at this office [MMJ's], and considerable native copper has been found in the seams of the rock." Ore specimens, as described, may have been purchased from a mineral dealer in some western district and brought to Maine. No specimens known.

Copper dendrites are found in limonitic gossan at the Callahan mine, **Brooksville**. The dendrites (to 1 mm) are composed of straight, "bumpy" spikes which are generally coated with cuprite (Gardiner Gregory, personal communication, 1990). The specimen was figured by Gregory (1969).

Native copper was reported from the Manhattan mine, **Brooksville** (MMJ, September 23, 1881). No specimens known.

Native copper was reported from Coombs Property, **Buck-sport** (MMJ, January 27, 1882). No specimens known.

Hitchcock (1862a) wrote of copper in **Kossuth** (= T7R2 NBPP): "Upon page 307 of the Preliminary Report [1861], mention was made of the discovery of native copper in No. 7 [township], near Carroll. The specimens were shown us subsequently, and are the genuine mineral. We made an effort to find the vein, in company with Mr. Levi Bailey, who procured them at first. He was unable to find the exact spot. The rock is coarse granite, and is not promising for such ores. The true locality must be further south-west. The rocks on Nickatou's lake have been described to us in such a way as to make us anxious to explore them for copper." No specimens known.

Copper and red oxide of copper were reported from the Copperopolis mine, **Hancock** (MMJ, May 13, 1881). On June 17, 1881 (MMJ), it was reported: "A large proportion of the slaty wall material which has been taken from the shaft, is fairly red with the oxide of copper, and with thin laminae of pure metallic copper." No specimens known.

The material identified for King (1967) from the Nevel quarry, Newry has recently been shown to be pyrite tarnished to resemble the brown patina of cuprite seen on some native copper from other localities. The reported malachite and cuprite were not observable on the specimen.

Copper was reported along with "copper silicate"(q.v.) (Bartlett, October 15, 1880) from the Hercules mine, **Penobscot** (also reported MMJ, June 3, 1881). No specimens known.

The report (MMJ, July 23, 1880) of native copper on fracture surfaces in rock at the Boss of the Bay "mine," across from Treasure (Sewards) Island, **Sorrento**, is assuredly a false report. The short (5 meter) adit of the Boss of the Bay mine does not apparently intersect any mineralized veins. Quartz veins and stringers are absent, as well. The mine was a stock adventure.

Copper was reported (MMJ, May 28, 1880) from a new mine, near Gardner Lake, **Whiting/Marion**: "Native copper has been discovered, very rich, one of the best surface showings of copper ever found in Maine. - [*Machias Union*. " Morrill and Hinckley (1959) called the prospect the Cooper Copper mine. No specimens known.

copperas

Concord - *The Old Bluff A*; **Dixfield**; **TE**; **East Andover**; **Greenwood**; **Katahdin Iron Works** - *Katahdin Iron Works M*; **Lebanon**; **Lubec** - *West Quoddy Head A*; **Monmouth**; **Portland** - *Jewells Island*; **Wales**; **Winthrop** - *Copperas M*

Copperas is an alteration on rocks and ores consisting of a wide variety of sulfates, etc. It frequently forms as the result of weathering of surfaces exposed by mining, road construction, or other recent excavation activity. Copperas has been reported by Belknap (1785), Jackson (1837a, 1839), Houghton (1861), and Hitchcock (1862b), but no modern determinations have been made. Copperas is sometimes equated with melanterite, but the older usage of the name was inconsistent. Some localities that have what appears to be *native* copperas, such as Katahdin Iron Works etc., may have been sites for the actual manufacture of copperas from pyrite, etc.

Jackson (1837a) wrote of West Quoddy Head, **Lubec**: "A large mass of pyritiferous slate, or slate charged with sulphuret of iron, is found near the light-house, in the lower part of the cliff. Where this rock has been exposed to the action of air and water, the sulphuret of iron has undergone chemical decomposition; the sulphates of iron, alumina, lime and soda are produced, forming an efflorescence on the surface of the rock."

Hitchcock (1861) wrote of Jewells Island, **Portland**: "The rock on Jewell's Island in Casco Bay is a pyritiferous mica schist, or a mica schist highly charged with pyrites. There are three beds of the highly pyritiferous rocks, and these are several rods wide. The rock on the north-west side of the island forms a wall from fifteen to thirty feet high, so that an immense amount of the pyritiferous rock is above the ocean level. Upon the surface of the rock, the substances formed by the decomposition of the

pyrites appear occasionally; which are copperas or the sulphate of iron, and alum or the double sulphate of alumina and potassa [potash]. The same pyritiferous strata crop out on Cape Elizabeth. There was formerly an establishment on Jewell's Island for the manufacture of alum and copperas." Jackson (1838a) discussed the copperas works on Jewells Island.

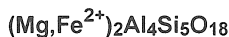
copper pyrite(s) = chalcopyrite

copper silicate?

Penobscot - *Hercules M*

Morrill and Hinckley (1959) report without description or reference that a copper silicate was found at the Hercules mine, **Penobscot**.

CORDIERITE (Cordierite Group)



Attean - *Hog Island A*; **Baileyville** - *Cookson Group, Kendall Mountain Formation, Woodland Formation*; **Beaver Cove** - *Burnt Jacket Mountain A*; **Blue Hill** - *Black Hawk M, Ellsworth Schist*; **Carrabassett Valley** - *public camp site A*; **Carrying Place Town** - *Bates Ridge A*; **Cookson Group** - *Calais, T21*; *cordierite isograd* - **Augusta, Sidney**; *Cupsuptic pluton contact* - **Lower Cupsuptic, Stetsontown, Upper Cupsuptic**; *Cushing Formation* - **Bath, Harpswell, West Bath**; **Edgecomb** - *Fort Edgecomb A*; *Ellsworth Schist* - **Blue Hill, Ellsworth**; *Flagstaff Lake igneous complex* - **Bigelow, Coplin, Dallas, Davis, Dead River, Eustis, Flagstaff, Lang, Rangeley, Stetsontown, Tim Pond**; *Flume Ridge Formation* - **Princeton**; **Gardiner**; **Jackman**; *Kendall Mountain Formation and Pocomoonshine Lake Formation* - **Alexander, Princeton**; **Kennebago Lake quadrangle** - *Greenvale Cove Formation, Perry Mountain Formation, Quimby Formation*; *Kittery Formation* - **Kittery, York**; **Linneus** - *Drew Hill A*; *Lobster Mountain volcanic rocks* - **Chase Stream, Misery, Sapling**; *Lucerne granite contact* - **Carroll, Kossuth, Springfield**; **Monhegan** - *soda aplite dike*; **Monroe**; *Moxie pluton contact* - **Bald Mountain, Big Squaw, Caratunk, East Moxie, Greenville, Indian Stream, Little Squaw, Squaretown**; *Onawa pluton contact* - **Elliotsville, Katahdin Iron Works, Monson, T7R9 NWP**; *Rome-Norridgewock pluton contact* - **Belgrade, Fairfield, Norridgewock, Oakland, Sidney, Starks, Vassalboro**; *Smalls Falls Formation* - **Rumford quadrangle**; **Unity?**; **York** - *Cape Neddick Complex contact aureole*; **T7R9 NWP** - *Third Mountain A*

Cordierite is very inconspicuous, although widespread, in Maine. In hand specimens it very closely resembles granular gray to smoky quartz. A continuous series exists between magnesium-

dominant cordierite and iron-dominant sekaninaite. It is generally associated with biotite in schists. Though widespread in Maine, it is generally best observed in thin sections of rock. Cordierite porphyroblast-bearing rock usually weathers with a pock marked surface

Albee and Boudette (1972) said of **Attean**: "The Seboomook Formation in the inner 0.2 mile of the metamorphic aureole [of the Hog Island Granodiorite] is a dark-gray cordierite hornfels; the hornfels is well exposed on an island in Wood Pond... Blocky cordierite porphyroblasts, typically 5 by 5 by 10 mm, are most abundant in the argillaceous layers and may constitute 25-35 percent of these layers. ... The cordierite porphyroblasts, which may consist of more than one crystal, commonly contain inclusions of quartz, white mica, and chlorite, and many have rims of white mica and chlorite."

Osberg (1968) mapped a cordierite isograd in the southern **Sidney** and northern **Augusta** area and wrote: "Cordierite forms as subhedral hexagonal grains that dissolve out to form pits on a weathered exposure... Under the microscope the porphyroblasts are 7 mm to 1 cm in length. Commonly cordierite is sieved by biotite, quartz, and some muscovite."

Lindgren (1925) mentions, but does not describe cordierite from the Ellsworth Schist contact with unspecified ore deposits in **Blue Hill**. He does, however, draw several conclusions:

"The ore deposits occur from one quarter to one mile from the contact and form lenticular masses of pyritic ore which grade into the schist. ... When Mr. Thompson's specimens were examined in the petrographic laboratory of the Massachusetts Institute of Technology, it was soon found that cordierite was an abundant and characteristic mineral. The ores are indeed a replacement of the schist in which they form lenticular bodies. The schist in this district contains quartz, biotite and chlorite as principal constituents. By replacement in the schist large quantities of cordierite and more or less anthophyllite have been formed together with additional biotite; there is also in places aggregates of apatite, developed at the same time as the rest of the mineralization. The cordierite is frequently altered to sericitic aggregates. The metallic minerals include magnetite, pyrite, pyrrhotite (with some pentlandite), chalcopyrite, molybdenite and some sphalerite, rarely galena.

This type of mineralization now found for the first time in America was formed at a high temperature, and I believe there can be no reasonable doubt that it was produced by emanations from the granite which outcrops in the close vicinity."

Forsyth (1953) also reported cordierite from **Blue Hill**.

At the Black Hawk mine, **Blue Hill**, cordierite forms gray fine-grained "spots" (to 4 cm across) embedded in brown biotite schist. Li (1942) wrote of the Ellsworth Schist, **Blue Hill**: "The cordierite, though in large grains, lacks clear-cut crystal boundary and often intergrows with andalusite and other minerals." Yates and Howd (1988) reported on the chemical composition of cordierite from the Black Hawk mine.

Ludman (1978) noted of the Cookson Formation, **Calais** and **T21**: "The bulk of the Cookson Formation is composed of

variably bedded rusty-weathering pyritiferous metasandstone with carbonaceous and non-carbonaceous metapelite. ... Abundant 5mm cordierite crystals and andalusite prisms the size and shape of rice grains impart a characteristic appearance to these rocks at the appropriate metamorphic grade." Ludman (1986, 1990a) noted cordierite while further defining the Cookson Group comprised of the **Calais**, **Kendall Mountain**, and **Woodland Formations** and noted the cordierite-bearing **Pocomoonshine Lake** and **Flume Ridge Formations** variously exposed in **Alexander**, **Baileyville**, **Crawford**, **Indian Township**, **Princeton**, **T26 ED BPP**, and **T27ED BPP**. Minor cordierite was noted in the migmatite zone of the **Digdeguash Formation**.

Boone (1973) reported of **Carrying Place Town**: "Cordierite appears southwest of the highest elevation on the Appalachian Trail where it crosses Bates Ridge, and persists as a major constituent of both metapelite and metagraywacke, even into the areas of highest grade metamorphism. ... Across the southwestern part of Bates Ridge the formation consists of muscovite-biotite-rich, cordierite-bearing knotted phyllite and schist (knotenschiefer) and massively bedded cordieritic metagraywacke and metaquartzwacke. ... Granofels in the alkali feldspar + cordierite zone [near Roundtop Mountain] becomes coarser and somewhat more massive with the disappearance of muscovite, but microscopically it retains a foliation marked by biotite and by elongate grains of quartz and feldspars in certain layers. ... Cordierite is characteristically polygonal in outline, rather free of inclusions, and not abundantly twinned. Sections stained for cordierite and both feldspars ... clearly show that the relative abundances of plagioclase, micropertthite and cordierite vary noticeably from one layer to the next..."

Boone et al. (1989) wrote of **Chase Stream**, **Misery**, and **Sapling**: "Pelitic beds within the Lobster Mountain volcanoclastic succession developed porphyroblastic cordierite where contact metamorphosed close to feeder dikes of the Middle to Late Ordovician volcanic succession."

Hussey (1988) writing of the **Cushing Formation**, **Bath**, **Harpwell**, and **West Bath** reported: "... the Yarmouth Island member, consists of weakly thin-bedded to massive, felsic to intermediate metavolcanic rocks with interbedded sillimanite and/or staurolite-bearing feldspathic gneisses, and zones of calc-silicate gneiss and amphibolite up to 20 m thick. Gedrite and cordierite are common in the felsic to intermediate metavolcanic rocks."

Griscom (1960) wrote of cordierite from near a public camp site between **Carrabassett** and **Bigelow**, **Carrabassett Valley**: "The norite then grades rapidly into a biotite diorite which locally contains up to seventy percent garnet. Occasionally cordierite inclusions occur."

Nielsen et al. (1989) wrote of the **Flagstaff Lake** igneous complex, **Bigelow**, **Coplin**, **Dallas**, **Davis**, **Dead River**, **Eustis**, **Flagstaff**, **Lang**, **Rangeley**, **Tim Pond**, and **T3R4 BKP WKR**: "Samples near the metamorphic contact contain the most cordierite and garnet, both of which commonly show textural evidence of resorption and/or re-equilibration (rounded crystal

forms, biotite reaction rims)." The chemical analyses of cordierite from the garnet gabbros of Nielsen et al. (1989) approach, but do not reach, sekaninaite in composition. Boone (1973) indicated that the high percentage cordierite-bearing rocks of the Long Falls area, **Flagstaff** have a strong purple tint associated with them. The rock resembles an even-grained (to 3 mm) red to purple brown granular crystalline rock (Gary Boone, personal communication, 1990). Griscom (1960) noted along Route #16, **Dallas**: "Dynamited boulders of garnet-bearing gabbro and diorite are abundant along the road for the next five miles. Many boulders [sic] contain inclusions of massive bluish-gray cordierite."

Boudette (1991) mapped the **Kennebago Lake quadrangle** and observed cordierite in the Greenvale Cove, Perry Mountain, and Quimby Formations. Of the Greenvale Cove Formation, Boudette (1991) reported: "Cordierite, andalusite, garnet, and sillimanite variably present, dependent upon proximity of rocks to Devonian intrusives [e.g. Elephants Head, Redington, and Spider Lake plutons]." In the Perry Mountain Formation: "Biotite, cordierite, and andalusite progressively developed with increasing grade of contact metamorphism in aureole of Flagstaff Lake pluton." In the Quimby Formation, Boudette (1991) reported: "Cordierite and andalusite (some chiastolite) and garnet porphyroblasts as much as 15 mm across variably developed."

Houston (1956) mapped a cordierite hornfels along the western margin of the Drew Hill deposit southwest of Meduxnekeag Stream, **Linneus**.

Dark gray phyllite and schist forming the northern contact zone with the Lucerne granite, **Carroll**, **Kossuth**, and **Springfield** has sulfide pods and contact metamorphic mineral assemblages (Doyle et al., 1961): "Accessory minerals include hornblende, chlorite and occasional crystals of cordierite. The sulfide zones of possible economic significance are widely exposed in this black schist and phyllite unit."

The sillimanite-grade zone of the Moxie pluton contact, **Big Squaw**, **Greenville**, **Little Squaw**, and **Squaretown** was mapped by Espenshade and Boudette (1964, 1967): "Sillimanite and cordierite occur with andalusite in pelitic hornfels and diopside in calc-silicate hornfels nearest to the intrusions." Espenshade and Boudette (1967) further reported cordierite from Big Squaw, Greenville, Harfords Point, Little Squaw, and Squaretown: "Sillimanite and cordierite occur at many places in a zone as much as several thousand feet wide adjacent to the Moxie pluton, but they seem to be absent at some places near the contact of the pluton... Cordierite forms small rounded grains, commonly 0.1-0.4 mm in size, that contain inclusions of quartz, biotite, and opaque minerals. Where most abundant, it composes about 25 percent of the rock and may give the rock a dark blue color. Spinel occurs with cordierite and orthopyroxene in some hornfels inclusions in the Moxie pluton." Newell (1978) mapped the sillimanite-cordierite zone of the southern Moxie pluton area, **Caratunk** and **Bald Mountain**. The contact zone probably

extends through **East Moxie** and **Indian Pond** to the area mapped by Espenshade and Boudette (1967).

The contact zone of the Cupsuptic pluton, **Lower Cupsuptic**, **Stetsontown**, and **Upper Cupsuptic** contains abundant cordierite porphyroblasts (to 3 mm) some of which served as the experimental material to establish the thermal exocontact action of the pluton (Harwood and Larson, 1969). Harwood (1966) noted: "Dark gray hornfels with large cordierite porphyroblasts; 2450' elevation 900' due west of 2660' summit of Cupsuptic Mountain" and noted, in general: "Commonly black or bluish-black grains of cordierite are visible on the fresh surface of the rock."

Lord (1900) noted cordierite in a soda aplite dike, **Monhegan**.

Philbrick (1936) reported on the contact metamorphism aureole around the Onawa pluton which extends from **Monson**, **Elliotville**, **T7R9 NWP**, to **Katahdin Iron Works**. At one location (T7R9 NWP): "about 600 feet northwest of the summit of Third Mountain ... Cordierite occurs as small cyclic twins with anhedral outline and attains a maximum size of less than 0.3 mm."

Osberg (1988) wrote on the contact metamorphic effects of the Rome/Norridgewock pluton, **Belgrade**, **Fairfield**, **Norridgewock**, **Oakland**, **Sidney**, **Starks**, and **Vassalboro**: "The middle-grade zone is based on the first appearance of andalusite, cordierite, or staurolite in pelitic rocks and on the first appearance of amphibole plus calcic plagioclase ($An_{60}-An_{95}$) in calcareous wackes."

Guidotti et al. (1975) used cordierite associated with biotite and chlorite from the Smalls Falls Formation in the Rumford quadrangle to develop models of metamorphic stability for the area.

Large masses (to 8 cm) of gray cordierite which are partly altered to clinocllore along fracture planes are labeled **Unity**, Maine (AMNH), but resemble specimens from Unity, New Hampshire. No known Unity, Maine occurrence.

Arthur Hussey (personal communication, 1992) indicated of the cordierite in **York**: "Deep blue cordierite in grains up to 5 mm, and patches of small grains up to 3-4 cm are conspicuously developed in the innermost part of the contact aureole around the Cape Neddick complex in York. Best locality I have seen [in Maine] for cordierite."

CORUNDUM (Hematite Group)

Al₂O₃

Andover?; **Arrowsic?** - *Arrowsic Emery M*; **Bath?** - *City Q*; **Blue Hill** - *Black Hawk M, Long Island A?*; **Carrabassett Valley** - *Owls Head A*; **Georgetown** - *Cape Elizabeth Formation*; **Gilead?** (alumina?); **Greenwood?** - *La Forest M?*; **Willis Mill A?**; **Harpwell** - *Ash's Point A, Whites Point A*; **Litchfield** - *Dennis Hill A*; **Newry?** - *Dunton Q*; **Paris?** - *Hoopers Ledge Q?*; **Rumford?** - *Goddard*

Ledge Q; Saco Bay - Biddeford, Old Orchard Beach, Saco, Scarborough; Smyrna?; Stoneham? - Harndon Hill Q, Sugar Hill A ?; Topsham?; Winthrop

Corundum is rare in Maine. Corundum is a mineral that requires special rock compositions or conditions to form. Typically, quartz-rich rocks such as granite pegmatite, granite, etc. do not have corundum in them as alumina is so reactive with silica that aluminosilicates such as andalusite or sillimanite would preferentially form or, more likely, alkali-bearing aluminosilicates such as feldspars, etc.

Burr (undated b) indicated that "emery" from **Arrowsic** is a garnet and is not true emery. The Arrowsic mine has garnet identical to that from Georgetown (Arthur Hussey, personal communication, 1990).

Haven noted in his diary October 20, 1940 of **Bath** (Morrill, 1966): "It was late when we started and we went to the Bath City Quarry where we collected corundum, hornblend[e], vivianite, and pyrrhotite alterations." No corundum specimens known.

Yates and Howd (1988) wrote of the Black Hawk mine, **Blue Hill**: "Corundum is present in BHE15 ... where it is armored by andalusite, cordierite, and retrograde muscovite and includes grains of gahnite, rutile, and sulfide. Corundum has also been described in the Blue Hill area by Gillson and Williams (1929)."

Boone (1973) reported of **Carrabassett Valley** that the rocks of: "The Owls Head roof remnant... are thinly layered, and contain hypersthene, plagioclase, biotite, hercynite-rich spinel, sillimanite, and sparse corundum, in addition to cordierite. Inasmuch as all the Silurian and Devonian pelitic rocks examined outside the confines of the gabbro are quartz-bearing, the rocks here are interpreted to have been desilicated within or adjacent to gabbroic magma."

Though corundum is cited from **Greenwood** (Dana, 1892; Pratt, 1906; Petar, 1929), even with mention of faceted stones (Putnam and Perham, 1968; Perham, 1987a), no reasonable outcrop area is known (Guidotti, 1965a; Osberg et al., 1985). No data have ever been reported to substantiate the find. Verrill (1863) was recognized for his activity at the Boston Society of Natural History: "Mr. A. E. Verrill exhibited specimens of Zircon and Corundum from Greenwood, Me. The latter was a hexagonal crystal, one and three quarter inches in length, and an inch in diameter. It occurred with others of similar and larger size in a micaceous schist." In 1869, Dr. N. T. True wrote: "Corundum - Sapphire. This mineral exists in Greenwood, on the authority of Prof. Verrill; but I have not seen it. Some of these are three inches in length." Inexplicably, Dana (1892) said: "...in *Maine*, at Greenwood, in cryst. in mica schist, with beryl, zircon, lepidolite, rare." The associated minerals in "mica schist" are even harder to believe than the corundum, particularly lepidolite. Marble (1948) wrote: "One occurrence of Corundum is reported for Maine. I have visited the spot in Greenwood, but no luck. George Howe showed me a crystal from there." Putnam and Perham (1968) wrote: "According to George Howe, ruby has been reported from the Willis Mill area in Greenwood about fifty years

ago. Has corundum been reported since then? Professor Verrill is said to have reported a 9 ¹/₂ carat blue sapphire from the Willis Mill stream in Greenwood." No appropriate Verrill report is known. "Emery" has been reported from Greenwood (True, 1869; Morrill et al., 1958) and **Andover** (Morrill et al., 1958), but no samples are currently known to verify if the material was true emery consisting of corundum and magnetite or a look-alike for emery consisting of garnet, etc. The reports of corundum from Greenwood are undoubtedly based on misidentification and folklore.

Corundum has been verified by Hussey (1985) in thin sections of large andalusite crystals (7 x 1.5 cm) in quartz-biotite-muscovite schist in the pelitic portions of the Cape Elizabeth Formation exposed at Ash's Point and White's Point, **Harpwell**. Pale blue corundum is seen as visible elongated, irregular inclusions (to 2-3 mm) on broken surfaces of pink andalusite crystals. Found similarly in **Georgetown** (Arthur Hussey, personal communication, 1992).

Corundum has been found in an albitite on southwest Dennis Hill near Dennis Brook and Routes #126 and #9, **Litchfield**. Barker (1965) wrote: "... an albitite pegmatite, cuts metasediments and foliated mafic syenite in the south-west corner of the pluton. It contains antiperthitic albite, muscovite, black tourmaline, epidote, and corundum. ... Corundum occurs in subhedral, hexagonal prisms up to 10 x 15 mm, spotted sky-blue in pale gray-blue, surrounded by white to pale-green mica." Barker (1965) also listed corundum from nepheline syenite, Litchfield: "The nepheline contains 0.5 mm prisms of corundum."

Swanson (1955) reported finding blue corundum in cleavelandite from [Dunton quarry], **Newry** based on a hardness test. The mineral undoubtedly was blue tourmaline.

Morrill (1943) reported on chrysoberyl from an unspecified locality presumed to be Hoopers Ledge quarry, **Paris**. Associated with the chrysoberyl, he observed: "On one side of the large chunk is a very small gemmy golden sapphire." Given the brevity of the report, the material should be presumed misidentified. Wintringham (1962) expressed the same concern.

Morrill et al. (1958) reported corundum from Goddard Ledge quarry, **Rumford**: "Corundum Xls (Red)," but corundum is extremely unlikely to form in a silica-rich pegmatite. No specimens known.

Luepke and Grosz (1986) reported corundum among the heavy minerals in nearshore sediment samples of Saco Bay, **Biddeford, Old Orchard Beach, Saco, and Scarborough**.

Brown (1941), in his lists of minerals found in various states, provided the only mention of "corundum" from Harndon Hill [Lord Hill?] quarry, **Stoneham**: "Topaz, Associated with Corundum." Another Stoneham entry said: "Golden Beryl, Associated with Corundum." Additional entries included: "Sugar Hill" [Stoneham] and "Topsham Feldspar Quarries, Sagadahoc Co. *Corundum ... * denotes fluorescence." These entries are completely unsubstantiated by specimens or by any other reference.

The Yedlin micromount collection (NMNH) contains nine corundum specimens from an unspecified location in **Winthrop**.

COVELLITE

CuS

Blue Hill; Brooksville - Cape Rosier M; **Gouldsboro** - Gouldsboro M; **Hancock** - Copperopolis M; **Kibby; Woolwich?** - U.S. Route #1 road cut; **T3R4 BKP WKR** - Hardin prospect - Kennebago; **T12R8 WELS** - Bald Mountain M

Li (1942) reported of unspecified **Blue Hill** areas: "Chalcopyrite is next in abundance. It is younger than pyrite or pyrrhotite since it fills fractures in pyrite and surrounds and replaces grains of pyrite or pyrrhotite. It surrounds sphalerite which in turn contains small globules of chalcopyrite. In places, chalcopyrite has been cut by secondary covellite veinlets." Description based on microscopic examination.

Covellite is known from the Cape Rosier mine, **Brooksville**. The covellite forms 1 mm, or less, metallic indigo-blue partial hexagonal crystals in vugs in talcose phyllite. Brochantite and linarite are also found in vugs several centimeters away on some specimens.

Li (1942) wrote of the Gouldsboro mine, **Gouldsboro**: "Galena contains small areas of chalcopyrite and indents both chalcopyrite and sphalerite. It is cut and replaced by secondary covellite along the periphery and along the fractures. ... While a small part of the chalcopyrite occurs as small blebs and dots in the sphalerite. Most of it occurs independently and encloses sphalerite. In turn, it is cut by veinlets of secondary minerals."

Li (1942) also reported of the Copperopolis mine, **Hancock**: "Galena replaces chalcopyrite in places. The latter is also traversed by several veinlets of secondary covellite and hydrous iron oxide."

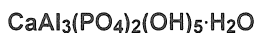
Stan Perham (1963a) reported of **Kibby**: "A report was made to the writer of a vein of lead-silver five feet or more in width in the Kibbey [sic] township. Samples of the mineral covellite taken north of the Kibbey finds have been seen by the writer." The only Kibby location previously mentioned was Kibby Stream.

Donnell (1958) reported covellite with malachite from a U.S. Route #1 road cut, **Woolwich**. The mineral may have been bornite. No covellite specimens known.

The Hardin prospect, now unknown to its exact location, Kennebago, **T3R4 BKP WKR** produced bright metallic blue covellite plates (to 1 cm) intergrown with chalcopyrite in milky quartz. One grain (2 mm) of gold was nearby in one matrix specimen (BC collection).

Covellite from the Bald Mountain mine, **T12R8 WELS** forms minute (less than 1 mm) alteration selvages on chalcopyrite (BC collection).

CRANDALLITE (Crandallite Group)



Mexico? - U.S. Route #2 road cut; **Newry** - Dunton Q, Rose Quartz Crystal A; **Paris** - Mount Mica Q

Crandallite has had a confusing history in Maine. It was originally reported that the ankerite (q.v.) crystal clusters ("*Wheaties*") from the U.S. Route #2 road cut, **Mexico** were crandallite. Frew (1957) wrote: "These tan crystals have been difficult to identify. Some were sent to the Massachusetts Institute of Technology, some to the University of Maine, and several individuals have tested them. As of now, we are calling them Crandallite, as this is the only identification agreed upon by two people. Mr. Jacobs made this identification by x-ray diffraction patterns. Others have identified them as calcite, dolomite, barite, celestite, and ankerite. Some of these crystals have an overgrowth that may be calcite." The mineral is ankerite.

Genuine crandallite has been found at the Dunton quarry, **Newry** (King, 1989c). It is found in blue tourmaline-lined vugs in cleavelandite as well as in interstices in cleavelandite. The tourmaline-lined vugs frequently contain siderite, quartz, secondary phosphates, etc. The crandallite forms complete radiating spherical-rosettes of plates which are generally 1-2 mm. The color varies from white to tan, but can be stained by late-stage minerals such as diadochite, manganese oxides, etc. The material was once sight-identified as fairfieldite (King, 1975b) and Figure 9 of that article illustrated crandallite rosettes and not fairfieldite. The 1-2 mm crystals are among the largest ever found for the species in the world, though multigranular sprays from Blaton, Belgium are spectacular by comparison.

Crandallite crystals and perhamite crystals are nearly visually indistinguishable. Maine crandallite is generally off-white, pink, tan, etc. and very irregular to serrated or corrugated; while perhamite is generally snow-white to colorless, has a pearly luster on the largest face, has generally sharper crystal shape, and forms tighter rosettes than crandallite.

Crandallite has been found as light ashen gray spherical rosettes of platy crystals (to 1 mm) in interstitial cavities in cleavelandite from Mount Mica quarry, **Paris**. Some of the crandallite is found as glassy botryoids which show some individual sharp hexagonal platy crystals extending out of the botryoids (to 2 mm) (Gene Bearss, personal communication, 1991). The Mount Mica quarry crandallite is chemically intermediate between crandallite and goyazite.

cronstedtite? (Serpentine Group)



allochthonous serpentinite - Alder Stream, Jim Pond, Seven Ponds

Boudette (1991) reported cronstedtite from a series of allochthonous serpentinites, **Alder Stream, Jim Pond, Seven Ponds**: "Clinochrysotile serpentinite, soapstone, and virginites - Mottled, waxy dark-green, very fine to fine-grained, massive, carbonate-veined, sheared chloritic talcose serpentinite with or without gradational borders of soapstone (talc-chlorite-magnetite rock), blackwall (chlorite rock and talcose carbonate rock), and virginites (marble-like rock) (see Boudette, 1982). Composed of 90 percent clinochrysotile and magnesian chlorite (not optically distinguishable), 5 percent each of chlorite (cronstedtite [sic], clinochlore, and penninite) and magnetite, and trace amounts of talc, carbonate, chromite, and chromian muscovite. Relicts of olivine and orthopyroxene, sulfide minerals, and both slip and cross-fiber asbestos present in places. ..." Although the name cronstedtite is misspelled, the reason for incomplete acceptance of the identification is based on the apparent method of identification, thin-section analysis. Cronstedtite is a very uncommon iron-rich serpentine containing ferric iron (cf. greenalite). In the absence of detailed chemical analysis, the mineral should be considered only provisionally identified.

cryolite? - appears to be misidentified

Lubec? - *Denbow Point M; Warren?*

Cryolite was listed from the quartz and galena veins of the Denbow Point mine, **Lubec** by Morrill and Hinckley (1959), but the report is probably in error. No specimens known.

"Cryolite" specimens from **Warren** in the O. Ivan Lee collection (AMNH #27666) consist of fine-grained albite and muscovite intergrowths and no cryolite. The name cymatolite might have been intended, as the definition of cymatolite might have been overextended to cover the material in question.

CRYPTOMELANE



Poland - *Berry-Havey Q; Stoneham* - *Lord Hill Q*

Bright to resinous black nearly spherical botryoids (to 0.2 mm) occur tightly bunched in cavities in rusty siderite with fairfieldite in cleavelandite at the Berry-Havey quarry, **Poland** (chemical analysis and XRD, this study). Poorly crystalline cryptomelane might be a common component of black manganese minerals in Maine's pegmatites.

Black botryoids (to 7 mm) of cryptomelane (XRD and chemical analysis, this study) with varying minutely mosaic to cryptocrystalline coarse cross-sectional banding occur in vugs in quartz at the Lord Hill quarry, **Stoneham**. Resinous to pitchy medium brown botryoids (to 2 mm) of goethite can be associated. The surface of the goethite botryoids can be smooth while the cryptomelane botryoids can appear to be minutely stuccoed.

CUBANITE



Brooksville - *Callahan M; Union* - *Harriman P*

Park and Bastille (1973) report cubanite from the Callahan mine, Harborside, **Brooksville** without description. The cubanite undoubtedly formed microscopic brassy yellow grains embedded in chalcopyrite-, sphalerite-, pyrite-bearing ore.

Rainville and Park (1976) say of **Union** material that: "other sulfides that have rarely been observed include bornite, cubanite, galena (R.S. Young, unpub. data), and gersdorffite." No description or indications of precise association are indicated, nor is the size reported. From the entry, it can be surmised that the mineral was seen in only a minimal amount of material and was observable only using high-power magnification. (On a worldwide basis, massive cubanite would closely resemble chalcopyrite in hand specimen.)

CUMMINGTONITE (Amphibole Group)



Ammonoosuc Volcanics - **Grafton, Upton; Andover North Surplus** - *Dunn Notch A, Sawyer Mountain A; Appleton Ridge Formation* - **Appleton, Searsmont; Aziscohos Formation** - **Lincoln Township, Magalloway; Bath; Benner Hill unit** - **Belfast, Belmont, Northport, Searsmont; Big Squaw** - *Big Squaw Mountain trough A, east Big Squaw Pond shore, northwest of Little Notch Pond; central Brooks quadrangle; Brunswick* - *Cooks Corner A; Dallas* - *Route #16 boulders; Flagstaff* - *Flagstaff Lake igneous complex gabbro; Flagstaff Lake pluton* - **Coplin, Dallas, Davis, Eustis, Lang, Rangeley, Stetson town, Tim Pond; garnet granofels** - **Dallas, Davis, Lang, Rangeley; Grafton** - *York Pond outlet A; Greenvale Cove Formation* - **Coplin, Dallas, Eustis, Lang, Redington; Greenville** - *central western Lower Wilson Pond shore; Harfords Point* - *island in Moosehead Lake, west of Harfords Point on Moosehead Lake shore; Harpswell* - *Cushing Formation on Long Point; Little Squaw* - *north of eastern Little Squaw Mountain; calc-silicate gneiss of Penobscot Block* - **Camden, Hope, Lincolnville, Northport; Spring Point Formation** - **Cape Elizabeth, Harpswell, Scarborough, South Portland; Sugarloaf gabbroic massif** - **Carrabassett Valley, Kingfield, Mount Abram; Union** - *Harriman P; Warren* - *Warren Nickel P*

Cummingtonite is an amphibole which can coexist with other amphiboles in the same rock. Its identification has been mostly restricted to thin section observation, and chemical analyses will undoubtedly further divide the reported cummingtonites into additional species.

Milton (1961) wrote of **Andover North Surplus**: "Hornblendite occurs on the south side of Sawyer Mountain, [Andover]

North Surplus... Only a single outcrop was found, but blocks up to 15 feet across occur in float on the hillside. The rock is composed of about 75% amphiboles, about 10% chlorite and 5% each of biotite, apatite, and opaque minerals. The amphiboles form grains up to three inches long arranged in a matted texture that makes the rock extremely tough. The amphiboles are a pale green actinolite and a white cummingtonite usually nearer the rim [of the amphibole grain as seen in thin section]." Hornblende and cummingtonite, as well as hornblende, gedrite, and cummingtonite associations were noted by Milton (1961).

Green (1964) reported cummingtonite from the Aziscohos Formation (A - zis - co - hoss) of **Lincoln Plantation** and **Magalloway**: "Metamorphosed rocks of igneous origin constitute about 5 per cent of the Aziscohos Formation. ... The rocks range from dacitic to basaltic. Most are rather mafic amphibolites, some of which contain cummingtonite."

Cummingtonite was described (Espenshade and Boudette, 1967) from an area between Big Squaw Mountain and Trout Pond Mountain, the eastern shore of Big Squaw Pond, and an area northwest of Little Notch Pond, **Big Squaw**; from near the southern shore of a point on the western shore of Lower Wilson Pond, **Greenville**; from an island in Moosehead Lake, as well as a point on the shore west of Harfords Point, **Harfords Point**; and from a spot north of eastern Little Squaw Mountain, **Little Squaw**: "This monoclinic amphibole, cummingtonite, occurs as colorless crystals that have very pale blue-green borders and as pale-tan crystals. It is commonly twinned and forms large irregular prisms or clusters of fine radiating prisms having fibrous texture. Cummingtonite is very commonly in optical continuity with normal hornblende. It is commonly intergrown with chlorite and replaces plagioclase, orthopyroxene, clinopyroxene, biotite, and hornblende; it tends to replace orthopyroxene more completely than it does clinopyroxene. Carbonate may also be associated with cummingtonite. Cummingtonite is a late mineral that in some places appears to have formed deuterically from residual liquids. It also has formed as an alteration mineral along shear zones or joints." Espenshade (1972) further described cummingtonite from the Moxie pluton: "The low-calcium amphibole cummingtonite is widespread in the various rocks and is particularly abundant in diorite and quartz diorite. It is present in 19 of the 32 samples listed in table 1. Under the microscope, cummingtonite characteristically forms aggregates of long fibrous colorless twinned crystals; it is medium green in hand specimens. Crystal edges adjacent to plagioclase generally have a thin green zone which is probably high-calcium amphibole. Cummingtonite and hornblende are very commonly intergrown. In some rock, orthopyroxene crystals occur within cummingtonite aggregates and appear to be relics of larger crystals that have been partly replaced by cummingtonite. Chlorite and cummingtonite are intergrown in a few rocks, and talc probably occurs with cummingtonite in several places." (Unanalyzed cummingtonite is found in bulk analyzed, iron-rich rocks and associated with ferrosilite and fayalite, whose chemistry was determined by thin

section analysis, which suggests some of the cummingtonite might be iron-rich and could possibly grade into grunerite.) Hon and Schulman (1983) noted the mineral in the Moxie pluton, as well.

Bickel (1974) reported cummingtonite from the garnet, andalusite, and sillimanite zones of the central **Brooks quadrangle**. Bickel (1976) said of the Muzzy Ridge Member of the Appleton Ridge Formation, **Belmont** and **Searsmont**: "Most of the rock in the Muzzy Ridge Member is composed entirely of cummingtonite and garnet with minor biotite, plagioclase, and quartz, and with or without abundant hornblende..." The calc-silicate gneisses of the andalusite through sillimanite - K-feldspar zones of the Penobscot Block (Bickel, 1976), **Camden**, **Hope**, **Lincolnville**, and **Northport** contain minor amounts of cummingtonite. Charles Guidotti (personal communication, 1990) indicated that the cummingtonite of the Gushee Member of the Penobscot Formation and Benner Hill unit, **Belfast**, **Belmont**, **Northport**, and **Searsmont** is a "manganese variety." Kimball (1981) analyzed manganoan cummingtonite from the Muzzy Ridge lentil of the Appleton Ridge Formation, but that material actually corresponds to tirodite (q.v.).

Boone (1970b) noted: "Sparse patches of quartz enclosing cummingtonite..." in gabbro of the Flagstaff Lake igneous complex, near Long Falls of the Dead River, **Flagstaff**. Boudette (1991) reported cummingtonite from the Flagstaff Lake pluton, **Coplin**, **Dallas**, **Davis**, **Eustis**, **Lang**, **Rangeley**, **Stetsontown**, **Tim Pond**: "Characteristic transformation texture shows orthopyroxene enveloped by diallagitic clinopyroxene in turn enveloped by brown hornblende. Some brown hornblende passes irregularly to green amphibole (actinolite) which is irregularly replaced by a colorless amphibole (cummingtonite)." Boudette (1991) also listed cummingtonite/grunerite from a garnet granofels, **Dallas**, **Davis**, **Lang**, and **Rangeley**. Boudette (1991) also noted cummingtonite in the Greenvale Cove Formation: "Apatite present in some rocks; green hornblende and cummingtonite found where rocks become migmatitic."

Kimball (1981) chemically analyzed cummingtonite from the Ammonoosuc Volcanics, **Grafton** and **Upton**: "The second hornblende bearing assemblage is hornblende-cummingtonite-plagioclase-quartz-biotite or chlorite-ilmenite. In this assemblage [cummingtonite] occurs as: 1) small grains (up to 0.1 mm) in contact with cummingtonite... Cummingtonite occurs as distinct laths up to 1.0 mm long. The blades are colorless and contain few inclusions..."

Hussey (1988) described the unusual associations of the Spring Point Formation, **Cape Elizabeth**, **Harpwell**, **Scarborough**, **South Portland**: "The Spring Point Formation consists primarily of metamorphosed basic and intermediate volcanic tuffs and flows. These are represented now by chlorite-spessartite phyllite, actinolite gneiss, and hornblende-garnet amphibolite locally with cummingtonite and rarely anthophyllite." A specimen from the Cushing Formation, **Long Point**, **Harpwell** has light tan to pinkish brown laths (1-3 mm) which give the

fine-grained rock a sparkle (Arthur Hussey, personal communication, 1990). Hussey (personal communication, 1992) added: "I have identified cummingtonite in thin section from many amphibolites and light-colored intermediate metavolcanics of the Cushing and Spring Point Formations in the greater Casco Bay area where the metamorphic grade exceeds that of the garnet zone. At one locality (the first roadcut on the west side of Route #24 south of Cooks Corner, Brunswick) cummingtonite occurs abundantly along with hornblende and gedrite. This outcrop is registered as one of the localities in the Critical Areas Program of the State of Maine."

Boone (1973) listed cummingtonite from the Sugarloaf gabbroic massif, **Carrabassett Valley**, **Kingfield**, and **Mount Abram**.

Rainville and Park (1976) said that the Warren Nickel body, **Warren**: "is composed predominantly of andesine - labradorite, hornblende, cummingtonite, and biotite. ... Augite is present in minor amounts and is extensively uraltized to hornblende and cummingtonite. ... Cummingtonite occurs as radiating aggregates of prismatic crystals commonly with irregular crystal boundaries. Cummingtonite is almost invariably intergrown with hornblende, where both minerals are present, and they appear to be contemporaneous."

CUPRITE

Cu₂O

Blue Hill - *Douglass M*; **Brooksville** - *Cape Rosier M*; **Hancock?** - *Copperopolis M*; **Newry?** - *Nevel Q*; **Pembroke** - *Barrett P*, *Big Hill M?*; **Perry** - *one mile north of Perry*; **Topsham Area?**

Earl (1950b) noted at the Douglass mine, **Blue Hill**: "The ore minerals observed in the pit and on the dump are pyrite, chalcopyrite, pyrrhotite, chalcocite, arsenopyrite, zinc blend, magnetite, and cuprite." No specimens observed.

The Cape Rosier mine, **Brooksville**, produced an interesting assemblage of secondary copper minerals. The cuprite from there is found as dark red octahedral crystals as well as dodecahedral crystals (to 1 mm) on rusty talcose rock. The crystal faces vary from lustrous to dull. Associated species include pale blue-green smithsonite in indistinct crystals, rusty clear to gray prismatic smithsonite crystals (to 1 mm), and malachite needles (to 2 mm). Linarite, brochantite, aurichalcite, and chalcophyllite are rarely associated, as well. Some cuprite is found coating copper dendrites. Carpenter and Foster (1960) were unable to verify cuprite from this locality, but Gregory (1969) stated that it was found both as "octahedrons and capillary crystals."

Copper and red oxide of copper were reported from the Copperopolis mine, **Hancock** (MMJ, May 13, 1881). On June 17, 1881 (MMJ), it was reported: "A large proportion of the slaty wall material which has been taken from the shaft, is fairly red

with the oxide of copper, and with thin laminae of pure metallic copper." No specimens known.

The cuprite from the Nevel quarry, **Newry** identified for King (1967) has been recently re-identified as red tarnished pyrite. The reported associated "malachite" and "copper" have been re-identified as a green Newton's ring in albite and tarnished pyrite, respectively.

Reddish brown cuprite coatings (to 1 mm patches) were thought to be found in vugs at the Big Hill mine, **Pembroke** with magnetite crystals (to 1 mm), hematite crystals (to 1 mm), and quartz crystals (to 2 mm) in chalcopyrite-bearing matrix, but the only specimens observed have reddish brown earthy hematite.

Cuprite from the Barrett prospect, **Pembroke** occurs in 2 mm octahedral as well as complexly formed crystals associated with malachite tufts and clusters (to 4 mm) on rusty surfaces and cavities in fine-grained quartz-mica rock impregnated with chalcopyrite. A few of the dark red cuprite crystals have a partial, barely discernible, malachite coating.

Bastin and Williams (1914) make the enigmatic entry, for **Perry**, concerning vesicular diabase: "on shore 1 mile north of Perry... The filling is mainly white calcite ..., but in a few places fractures and vesicles are coated with a brick-red mixture of iron and copper oxides." The "copper oxides" are probably a whimsical identification. No specimens known.

Wheeler and Wheeler (1878) wrote of **Topsham**, **Brunswick**, and **Harpswell**: "The following minerals have also all been found in some one or more of the three towns, though the exact locality we are unable to designate: Copper Pyrites, Malachite, Calcite, Hematite, Cuprite, Epidite [sic], and Molybdate." No cuprite specimens known.

cyanite = variant spelling of kyanite; also the original spelling

cymatolite = mixture of albite and muscovite

Auburn - *Greenlaw Q*; **Buckfield**; **Newry** - *Dunton Q*; **Norway**; **Peru**; **Rumford** - *Black Mountain Q*; **Stoneham** - *Lord Hill Q*; **Topsham**; **Warren** - *Starrett Q*

Cymatolite is a white fibrous to foliated mixture of intergrown muscovite and albite which usually doesn't quite resemble its component minerals. Cymatolite usually forms as a pseudomorph after spodumene, but can be found replacing specimens whose parent mineral is unrecognizable. The foliated texture is usually curved and the continuity of the texture can range to 10+ x 10+ centimeters. The material is decidedly uncommon in Maine. Most of the noted occurrences are from Morrill et al. (1958).

Cymatolite replacements of spodumene from the Dunton quarry, **Newry** have a dull ashen gray to white, wavy foliated to

wavy fibrous texture. No relict spodumene is evident and the uniform appearance of the pseudomorph disguises the presence of a mica.

Cymatolite very similar to Dunton quarry, Newry specimens has been found at the uppermost pit #5 of the Black

Mountain quarry group, **Rumford** (Neil Wintringham, personal communication, 1992).

cyrtolite - see zircon

D

dahllite (Apatite Group) - a varietal name indicating carbonate-hydroxyl [CO_3OH] substitution for phosphate in hydroxylapatite (q.v.) or fluorapatite (q.v.)

Buckfield - *Bennett Q*; **Newry** - *Dunton Q*, *Rose Quartz Crystal L*, *Scotty Q*; **Paris** - *Mount Mica Q*, *Ryerson Hill Q*; **Poland** - *Berry-Havey Q*; **Rumford** - *Black Mountain Q*

Dahllite is a botryoidal variety of carbonatian apatite, usually hydroxylapatite, but has been assigned to botryoidal carbonatian fluorapatite mostly by collectors. The essential feature of the variety is its botryoidal nature, but collectors have incorrectly called visible *crystals* of hydroxylapatite by the name dahllite. Dahllite and francolite (q.v.) have long-term usage in Maine, but the names should be used consistently. Dahllite usually has a radially fibrous internal texture and can show alternating "growth rings." The chemical difference between dahllite and francolite is not visibly distinguishable and not only might the appearance of these two varieties imperceptibly grade into one another, the fluorine to hydroxyl ratio might vary at a given locality according to the crystallization event which produced the mineral in question. The variety is generally found in vugs and is usually the latest mineral formed and so coats any pre-existing minerals. The color is cream to white, but can vary due to brown iron or black manganese mineral staining.

At the Bennett quarry, **Buckfield**, dahllite is composed of botryoidal masses and grades into rounded, thin tabular crystals of hydroxyl-apatite tightly grouped in branching stacks, nearly simulating botryoids (to 4 mm). Dahllite can be found in vugs in cleavelandite or with transparent quartz crystals (to 5 mm) lining fracture surfaces in pegmatite.

Landes (1925) described Bennett quarry, as well as Mount Mica, Paris and Auburn, dahllite:

"Dahllite... appears in yellowish green crusts coating various minerals... The coating is most striking when eosphorite is the host. Prismatic crystals of that mineral are often completely covered and the terminations rounded off, so that pseudostalactites result. Solution remnants of fairfieldite and rhodochrosite are similarly coated by crusts of dahllite. ...

A minor occurrence of the dahllite was noted in some of the rhodochrosite specimens. Instead of well-defined fibers dahllite here appeared in excessively minute yellowish particles replacing rhodochrosite. ... At Mount Mica dahllite was also observed as a dark green

coating on eosphorite. The prismatic habit of the latter mineral produces pseudostalactites of dahllite similar to those at Buckfield.

Certain specimens from Auburn in the Harvard Mineralogical laboratories contained a mineral in small but well defined white rosettes which coated other minerals. Optical and chemical study proved the unknown to be francolite... which is chemically similar to dahllite, but contains fluorine and differs from that mineral in being biaxial."

Botryoidal dahllite is also white and fills vugs in cleavelandite, Scotty quarry, **Newry** (Faulkner, 1954). The cauliflower-like dahllite has a stellate, radial pattern in cross-section. Dahllite is generally visually indistinguishable from francolite (q.v.). Scotty quarry "dahllite" also forms stacks and rosettes of milky white crystals (to 2 mm), but this material should be simply called hydroxylapatite.

Dahllite has a variety of expressions at the Dunton Gem quarry, Newry. White "carpets" of earthy botryoids line cavities and interstitial voids in cleavelandite. The voids might be only 1 mm or up to many centimeters. Dahllite with eosphorite combinations can be highly prized. Dahllite frequently forms a thin coating on ordinary fluorapatite crystals, but the "coating" is difficult to distinguish from an etched, anion-exchanged exterior.

Brown, tan, and cream-colored botryoids (less than 1 mm each to several millimeters) of dahllite are found lining vugs of crystallized albite at the Rose Quartz Crystal locality on Plumbago Mountain, Newry. Eosphorite, rose quartz crystals, and botryoidal hydroxyl-herderite are frequently associated. White botryoidal francolite lining vugs from the Whitehall prospect, Newry has been mistaken for hydroxyl-herderite. Waxy dahllite botryoids can mimic botryoidal hydroxyl-herderite.

Dahllite from the Ryerson Hill quarry, **Paris** consists of white irregularly rusty stained botryoids (to 2 mm, AMNH collection) in patches (to 1+ cm) coating eosphorite crystals in quartz.

The Berry-Havey quarry, **Poland** has tan spherical dahllite (to 2 mm each) coating fracture surfaces on microcline. The surface of some of the botryoids is crackled and the luster can vary from waxy to earthy.

Tan waxy dahllite botryoids coat the entire linings of some vugs in albite at Black Mountain, **Rumford**. The "bubbly" coatings can coat albite, eosphorite, and other crystals and present a "ghostly" pseudomorph of the underlying material.

damourite (Mica Group) - a varietal name indicating a very fine-grained mass of muscovite (q.v.).

Auburn - Greenlaw Q, Keith Q, Pulsifer Q; **Buckfield** - Bennett Q; **Township D** - Bemis Stream P; **Greenwood** - Harvard Q, Tamminen Q; **Hebron** - Mount Rubellite Q; **Newry** - Dunton Q; **Norway** - BB #7 Q; **Paris** - Mount Mica Q; **Rumford** - Black Mountain Q, Red Hill Pegmatite #1 Q; **Stoneham** - Lord Hill Q; **Topsham** - Fisher Q

While a few mineralogists wish to rid the world of varietal names entirely, there should actually be a greater push for the accurate use of varietal names. Damourite, however, is a particularly variable material and of considerable interest to Maine collectors, and some discussion of its significance is in order. Damourite was first named by Delesse (1845). By 1892, Edward Dana had this summary to offer: "Damourite. Including margarodite, gilbertite, hydro-muscovite, and most hydro-mica in general. Folia less elastic and luster somewhat pearly or silky and feel unctuous like talc. The scales are usually small and it passes into forms which are fine scaly or fibrous, as sericite, and finally into compact crypto-crystalline kinds called oncosine, including much pinite. ... Often derived by alteration of cyanite, topaz ..., corundum... Although often spoken of as *hydrous* micas, it does not appear that damourite and the varieties following necessarily contain more water than ordinary muscovite; they may, however, give it off more readily."

While Genth (1873) described the alteration of some North Carolina minerals as being composed of damourite, his usage mostly involved visible flakes of mica, with only a few circumstances: "The scales of damourite occasionally become so fine that they cannot be distinguished with the naked eye and the mineral becomes massive, sometimes globular, sometimes with a slaty structure, similar to talc slate. This is often mixed with aggregations of larger scales of a greenish-white color and pearly lustre." Genth (1873) went on to describe the fibrous appearance of some damourite, which is the side view of parallel stacking of muscovite flakes. Regarding the cryptocrystalline damourite Genth (1873) said: "This variety of damourite much resembles some kinds of serpentine. It has a yellowish oil-green color, its lustre is waxy or dull." Currently, the usage for damourite, as a variety of muscovite, is that damourite is a fine-grained, variously colored, serpentine-like material which forms replacements after topaz, tourmaline, feldspar, etc.

Some ball muscovites from the Towne and other nearby quarries, **Auburn** have been incorrectly called damourite when only the side view of the crystals are seen and they look oily and green. Pinite is perceptibly no different than damourite except that its usage has been applied to a seemingly harder, slippery alteration of spodumene. Visibly scaly, though frequently fine-grained, muscovites are generally relegated to other muscovite varieties such as sericite, margarodite, etc. Damourite should be homogeneous without visible cleavages. The color varies from green through red-purple.

George Kunz wrote to Genth (Genth, 1884) of [Lord Hill quarry] **Stoneham**: "This vein is on the top of Harndon hill [sic], about one hundred feet from the place where was found the topaz obtained by me ... and is not the same pocket, as stated in the article, in the American Journal of Science, Jan. 7, 1884. The vein is almost entirely margarodite, occurring here in unexampled crystals. These at times cover spaces four or five inches square with distinct perfect crystals of margarodite, also altering to serpentine, and associated with it what is possibly topaz, altered into serpentine [sic!]." Several kinds of damourite occur at the Lord Hill quarry. One kind is greenish brown, fine-grained, greasy and appears identical to serpentine. Another fine-grained damourite at the Lord Hill quarry, sometimes replacing topaz, is pink to lilac in color.

Clarke (1884b) analyzed two damourites from Lord Hill quarry, Stoneham for Nathan Perry. Specimen "A" was "Subfibrous compact, light grayish green in color, greasy luster, associated with albite and topaz" while specimen "B" was "Broadly foliated micaceous, light grayish green, strong mother-of-pearl luster, also associated with topaz." The two damourites were not particularly unusual chemically except they had about 4 weight % FeO.

Clarke and Diller (1885), generally following the usage of Genth (1873), reported of Lord Hill (erroneously called Harndon Hill in early references), Stoneham: "Meanwhile Mr. Perry had called our attention to some apparently altered topaz; the crystals of which, having the unchanged mineral at the centre, were transformed upon the surface to a dark purple, soft substance, easily cut with a knife. Between the purple zone and the topaz was a greenish, intermediate layer, which shaded off imperceptibly into the original nucleus. ... This mineral occurs at the locality in two forms; first, as a broadly foliated mica, much like a pale green muscovite, and sometimes very well crystallized; and secondly, as a massive, subfibrous, dark green variety, suggestive of steatite or serpentine." The replacement of topaz by damourite was shown by Clarke and Diller (1885) to progress preferentially along cleavage planes as well as concentrically inward. In the same article, Clarke and Diller miss the potential for understanding the significance of fluid inclusions: "In the topaz there are many liquid inclusions ... from which the bubble readily disappears upon heating..."

Pink replacements of damourite after elbaite have been found at the Greenlaw quarry, **Auburn** (Gene Bearss, personal communication, 1991).

Damourite at the Bemis Stream prospect, township **D** occurs as fine-grained replacements of gray spodumene in cleavelandite. The damourite can resemble serpentine, which does not occur in granite pegmatites anywhere, and varies from gray, gray green, gray brown through yellow green and even terra cotta red.

Damourite from the Tamminen quarry, **Greenwood** occurs in several colors. Fine-grained gray green replacements of spodumene(?) (to 8 cm) have a mottled and oily appearance. Additionally, discontinuous lenses of rose purple damourite (to 7 x 7 x 0.5 cm) occur cutting gray fine-grained lepidolite associ-

ated with albite and muscovite. A thin layer of unctuous pink montmorillonite can be found coating the damourite. Similar material is found at the Harvard quarry.

Clarke (1886b; and almost exactly in Clarke, 1887a) described the pseudomorphs of damourite from Mount Rubellite quarry, **Hebron**: "The deposit at this point, about seven miles southeast of Mt. Mica, has long been well known to collectors. It has only been superficially opened, however, and deserves more systematic exploration. ... Associated with the Hebron lepidolite there have been found many specimens of red and green tourmaline, which, while preserving their crystalline form, have undergone an alteration into a softer mineral of an opaque, talcose appearance. Some of the material so derived from tourmaline has been supposed to be lepidolite; and as it was possible that a study of it might have interest, an analysis was made by Mr. R. B. Riggs. The specimen chosen was originally rubellite, and its specific gravity, as determined by Mr. T. M. Chatard was 2.87. ... Analysis as follows... These results show clearly that the alteration product is not lepidolite but damourite, a fact which could hardly be altogether unexpected. The material analyzed was received from Mr. N. H. Perry of South Paris, Maine." Similar results were reported by Riggs (1889).

Some of the pseudomorphs after tourmaline are composed of several micas. The observed pseudomorphs generally appear to be fine-grained pink muscovite (damourite) or lepidolite after tourmaline. Tschermak (1902) wrote of tourmaline replacements: "[From Hebron in Maine, are situated in front of me such pseudomorphs only, that appear almost complete. There are small, short, greenish gold tourmaline columns, embedded in lepidolite and decomposed feldspar. On the fractures, you can prove to yourself the whole compact {mass} is rarely comprised of hard grains, by scratching moderately with the soft point (Hardness somewhat below 3). The microscopic view shows a complete continuous aggregate of very fine dimensions and of many small colorless foliae, ordered along the long axis of the prism, and at one place are enclosed small grains of tourmaline, and the intergrown {grains} are situated parallel to the external form. The picture is of many threaded points of curved, cloudy streaks, corresponding to the original cross-fractures. The foliae have a somewhat higher refractive index than Canada balsam and are optically biaxial. In the blowpipe flame it shows through its abnormally strong swelling and through the flame color and the degree of the complete fusibility the {expected} behavior of Cookeite, the association with lepidolite is well-known.]" Modern specimens of Mount Rubellite quarry damourite are scarce. They are generally as historically described, consisting of gray green through pink fine-grained replacements of elbaite with relict grains of elbaite, quartz, etc. Some pink elbaite is noticeably replaced by coarse lepidolite and has been incorrectly labeled damourite.

A pink unctuous fine-banded damourite has been labeled "the back side of Plumbago," **Newry** (probably a reference to the Dunton quarry), but no well-located specimens are known.

Damourite from Black Mountain quarry, **Rumford** was briefly described in Riggs (1889): "The Rumford alteration was examined microscopically by Mr. J. S. Diller, who observed as follows: 'Under the microscope it is seen to be composed of two minerals most thoroughly intermingled in nearly equal proportions. One of these minerals is micaceous in structure, with strong double refraction like damourite, which it closely resembles in general appearance. The other mineral is clear, colorless, and apparently monoclinic, with a rather low index of refraction and moderately intense double refraction.' " Damourite is rare at the Black Mountain quarry and no specimens were available for study.

The Red Hill Pegmatite #1 quarry, Rumford has a damourite which can have a slightly foliated appearance. The yellow-green, oily appearing and unctuous, serpentine-like damourite can form discontinuous "veinlets" (to 7 x 7 x 0.4 cm) in blocky white microcline.

danburite?

Paris - Mount Mica Q

No specimens of danburite are known from the Mount Mica quarry, **Paris**, and no earlier reference than Morrill et al. (1958) is known. The name may have appeared from a misreading for damourite or by the over-zealous misidentification of other species.

daphnite (Chlorite Group) = variety of chamosite

Littleton - Littleton Ridge P; T9R3 WELS - Hovey Mountain P

Pavlidis and Milton (1962) wrote of **Littleton** and **T9R3 WELS**: "The varieties of chlorite suggested by optical properties are penninite, clinocllore, and daphnite. The chemical analysis of the rocks from Littleton Ridge... and the partial chemical analysis of composite samples from diamond-drill holes through a siliceous carbonate deposit on Hovey Mountain... indicate low MgO... The relatively small amount of MgO in these samples also suggests that the bulk of the chlorite in these rocks is [more] iron rich than magnesian."

DATOLITE

CaBSiO₄(OH)

Blue Hill - Black Hawk M; Perry - Loring Cove A

Translucent colorless datolite grains (1-2 mm) have been found at the Black Hawk mine, **Blue Hill** in white, pyrite-bearing

calc-silicate rock associated with yellow-green vesuvianite grains (up to 1 mm). The grains are rounded and multiply grown.

Clear typical, but incomplete, datolite crystals (to 1 cm) have been found in crystal-lined fractures in basalt in the northern Loring Cove area, **Perry**. The crystals are wedge-shaped and show an oily luster. The crystals can be 1 cm associated with 3 mm prehnite crystals in rosettes. The datolite can have a clear granular appearance.

delessite? (Mica Group)

Castle Hill; Perry - Loring Cove A

Delessite is a generic name which does not always signify a specific mineral. The name is used for splendid brown to brownish black micas, particularly chlorites and occasionally stilpnomelane-group minerals, but at the Loring Cove area, **Perry**, delessite is a name used for earthy amygdule-linings. The "delessite" is medium grass-green (probably a chlorite) with a dark greenish black border and surrounds central cavity-filling stilbite.

deweylite - a mixture of stevensite (q.v.) and clinoclinochrysotile, etc.

Thomaston - Dragon Cement Q

DIADOCHITE



Auburn - Maine Feldspar Q; Greenwood - Emmons Q; Newry - Bell Pit, Dunton Q; Paris - Mount Mica Q; Stoneham - Cole Q

Diadochite is usually a botryoidal resinous mineral and can be the latest formed mineral in an association, but is usually inconspicuous. The color varies from very dark orange-red, dark red, through red-brown to black. Though relatively few localities are recorded, it could be found at most of the triphylite-bearing pegmatites. Resinous botryoidal goethite can be confounded with diadochite.

Diadochite has been observed as resinous black, with red internal flashes, botryoidal patches (2 mm) on albite crystals (to 5 mm) with small muscovite crystals (to 3 mm) and pale green fluorapatite crystals (to 3 mm) at the Maine Feldspar quarry, **Auburn**.

At the Bell pit, **Newry**, reddish brown to black, with red internal flashes, resinous diadochite can be found lining vugs (to 1 cm) in siderite - quartz - montebasite, but the mineral is almost always directly on siderite. Green to brown earthy botryoids (1 mm) of mitridatite can be present. Diadochite is found commonly in the phosphate assemblages at the Dunton quarry, **Newry**. It is usually reddish orange, but can vary in color as at

other localities to almost black. Interstices in cleavelandite plates can be lined with a thin film of dark orange-brown diadochite. Some diadochite botryoids, in bubble-like strings across vugs, can be found. **Dunton Gem quarry**, **Newry** diadochite can be found as resinous, dark red-orange, sometimes crackled, coatings on albite crystals or lining blue tourmaline "eye" vugs or cleavelandite interstices. The cores of the resinous diadochite botryoids can be filled by green to brown earthy mitridatite.

Diadochite from the Mount Mica quarry, **Paris** forms small resinous red-brown botryoids (much less than 1 mm) on earthy green mitridatite associated with laueite and stewartite.

diallage (Pyroxene Group) = altered diopside or augite

Addison - Black Diamond Q, Pleasant River Black Granite Q; Berwick - Spence and Coombs Q; Deer Isle - Deer Isle M, Terrys Pond A; Monhegan Plantation - White Head Q; Saint George - Long Cove Q

Diallage is a varietal name and sometimes is a synonym for blocky, slightly altered diopside or augite. Dale (1907) and Smith (1923) reported diallage from many localities. Smith (1923) said of the Pleasant River quarry, **Addison**: "This rock... is an hypersthene-olivine gabbro of almost black shade and of medium ophitic texture, with black particles up to half an inch and slender whitish crystals. ... Under the microscope this rock consists, in descending order of abundance, of slender whitish transparent crystals of a feldspar (with both lime and soda, andesine-labradorite) intricately interlaced, the spaces between which are filled with a dark-brownish diallage..., black mica (biotite), a little hypersthene, and greenish olivine, together with secondary magnetite, a white mica, and calcite. The diallage is altered along its edges to hornblende."

Morrill and Hinckley (1959) described diallage as "yellow-foliated" from the area of Terrys Pond to The Reach, **Deer Isle**, but diallage can be green, brown, etc. However, Jackson (1838a), the original reference, wrote of Deer Isle serpentine: "*In other localities* [emphasis added], the rock was filled with foliated diallage, giving yellow spots of changeable hue to the mass, when polished."

Lord (1900) wrote of **Monhegan**: "A distinctive mineralogical feature of the Monhegan rocks is the subordinate position occupied by the monoclinic pyroxene. In the noritic types it is usually absent or distributed sporadically in the form of irregular grains heavily charged with magmatic inclusions. It is in the gabbroitic facies only that this mineral assumes larger proportions. The greenish brown, thick tabular crystals are of irregular outline, and but slightly pleochroic. They show well developed prismatic cleavage and the orthopinacoidal parting characteristic of diallage. ... The diallage is replete with ferritic inclusions, quite similar in character to those of the hypersthene, and is in general considerably uralitized."

diamond?

Andover?; coast of Maine?; Freeport?

Diamond was casually mentioned from "the coast of Maine" without description or specific locality by Sampter (1949). Putnam and Perham (1968) reported: "Diamonds have been found on an island in the St. Lawrence River east of Montreal. Does this mean also that the thought of diamonds around Colebrook, New Hampshire, Andover, and Freeport, Maine, are not as far fetched as might be? Peridotite from Freeport actually yielded a small small diamond according to H. W. Haven of Portland." There is no evidence to substantiate the claim. The report is unbelievable.

DIASPORE

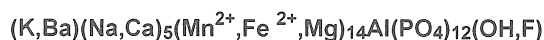
AIO(OH)

Litchfield - Dennis Hill A

Thugutt (1910) studied the fine-grained, chalky white alteration of sodalite called hydronephelite (q.v.), and concluded, based on specimens from **Litchfield**, Maine and Norway (the country) that hydronephelite was composed of natrolite (≈82%), gibbsite (≈15%), and diaspore (≈2%). Diaspore is not visually distinguishable from its associated components in hydronephelite.

diatomaceous earth = fossil diatoms = diatomite

DICKINSONITE



Auburn - Greenlaw Q, Groves Q, Keith Q; **Greenwood** - Emmons Q, Tamminen Q; **Hebron** - Mount Rubellite Q; **Newry** - Dunton Q, Nevel Q?; **Poland** - Berry-Havey Q; **Rumford?** - Red Hill Q

Dickinsonite is a rarer phosphate than has been imagined by some collectors. Many massive dark green fluorapatite specimens have been erroneously called dickinsonite. Dickinsonite is a platy to foliated mineral which has a perfect cleavage parallel to the plates and which occurs in late stage phosphate-siderite/rhodochrosite assemblages. Many world-wide locations for "dickinsonite" are actually iron-rich specimens of the series with arrojadite. Maine's established locations constitute a large percentage of the world's total, but even in Maine specimens are rare.

Dickinsonite has been found in rich emerald green to dark grass-green cleavages in masses to several centimeters at the Greenlaw quarry, **Auburn**. The dickinsonite occurs as an alteration of brownish pink lithiophilite. The lithiophilite was appar-

ently intergrown with arsenopyrite in a graphic texture and was replaced not only by dickinsonite, but also clove to cinnamon brown triplite and minor rhodochrosite. Several patches of brown pearly reddingite cleavages are sometimes intergrown with the dickinsonite.

Grass-green laminated to foliated dickinsonite grains (to several mm) sometimes form selvages around pink to tan lithiophilite masses (to several cm) which have been partially to completely replaced by cinnamon brown triplite and dark green massive fluorapatite at the Groves quarry, Auburn. Some dickinsonite has been observed on the margin of montebrasite with quartz at the Groves quarry.

Salmon orange-pink lithiophilite in black-stained cleavelandite from the Keith quarry, Auburn occasionally has small olive green patches (to 2 mm) of dickinsonite inclusions.

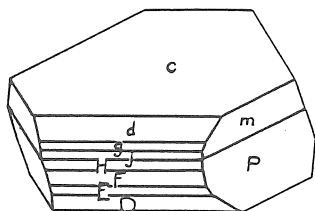
At the Emmons quarry, **Greenwood**, dickinsonite forms small patches (to 3 mm) of mottled emerald to avocado green cleavages and plates, without crystal form, in rhodochrosite. A single specimen of olive-green dickinsonite cleavages (to 2 mm) was found in the margin of a lithiophilite nodule from the Tamminen quarry, Greenwood.

Mount Rubellite, **Hebron** dickinsonite occurs in coarse foliated to micaceous grass-green masses (to 4 cm) embedded in tan rhodochrosite and white montebrasite associated with strunzite, eosphorite, arsenopyrite, fairfieldite, and sphalerite.

Bjareby (1958) listed dickinsonite from the Nevel quarry, **Newry**: "Usually I manage to get to the mine and quarries on Hall's Ridge of Plumbago Mtn., Newry (Oxford Co.), Maine. This time and at the last year's visit I found large cleavages of the quite rare phosphate species dickinsonite. ... The Newry material is like the Nancy [#2 quarry, Groton, New Hampshire] cleavages but somewhat bluish. Dickinsonite easily could be confused with cleavages of the darker varieties of manganapatite by the casual observer." The identification may have been made on dark green, oily-looking, fluorapatite or triphylite. Wintringham (1962) noted of the Nevel quarry, Newry: "Recently (1958), a massive green phosphate resembling manganapatite (but non-fluorescent) has been tentatively reported from the Nevel Quarry (Newry) as 'massive dickinsonite'; further testing is needed to verify this occurrence." No verified specimens known.

A single specimen of oily amber to greenish yellow dickinsonite has been verified (EDAX and XRD, this study) from the Dunton quarry, Newry. The dickinsonite consists of a single mass (to 8 mm) without noticable cleavage in cleavelandite associated with a pinkish brown triploidite mass (to 4 mm).

Dickinsonite was first found in Maine at the Berry-Havey quarry, **Poland** (Berman and Gonyer, 1930). The dickinsonite there is green, foliated (plates to 2 cm), and embedded in rhodochrosite associated with landesite, strunzite, reddingite, fairfieldite, carbonatian fluorapatite, and/or mitridatite. Some nodules show a zonal pattern from the contact with quartz and black-stained perthite pegmatite where a nodule of rhodochrosite has a thin blue rim or coloration of an unknown mineral and development of red-brown triplite. The dickinsonite forms ir-



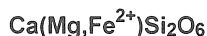
Dickinsonite, Berry-Havey Q, Poland (from Wolfe, 1940)

regular masses and crystallized areas at the center of the nodule. Occasional crude dickinsonite crystals have been observed. Tiny eosphorite crystals (to 1 mm) can be associated. Wolfe (1941) used Berry-Havey quarry, Poland dickinsonite to determine its formula type, unit cell dimensions, and crystallography.

Specimens of "dickinsonite" (PM 168-43-62) from Red Hill quarry, **Rumford** have proved to consist of green dusty beraunite coatings with triphylite, strunzite, hureaulite, etc. in siderite.

dicksonite = misprint for dickinsonite (Morrill et al., 1958)

DIOPSIDE (Pyroxene Group)



Addison - Pleasant River Black Granite Q; **Alfred** - North Alfred A; **Auburn** - Sangerville Formation; **Bath**; **Bethel**; **Casco** - Chute P; **Cornish** - Berry Ledge P, Day Hill P; **Crawford**; **Cushing**; **Deer Isle**; **Gray**; **Greenwood** - Harvard Q; **Lewiston** - City Q, Robinson Mountain A; **Limerick**; **Minot** - LaFlamme Q, Pitts-Tenney Q; **Mount Vernon**; **Newfield**; **Newry?** - Dunton Q, Whitehall P; **Norridgewock**; **North Haven**; **Orrington** - South Orrington; **Patch Mountain Member** - Greenwood, Norway; **Phippsburg** - The Basin L; **Raymond** - Camp Hinds L, "north of Panther Pond"; **Rumford** - Androscoggin River falls; **Sanford** - Webster P, 200 m L, 600 m L; **South Berwick** - Spence and Coombs Q; **Turner**; **Union** - Harriman P; **Vienna**; **Warren** - Warren Nickel P, West Warren A; **Weld** - Hildreths Formation in Mount Blue State Park; **Woodstock**

Diopside is a common mineral which occurs in a variety of rocks, particularly calc-silicate granulite beds. Augite, a related species, is commonly found in volcanic rocks such as basalt. Diopside grades into hedenbergite (q.v.) with increasing iron contents. Diopside can be a widely distributed mineral in inconspicuously small sizes, but yet volumetrically important in its host rocks. The Patch Mountain Member of the Sangerville Formation, particularly in **Auburn**, **Greenwood**, **Minot**, and **Norway**, is widespread in central Maine and has a particularly distinctive banded appearance which is diopside-bearing (Guidotti, 1965a). It is the contact rock of many of the pegmatites along the northeastern margin of the Sebago batholith.

Diopside from Day Hill, **Cornish**; Pitts-Tenney quarry, **Minot**; Webster prospect, **Sanford**; and other similar calc-silicate occurrences has consistent appearance. The 2-3 mm (up to 1 cm) doubly terminated grass-green crystals are found with calcite, grossular, vesuvianite, and plagioclase. The diopside is frequently gemmy and can be found as rounded to sharp crystals in subparallel to random groupings, frequently found on grossular crystal faces. The terminations occasionally show a white fibrous appearance. The grossular from these calc-silicate occurrences can have formed within the calcic, siliceous beds which resulted in extensive entrainment (inclusion) of diopside-rich layers in the grossular.

Fisher (1948) reported a locality in **Lewiston**: "The rocks on the southeastern side of Robinson Mountain are quartz-feldspar-biotite gneisses of the pejepscot formation[sic]. There are no prominent mineral localities found in this formation except where it is intruded by large masses of pegmatites. These gneisses are geologically older than the lime-silicate gneiss that carries the VESUVIANITE. The lime-silicate gneiss consists chiefly of quartz, feldspar which is near labradorite, zoisite, diopside (of which some fine specimens may be found) and calcite."

Some very large (to 2.7 cm) well-formed diopside crystals have been found in a limestone quarry in the west **Warren** area (HU collection).

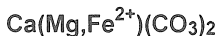
Pankiwskyj (1965) described a diopside occurrence in calc-silicate granulite which seems to correspond with the Hildreths Formation, Mount Blue State Park, **Weld**.

diopase?

Chalk Pond - **Beddington**, T22MD

Burr (1930) first listed diopase from Beddington. Morrill and Hinckley (1959) reported diopase apparently in the same entry which listed a fossil diatomite occurrence near Chalk Pond, Beddington - T22MD. Parsons (1859) reported on copper and probably stimulated the eventual diopase appellation: "Prof. Parsons, on Cambridge, exhibited and presented a specimen of Infusorial Earth, from the neighborhood of Bangor, Maine. Copper was said to have been detected in the silica of which the specimen was composed." The identification seems to be unsubstantiated.

DOLOMITE (Dolomite Group)



Alder Stream; **Boothbay Harbor** - Route #27 road cut; **Brunswick**; **Camden** - Carlton Q; **Carrabassett Formation** - **Blanchard**, **Greenville**, **Little Squaw**, **Shirley**, **Squaretown**; **Cherryfield**; **Concord**; **Hope** - Pierce Q; **Jim Pond** - Shallow Pond/Little Greenbush Pond A; **Kittery Formation**; **Linneus** - Drew Hill A; **Lubec?** - Lubec Lead M?; **Machiasport**; **Mapleton?** - Aroostook

River A; Mount Vernon; New Limerick - Drew Mountain lime Q; Newry? - Halls Ridge A; Patten; Pembroke; Phippsburg; Rockland - Barry Q, Dunton Q, Gay Farm Q, McLoon & Stover Q; Rockland - Rockport Q, Fred Ulmer Q; Thomaston - Dragon Cement Q, Levensaler Q, Marsh Q, Saint George River A; Union - East Union outcrop; Vienna; Warren - Saint George River A

Dolomite can be distinguished from calcite by its reaction to dilute hydrochloric acid. Calcite effervesces rapidly while dolomite will bubble slowly in the same acid.

Espenshade and Boudette (1967) reported ankeritic dolomite as an important component in the Carrabassett Formation exposed in the Greenville quadrangle, principally in **Blanchard, Greenville, Little Squaw, Shirley, and Squaretown.**

Typically curved white to pink dolomite rhombohedra (2-3 mm) were found in a vein in a road cut on Route #27, **Boothbay Harbor.**

White to tan dolomite from **Jim Pond** is massive with cleavages several millimeters to almost a centimeter and contains a variety of associated species including fuchsite, chromite, pyrite, etc.

Hussey (1962) wrote of the Kittery Formation (mapped from **Kittery to Biddeford to Berwick**): "Numerous ellipsoidal concretionary masses of calcite, dolomite, lime silicates, and quartz are very common in the Kittery formation [sic]. These concretionary masses range from about 2 inches to 1 1/2 feet long, and each is contained within the limits of a single bed. They are commonly zoned, with either calcitic or dolomitic centers." The concretions sometime show a chalky white rim which grades into gray cores and this chalky marginal rim serves to highlight the concretion's presence within the similar-appearing "limy" quartzite. Hussey (1962) illustrated typical concretions from the Israel's Head area, Ogunquit, York.

Toppan (1932) wrote of dolomite from the **Rockland** area:

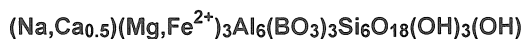
"Three types of rock are found in the Rockland formation [sic] of commercial importance; these are the 'soft rock,' the 'hard rock,' and the dolomite or magnesian limestone. The 'soft rock' which is the most easily worked is the purest limestone and is found in the easternmost quarries of the Rockland-Rockport Lime Company near Rockland. The 'hard rock' is less easily worked and contains a higher percentage of silica and magnesia. The dolomite is almost white and in composition is a nearly pure dolomite, the amount of magnesium carbonate commonly running as high as 40 per cent, although it may be somewhat lower locally. ... Beds of both 'hard' and 'soft' rock compose most of the limestone, the dolomite occurring at only one place within this area, about a mile north of the town of Thomaston."

The fine-grained dolomite of the Dragon Cement quarry, **Thomaston** is found so abundantly that its cream to beige color, in hand specimens, imparts a pink cast to the sections of the quarry it permeates. Dolomite also forms distinct coarsely crystalline veins and veinlets (to several tens of centimeters) in the

marble. Smith et al. (1907) reported that portions of the Rockland carbonate belt were so magnesian that the carbonate would not effervesce in acid. Jackson (1837a) analyzed dolomite from the Marsh quarry, Thomaston.

Trefethen (1945) provided chemical analyses of **Warren** dolomite and wrote: "There appears to be two horizons of the dolomite. The thickest and most favorable beds for further development are those lying adjacent to the St. George River in the north part of the town of Warren. The dolomite beds are very white, medium to coarse textured marbles. ... Locally the dolomite contains patches and thin seams of talc, and, near the margins of the beds, the marble is more siliceous and impure. ... From the reconnaissance studies so far carried out, it appears conservative to state that over a million tons of relatively pure dolomite is [sic] available in the Warren district." Toppan (1932) indicated: "The rock of West Warren area is a dolomite and forms a single belt striking about N. 20° E. and of unknown extent. It is coarser grained than the other dolomites of the Rockland quadrangle and contains crystals [grains] up to a quarter of an inch in cross-section. This coarseness of grain is due to the contact metamorphism of the dolomite by injections of granite as stated by Bastin [1908b]."

DRAVITE (Tourmaline Group)



Appleton - Appleton Mining and Smelting Company M; Blue Hill - Black Hawk M, Granger M, Mammoth M; Newry - Bell Pit, Nevel Q, Dunton Q, Scotty Q; Paris? - Mount Mica Q; Penobscot - Wallamatogus pluton; Rumford - Black Mountain Q; Smalls Falls Formation

Tourmaline is a ubiquitous mineral group in Maine. It is found as an accessory mineral in a great variety of rock types from schists and slates, through granites, and contact aureoles. Dravite, however, is virtually unknown in granites and pegmatites. Despite being a sodian mineral, dravite's requirement of major magnesium over iron content "dooms" the mineral from appearing in such magnesium-poor rocks as granite pegmatites. However, dravite "is a common phase in the Smalls Falls Formation" which is extensively exposed in west-central Maine (Charles Guidotti, personal communication, 1990). Schists, calc-silicate rocks, etc. are significantly magnesium-bearing in comparison to granite pegmatites. See discussion of the end-member tourmaline formula under elbaite.

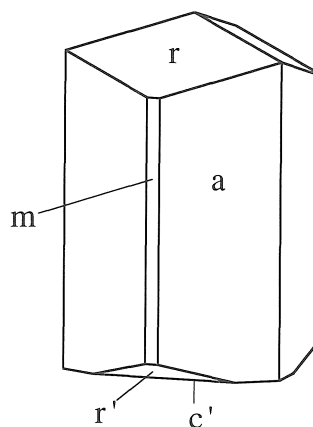
Though unanalyzed, tourmaline reported from the Appleton mine, **Appleton** is included here by analogy with nearby sulfide deposit tourmalines. The mineral was reported (MMJ, May 28, 1880): "Many fine crystals of tourmaline are found at this mine imbedded in the copper ore, and they make very pretty cabinet specimens," but it was reported in the same issue by Hitchcock: "The vein matter seems to be largely siliceous with argillaceous and hornblendic intermixture, having the yellow

sulphuret of copper and magnetic iron pyrites disseminated throughout." No specimens known.

The Black Hawk mine, **Blue Hill** has gray to brown, parallel to sub-parallel fibrous to acicular undulating and stellate mats (centimeters across) of dravite tourmaline embedded in sericitic granodiorite. The dravite is sometimes directly associated with galena, pyrite, chalcopryite, and pyrrhotite. Howd and Drake (1974) said: "... dravite (brown tourmaline) is present in veins and irregular masses which cross-cut both the contact metamorphosed Ellsworth rocks and the Sedgwick pluton. The tourmaline in turn is replaced by sulfide minerals, most commonly chalcopryite and pyrrhotite." Slack (1980) reported: "Tourmaline at the Black Hawk mine is most abundant in the copper-rich Mammoth and western A Zinc zones, where it occurs in close association with sulfides, in altered wall rocks, and in some post[-]ore pegmatite-aplite dikes. Tourmaline is present in a variety of colors and compositions. Brown or golden yellow dravite (Mg-tourmaline) forms intergrowths commonly with pyrrhotite and chalcopryite but rarely with sphalerite, galena, or pyrite. Adjacent to ore, altered Pond Quartzite may contain isolated patches of columnar needles or blocky crystals of red-brown dravite. Other localities show sunbursts of radiating golden dravite as much as 1 m in diameter and veins composed of dravite, Mg-chlorite, and quartz. In contrast, black crystals of Fe-rich tourmaline (schorl) are found in late magmatic segregations in granitic pegmatite and aplite dikes." Slack (1980) further summarized tourmaline localities, many of which probably are dravite-bearing. Several small dravite crystals (to 7 mm) were found in "pockets" in the Black Hawk mine (Hugh Durgin, personal communication, 1993). The dravite crystals had a colorless transparent shaft with brown and brownish black zones on the terminations.

Tourmaline from the Granger mine, Blue Hill is unanalyzed and is included here by analogy. The specimens were described (MMJ, March 11, 1881): "The ore is very handsome and makes very beautiful cabinet specimens. Numerous crystals are seen intermingled with the copper and quartz." No specimens available for analysis.

Dravite does not occur in granite pegmatites, but can be found in schists surrounding them. Some of America's finest dravite crystals, for example, comparable to those from Franconia, New Hampshire, have been found in the boron-rich aureoles which surround the Halls Ridge and Plumbago Mountain, **Newry** pegmatites in chlorite-actinolite schist. The individual, doubly terminated highly lustrous black crystals can be 10 x 1 cm. Star burst clusters (10-20 cm) are not uncommon. Some zones around these pegmatites contain abundant terminated 3 x 1 cm crystals thickly arranged in the chloritic schist (metagabbro). Though color does not serve to identify tourmalines very well, the Newry dravite, from both the Dunton quarry and Nevel quarry, is translucent greenish-brown in thin splinters, but appears opaque black in thick crystals. Henry and Dutrow (1990) report on the chemistry of the compositionally zoned dravite from the "Newry mines area."



Dravite, Dunton Q, Newry

Specimens of pocket-etched schorl from the Mount Mica quarry, **Paris** have been called dravite for no good reason.

Dravite is found in brownish-black 2-3 cm terminated prisms embedded in actinolite schist with a boron-rich aureole from the Black Mountain quarry area, **Rumford**. The dravite sometimes has easily visible triangular internal color zones.

dufrenite?

Newry? - Dunton Q; Standish? - Oak Hill P

Dufrenite is a scarce green to black botryoidal phosphate. It was presumed to be common until Frondel (1949) and Lindberg (Smith) (1949) showed that material called dufrenite was actually a relatively diverse group of similar-appearing minerals. **Newry** material labeled dufrenite is rockbridgeite (q.v.).

Doloff (1936) wrote of "dufrenite" from the Oak Hill prospect, **Standish**: "It occurs in cavities within triphylite, and where the process of alteration has gone on long enough, the dufrenite alone remains. It is typified by botryoidal-like masses in tiny columns, has an olive green to leek-green color, a light green streak, and a hardness of about 4 on Moh's [sic] scale. It is usually associated with other vari-colored products of the alteration of the primary phosphates." One of Doloff's (1936) specimens (AMNH 69670) consists of olive green vuggy and porous masses (to 3 x 5 cm) in brown-stained cleavelandite. The mineral is unbanded and resembles unoxidized beraunite. Where there are botryoidal surfaces, the surface is minutely granular. Some black relict zones are evident in the green masses. The specimen is being studied.

DUMORTIERITE



Edgecomb - Fort Edgecomb A; Georgetown - Westport Island A; Greenwood; Phippsburg - Hermit Island A; Stoneham? -

Lord Hill Q; Topsham - Fisher Q; Westport; Woolwich - U.S. Route #1 road cut

Small (to 3 x 0.3 mm) indigo-blue needles of dumortierite are occasionally found embedded in simple pegmatite veins along the shore of the Fort Edgecomb State Park area, **Edgecomb**. The mineral is very inconspicuous. (Mineral collecting is not allowed in the state park itself, without a permit.)

Dumortierite (Forrest Dexter, personal communication, 1972) is found in "metamorphic" rocks northeast of the Harvard quarry, **Greenwood**, but Guidotti (1965a) did not show appropriate rocks in the area. No specimen seen.

Dumortierite seems to occur as tiny (1 mm or less) purple patches in white sillimanite associated with blocky andalusite (to several cm) in quartz from Hermit Island area, **Phippsburg**. Specimen not analyzed.

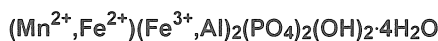
Mortus (1969) reported of the Lord Hill quarry, **Stoneham**: "I was very pleased to come up with a dumortierite pseudomorph of a topaz crystal with the faces quite evident..." The context suggests that the mineral replacing the topaz was dumortierite.

Purple dumortierite needles and bundles (to 7 mm) have been found with sericite and quartz at the "Fisher pocket," Fisher quarry, **Topsham** (Cliff Trebilcock, personal communication, 1990).

Individual splintery to fibrous crystals (2-3 mm) of indigo-blue dumortierite are frozen in chloritic microcline - muscovite - sillimanite - schorl granite pegmatite exposed along route U. S. Route #1, **Woolwich** (Arthur Hussey, personal communication, 1975). One specimen had a 2.5 x 3 cm patch of gray-blue crystals with individuals up to 2 x 0.2 cm. Additional occurrences are found in similar rocks in **Westport** and **Georgetown** (Arthur Hussey, personal communication, 1992).

E

EARLSHANNONITE (Whitmoreite Group)

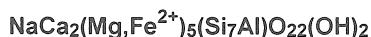


Greenwood - *Emmons Q*; **Newry** - *Dunton Q*

Earlshannonite, the manganese analog of whitmoreite, has been found at the Emmons quarry, **Greenwood**. It forms spherical red to orange-brown cores (less than 1 mm) covered with golden yellow "fuzz" of thickly grown crystals extending out of the mass. It is found in vugs of chocolate brown landesite crystals (to 2 mm) associated with jahnsite-(MnMnMn), and near some vugs which contain moraesite, rockbridgeite/frondelite, and mitridatite along with manganoan siderite.

Small, inconspicuous dark orange-brown earlshannonite crystals (less than 1 mm) from the Dunton quarry, **Newry** are found in vugs in manganoan siderite and blue elbaite eyes, with clear equant doubly terminated quartz crystals (less than 1 mm) and earthy olive-green mitridatite spheres (less than 1 mm).

EDENITE (Amphibole Group)



Passadumkeag River pluton - **Burlington, Carroll, Grand Falls, Lakeville, Lee, Lincoln, Springfield, T3ND, T3R1 NBPP, T4ND, T5ND BPP, T5R1 NBPP, T6R1 NBPP**; **Robbinston** - *hornblende granophyre, quartz-rich and quartz-poor monzonites*; **Sapling** - *"Gabbro Point", Round Pond Block A*

Ayuso (1984) reported edenite and other amphiboles from the Passadumkeag River pluton **Burlington, Carroll, Grand Falls, Kossuth, Lakeville, Lee, Lincoln, Springfield, T3ND, T3R1 NBPP, T4ND, T5ND BPP, T5R1 NBPP, T6R1 NBPP**:

"Amphibole is heterogeneously distributed in this granite. Near the granite-country rock contact, amphibole is absent. In a few areas within the core facies, amphibole and biotite are subequal in abundance, but more commonly, amphibole is subordinate to biotite. Two varieties of amphibole, a phenocryst and a matrix component, are present in the Passadumkeag River pluton. Amphibole phenocrysts (up to 0.7 cm) are black prisms, invariably euhedral to all other silicates except biotite. Although amphibole generally precedes biotite in the crystallization sequence, inclusions of unaligned [sic] biotite plates within amphibole suggest a stage of coprecipitation of these two phases.

... In accordance to the classification of Leake (1978), the amphiboles belong to the calcic group and range from edenite and edenitic hornblende to ferro-edenites and ferro-edenitic hornblende. The Fe/(Fe + Mg) ratios range from about 0.51 to 0.75 (table 8) without a distinct trend in the pluton from rim to core facies..."

Abbott (1978) identified amphiboles from the quartz-rich and quartz-poor monzonites of **Robbinston**: "The major mafic mineral, edenite-hornblende, occurs as subhedral or anhedral phenocrysts." Abbott (1978) was more specific for hornblende granophyre, also in Robbinston: "Edenite occurs as anhedral blocky phenocrysts but also occurs in the matrix."

Boone et al. (1989) reported "ferri-edenite," a name not currently recognized in mineralogical nomenclature, but gave an analysis consistent with aluminian ferrian edenite. The substitution of high valence cations resulted in lower sodium values and the name edenite is no longer truly accurate as a series name choice. (Leake (1978) indicated that the name ferri-edenite was used for amphiboles better called ferroedenite.) If current amphibole nomenclature is followed, it would not be possible to have a ferric edenite as site occupancies would have to be adjusted to compensate for the valence increase in the octahedral strip and consequently something must be in shorter supply in other sites. The mineral from "Gabbro Point" - a large point jutting from the south shore of the northwest cove of Indian Pond, **Sapling**, was figured as an intergrowth within subcalcic augite. One of Boone et al.'s (1989) analyses (#6) is intermediate between edenite, to which it is slightly closer, and a composition not previously found in nature and therefore not yet named: $\text{Ca}_2\text{Mg}_4\text{Fe}^{3+}\text{Si}_7\text{AlO}_{22}(\text{OH})_2$ - a member of the hornblende series. Analyses #1 and #2 [from the Round Pond Block adjacent to southern Round Pond, Sapling](Boone et al., 1989) could be called sub-sodic ferrian aluminian edenite and sub-sodic silicic ferrian aluminian edenite, respectively. Boone et al. (1989) listed these amphiboles as "ferri-barroisitic edenite" (#6) and "ferric, edenitic to actinolitic winchite" (#1, #2).

egeran = vesuvianite

Parsonsfield - *Dr. Swett's fields*; **Phippsburg** - *Basin Limestone Q*

Alger (1844) distinguished egeran from idocrase and probably represented Jackson's distinction: "Idocrase occurs crystallized, either solitary or in groups; and massive. ... EGERAN. It occurs in diverging groups of deeply streaked translucent crystals

tals, of a liver-brown color..." Jackson (1838a, 1839) referred to **Phippsburg** egeran several times. In his first visit, Jackson (1837a) reported idocrase. During his second survey (1838a), he listed only egeran associated with pargasite and yellow garnet, manganesian garnet [sic!], and cinnamon stone garnet (the garnets were apparently all grossular with varying colors).

Jackson (1838a) reported of **Parsonsfield**: "... we found an abundance of a rare variety of egeran, and beautiful crystals of yellow garnet, pargasite, adularia and scapolite. They occur in a granular variety of limestone, which is scattered in profusion, in the fields near Dr. Swett's house."

elaeolite = nepheline

ELBAITE / OLENITE (Tourmaline Group)

Elbaite - $\text{Na}(\text{Li}_{0.5}\text{Al}_{0.5})_3\text{Al}_6(\text{BO}_3)_3\text{Si}_6\text{O}_{18}(\text{OH})_3(\text{F},\text{OH})$

Olenite - $\text{Na}(\text{Al})_3\text{Al}_6(\text{BO}_3)_3\text{Si}_6\text{O}_{18}(\text{O})_3(\text{OH},\text{F})$

Andover? - *Black Mountain Q?*; **Andover North Surplus?** - *Dunns Notch A*; **Auburn** - *artesian well excavations near Haskell Corner and Androscoggin River, Goff Hill Reservoir A, Greenlaw Q, Groves Q, Hatch Q, Keith (Towne) Q, Maine Feldspar Q, Moulton Q (= Pulsifer Q extension), Pulsifer Q, Smith Q, Wade Q, Welcomes Corner A, Western Avenue excavation*; **Baldwin (=Standish?)**; **Bangor?**; **Brunswick**; **Buckfield** - *Bennett Q, General Electric Q, Owls Head Q, Westinghouse Q (=Dudley Ledge Q=Lewis Q)*; **TD** - *Bemis Stream P*; **Dixfield** - *Little Brown Mountain A, road excavation*; **Falmouth** - *Falmouth High School excavation*; **Georgetown** - *Booker Q, Consolidated Q, Tourmaline prospect near Consolidated Q*; **Greenwood** - *Emmons Q, Gross P, Harvard Q (= Hicks Pond L?), Locke Mills A railroad cut, road excavation, Tamminen Q, Tiger Bill Q, Waisanen Q*; **Hanover** - *logging road exposure*; **Hebron** - *Hibbs Q, Mills Q (probably = Mt. Marie Q in Paris), Mount Rubellite Q, No. 4 Hill Q*; **Minot** - *Harris Farm A*; **Newry** - *Bon Ami Q, Crooker Q, Dunton Q, Martin P, Nevel Q, Puzzle Mountain A, Rose Quartz Crystal L*; **Norway** - *BB #7 Q, Forrest Langway Home A, Tubbs Ledge Q*; **Oxford**; **Paris** - *Hall Q, Hoopers Ledge Q, Irish Q, Lee Dunham Farm A, Mount Marie Q, Mount Mica Q, Pechnik Q, Wright Farm A*; **Peru** - *Eberhard Ledge A*; **Poland** - *Berry-Havey Q*; **Pownal**; **Roxbury?** - *"five or six miles north of Black Mountain"*; **Rumford** - *Black Mountain Q, Lovejoy Uplands A?, Red Hill Q (=Kimball Q?), Rumford Library excavation, Virginia A?*; **Sanford?**; **Standish** - *Oak Hill Q = Hussey Farm A?*; **Stoneham** - *Albany manway A, Lord Hill Q, Willis Warren Q*; **Topsham** - *Fisher Q, Porcupine Hill Q, Square Pit, Trenton Q (G.D. Willes Q)*; **Weld** - *Tumbledown Mountain A*; **West Paris** - *Cobble Hill Q (Ski Pike Q), Kitridge Hill Brook A, A. C. Perham Q, railroad cut*; **Woodstock** - *Koskala Q*

Introduction

Gem tourmaline has so captured the minds of Maine mineralogists, miners, and mineral collectors that a significant amount of miscellaneous facts should be included along with a description of specimens, associations, and locations. A large literature has been developed regarding Maine tourmaline's contribution to understanding the mineralogy of the species. Indirectly, due to elbaite's presence in Maine pegmatites, much consequential research has been directed at these pegmatites. By twentieth century standards, Maine's tourmaline production is relatively minor. Historically, Maine tourmaline enjoys the reputation it does because Maine was one of the first producers of gem crystals, and there were few competing sources of supply. (Note: many of the reports of colored tourmaline in Maine which are located outside of the well-known pegmatite occurrences are probably misidentifications. Pink andalusite has been frequently thought to be pink tourmaline and grass green epidote has been thought to be green tourmaline. Other minerals have also been confounded with tourmaline. But for the mode of occurrence, both epidote and andalusite can be effective look-alikes for elbaite. In some cases, green epidote in quartz could fool even the astute collector and mineralogist. Fortunately, neither epidote nor andalusite are yet known to occur in Maine pegmatites.)

Jane Perham (1965a) published an extensive list of Maine gem tourmaline locations. Feuchtwanger (1871) is credited: "He also made some remarks upon a collection of **Tourmalines** of various colors, one of a fine red tint, and others of a beautiful yellow, which had been brought from the vicinity of Bangor, Maine." This entry has been misconstrued by some to mean that the source of the crystals was a deposit in the area, rather than having been bought from Augustus Hamlin who lived in that city.

Bastin (1911) wrote of Maine gem tourmaline: "The prices obtained in Maine are higher than those current in New York City, because most are sold at retail to residents of the State or to summer tourists and have enhanced value as souvenirs. Rubellite and emerald-green varieties bring at retail from \$8 to \$20 per carat. The indicolite and olive-green varieties bring from \$6 to \$18 a carat."

This section will begin with a discussion of elbaite and its relation to olenite, followed by a discussion of color in elbaite and some varietal names distinguished by color. The mode of occurrence will be reviewed descriptively as to the nature of pockets and "eyes," followed by description of specimens from various locations along with pertinent historical notes.

Elbaite - Its Relation to Olenite and Schorl

Elbaite has long been synonymous with "lithia" or "lithium" tourmaline. As early as Riggs (1889) it was recognized that elbaite and schorl could form a continuous series and this series has been further characterized by Donnay (1963) and other researchers. Recently, the mineral olenite was described (Sok-

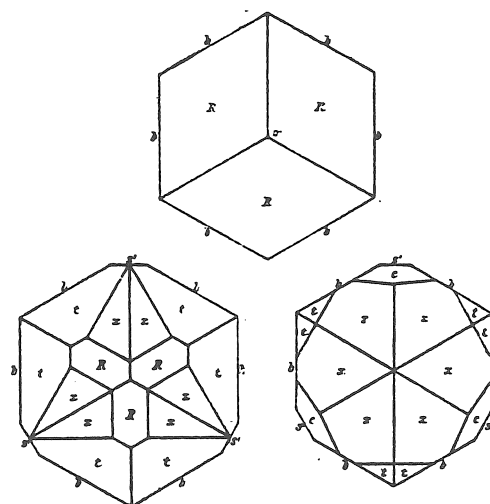
olv et al., 1986). Olenite is a species which does not require essential lithium. Dietrich (1987) suggested that the introduction of olenite into tourmaline's nomenclature had profound implications on the traditional definition of elbaite. Chemical analysis is sometimes insufficient to determine if enough lithium is present in a particular sample to justify the name elbaite. (Most elbaites are intermediate in composition. Riggs (1989) further noted that some Maine "elbaite" were quite variable in fluorine content - given that his own analyses were internally consistent.) Wise and Brown (1992) noted that slightly alkali-deficient olenite and alkali-deficient olenitic elbaite occurred at the Black Mountain quarry pegmatite, Rumford. Although Wise and Brown (1992) indicated that the material was 50-58% elbaite, the Y and Z sites were assigned full aluminum occupancies. The olenite occurred as pale pink to pale green crystal sections embedded in quartz or interlaminated as green sprays in muscovite. The olenite occurred in zones of the pegmatite without conspicuous lithium mineralization (i.e. no spodumene, lepidolite, montebrasite, etc.). Genuine elbaite was found in association with lithium-bearing species.

Many of the "undistinguished" tourmalines from pegmatites and various vein assemblages that show little lithium mineralization could be schorl, dravite, foitite, olenite, etc. Particularly this may be true of fibrous examples with brown to blue internal reflections. Although the original olenite was found as a thin compositionally unique zone within an elbaite crystal, the only specimen from the type locality that is known; one analysis suggests that olenite has even been found at San Piero di Campo, Elba, Italy (El-Hinnawi and Hofmann, 1966) - the type locality for elbaite! Analyses by Riggs (1989) would suggest that olenite, or near olenite, could have been found at the Mount Mica quarry, Paris. (Also note that fluorine is present in Maine lithia tourmalines (Riggs, 1989), while fluorine is very minor in type olenite. No nomenclature exists to cover fluorine or hydroxyl dominance in the O_3 site in tourmaline.)

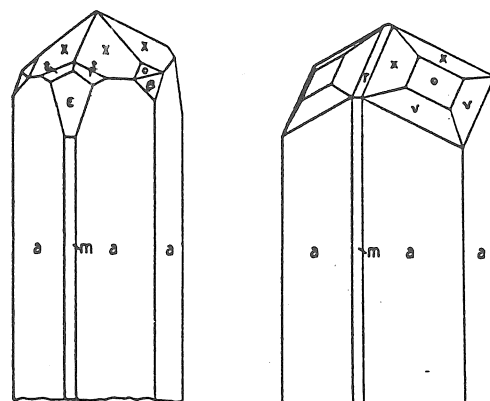
Of particular interest to Maine collectors is elbaite's relationship to schorl. Historically, collectors have considered schorl to be an opaque mineral, while a dark tourmaline with some transmission of light must be an elbaite. Actually, there are probably some dark green and dark blue intermediate-composition schorl gemstones from Maine. Dark green and dark blue Maine pegmatite tourmalines could be schorl. The dark blue tourmaline armoring of garnet and triphylite and some hollow blue tourmaline eyes reported by King (1991a) are the indicolite variety of schorl, for the most part (chemical analyses, this study). One indicolite from the Mount Mica quarry could be another tourmaline species, and study of the chemistry of this group is continuing.

Crystallography of Elbaite

Elbaite crystals generally have similar shapes. Maine crystals are generally elongated as well as being striated along their lengths. Striations on elbaite are usually very coarse, resulting in



Mount Mica Q, Paris (from Goldschmidt, 1923)



Dunton Q, Newry, (from Fraser, 1930)

Elbaite

the crystal cross-sections being far from symmetrical. Frequently, crystals have a corrugated appearance. Smooth-faced or even symmetrical, lightly striated crystals are virtually unknown. Additionally, elbaite crystals are generally distorted. Various equivalent crystal faces will be represented by different sizes, and terminations may be positioned far "off axis." Frequently, one or more faces of a particular form will be "missing."

The words which describe tourmaline faces are of three common types. The sets of faces which enclose a tubular volume of space are "prisms." Faces which are inclined to the vertical axis are ordinarily called "pyramids." Faces which perpendicularly cut the vertical axis are called "pedions." (Some collectors will note that faces which cut only one axis are sometimes called pinacoids, but pinacoids are sets of faces which are related to each other by a mirror plane of symmetry, while basal faces in tourmaline, and similar lower symmetry minerals, have no equivalent face on the opposite end of the crystal. When only one face is present in such a form, it is called a pedion. When a

TABLE 1.

	Symbol	Form
prisms	m	$\{10\bar{1}0\}$
	m_1	$\{01\bar{1}0\}$
	a	$\{11\bar{2}0\}$
	S	$\{21\bar{3}0\}$
pyramids	r	$\{10\bar{1}1\}$
	r'	$\{10\bar{1}\bar{1}\}$
	e	$\{01\bar{3}2\}$
	J	$\{20\bar{3}1\}$
	y	$\{40\bar{4}1\}$
	n	$\{02\bar{2}1\}$
	q	$\{03\bar{3}4\}$
	w	$\{11\bar{2}2\}$
	K	$\{12\bar{3}2\}$
	t	$\{21\bar{3}1\}$
	D*	$\{41\bar{5}1\}$
	f*	$\{95\cdot\bar{14}\cdot3\}$
basal pedions	c	$\{0001\}$
	c'	$\{000\bar{1}\}$

*Faces of approximate determination

positive and negative pedion (denoted c and c' respectively) are found on a single crystal, they are independent from each other, but still have the same generic name. Note: tourmaline pyramids are not the same as bipyramids. Bipyramids are symmetrically related and the bipyramidal faces on one end of a crystal ideally must be present on the other end, when the crystal is properly doubly terminated. Tourmaline crystals do not have bipyramids.)

All tourmaline crystals appear somewhat asymmetrical as there is no horizontal mirror plane. For this reason, opposite ends of a crystal will usually have different termination styles. One end might have a single flat face, while the other might have numerous sloping pyramidal faces. When singly terminated crystals of elbaite are found in a gem pocket and there are two kinds of termination styles present, they might represent what a doubly terminated crystal should be like if properly reassembled.

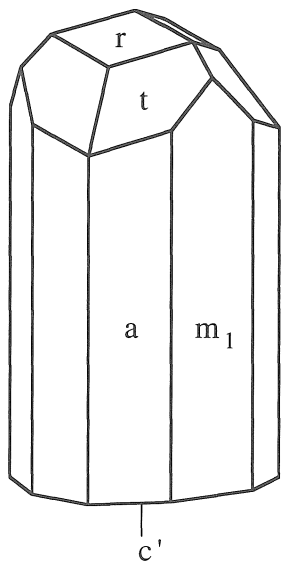
Elbaite generally shows terminations somewhat different than schorl (q.v.). Elbaite crystals frequently have some high angle pyramidal crystal faces in addition to familiar normal pyramidal faces. Table 1 contains a list of faces which have been commonly observed on Maine crystals in addition to several which are approximations of what have been observed. The various combinations of forms produce interesting crystal cross-sections. Some prisms are composed of three or six faces and when in combination, as well as alone, can produce three, six nine, or rarely twelve-sided crystals.

Some texts have designated certain pyramid or prism forms to be first- or second-order, etc. First-order forms have a "1" in the first digit of their numerical symbol (along with the additional numerical designations required for a prism or pyramid), while, similarly, second-order forms have a "0" for the first digit in their numerical symbols. Inspection of several of the elbaite drawings given here will illustrate how the change in the numerical symbols affects the placement of faces on the drawings. Ford (1932) is a commonly available textbook describing crystallographic nomenclature.

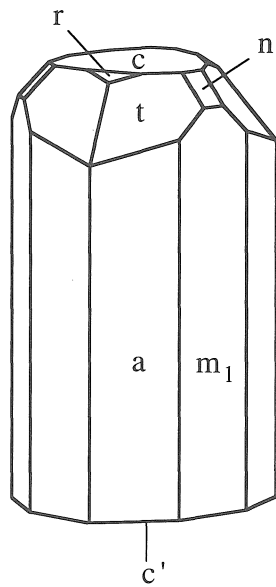
In some cases, several differently formed tourmaline crystals are found in a gem pocket and the character of tourmaline crystals can be very different from adjacent pockets. The accompanying illustrations were made using a computer program (SHAPE 2.0 by Eric Dougherty, modified for the Macintosh computer by Peter Richards, 1988). Actual Maine crystals were measured with a contact goniometer and crystal drawings were made using angle tables calculated by SHAPE. Two doubtful forms were observed, but which nearly exactly represent faces on the crystals examined. The following illustrations are labeled as to the locality of origin of the particular crystals. It should not be assumed that any one shape is characteristic of, or exclusively from, the locality indicated as many habits are found at a single locality, but there are some common crystal shapes and color combinations which collectors will recognize as typical of a particular locality.

Color Variation in Elbaite

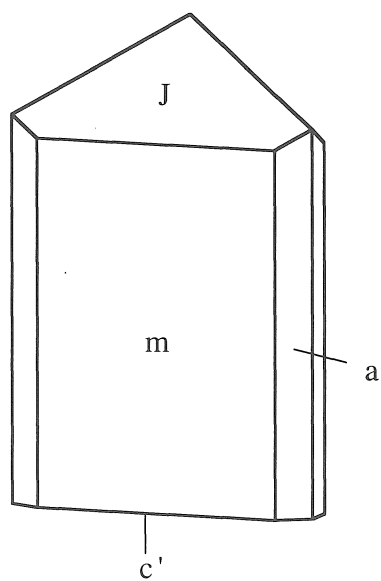
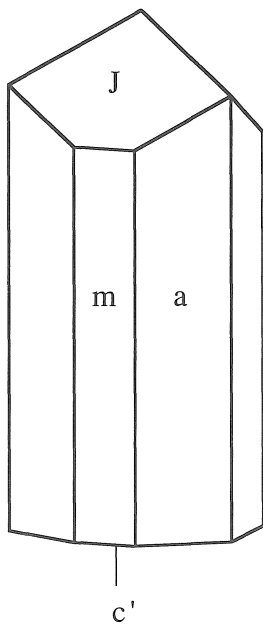
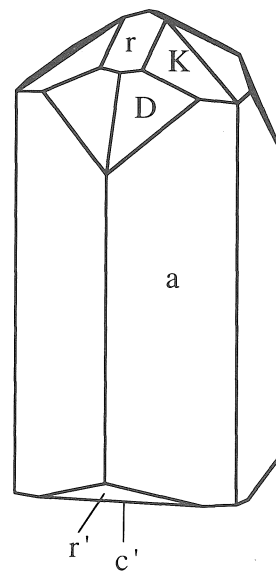
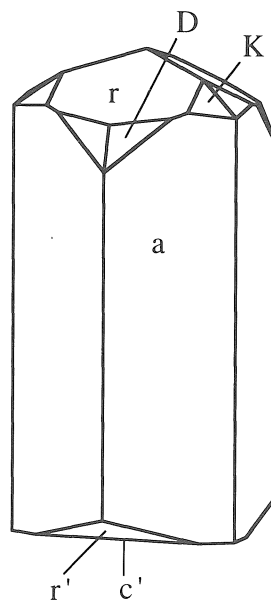
Tourmaline is Maine's official state mineral (Fairbanks, 1976), and though the law only specifies "Tourmaline" the intent was clearly to designate the transparent gem material. Only elbaite/olenite satisfies the gem requirement when known Maine specimens are considered. Elbaite is a member of the tourmaline group and there are several varietal names based on color. Rubellite is ordinarily reserved for red specimens, but the name is frequently applied to pink and purplish-red colors. Indicolite is blue tourmaline of any shade while verdelite is an uncommon name used for the green shades. The dark blue to blue black, as well as very dark green, tourmalines frozen in cleavelandite, which have frequently been called the indicolite variety of elbaite, are iron-bearing and can grade into schorl, however. (Quensel and Gabrielson [1939] wrote of a lithia tourmaline: "The highest content, 7.07 % FeO is found in a dark-green tourmaline from Auburn, Maine." Schorls can have just over 15 weight percent FeO, so the Auburn tourmaline cited is intermediate between schorl and elbaite/olenite.) Achroite is supposed to be absolutely colorless without hint of pink or green tints, but in practice the name achroite has been applied by writers such as Hamlin (1873, 1895) for nearly colorless elbaite, but which have extremely faint pink or green tints. Watermelon tourmaline undoubtedly first came from the Mount Mica quarry, Paris and is a combination of a concentrically zoned red or pink core with a green rind. (See descriptive section on watermelon tourmaline



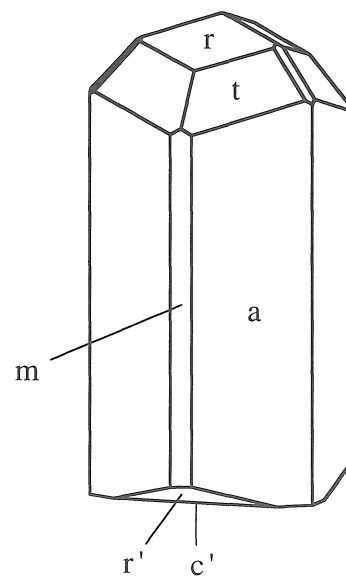
Pulsifer Q, Auburn



BB#7 Q, Norway

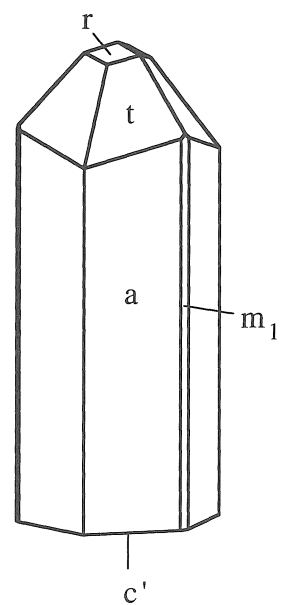
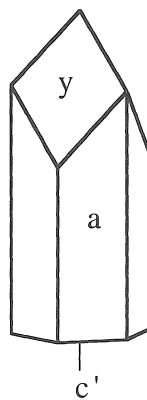
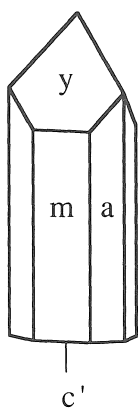
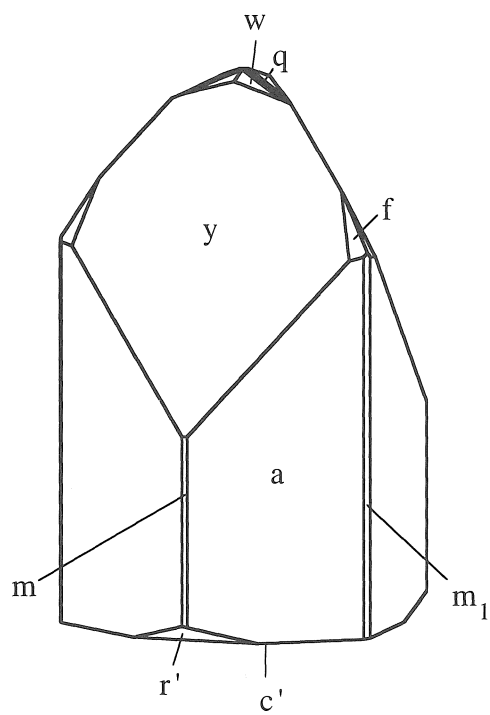


Bennett Q, Buckfield

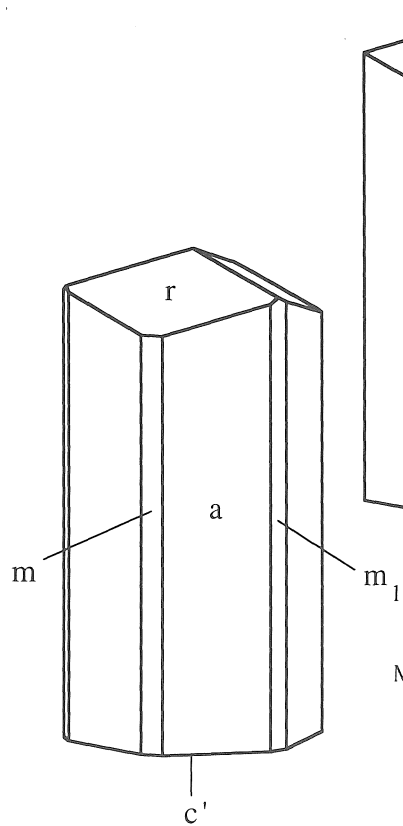


Mount Rubellite Q, Hebron

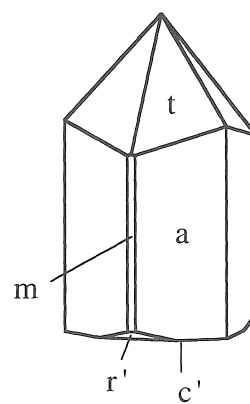
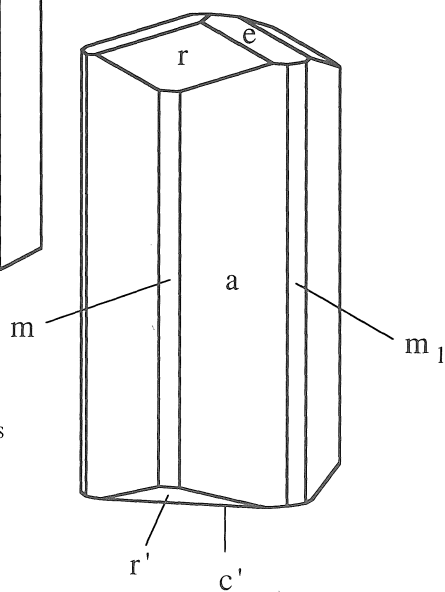
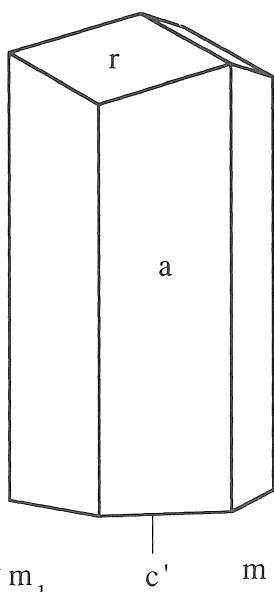
Elbaite



Fisher Q, Topsham



Mount Mica Q, Paris



Berry-Havey Q, Poland

Elbaite

for historical discussion of the name.) Cucumber tourmaline has a white or light green core with a green rind. Tourmalines which show color zoning along their lengths are called "bi-colored," "tri-colored," "multi-colored," etc.

Riggs (1889) discussed: "The question of color is one of some consequence, particularly when the varying colors of the lithia tourmalines are concerned. the lithia tourmalines, containing more or less manganese, give us the red, green, and blue, as well as colorless varieties; the shades of color not depending on the absolute amount of manganese present, but rather on the ratios existing between that element and iron. When the ratios of Mn : Fe = 1:1 we have the colorless, pinkish, or very pale green tourmaline. An excess of manganese produces the red varieties. If on the other hand, the iron be in excess, the result is the various shades of green and blue." Though Riggs' (1889) discussion is no longer exact, in detail, he was the first writer to show the role of iron and manganese in coloring tourmaline. Clarke (1899, 1900a) and Penfield and Foote (1899) also discussed the significance of Maine tourmaline chemical analyses.

Quensel and Gabrielson (1939) further summarized concerning coloring agents in Swedish tourmaline:

"According to JENKS [1935] a deposition from solutions with decreasing content of iron would give rise to the following succession of colours: black, dark blue, dark green, light green, blue, red, white, and colourless or pale red or green. The deeper colours are caused by bivalent Fe. With decreasing content of iron, the chromic properties of Mn assert themselves and occasion colours in red, rose or pink. The colourless tourmalines (achroites) or those of weak colouring are poor in both Fe and Mn. The succession blue-red from the center in the elbaïtes from Utö would according to JENKS [1935] denote a crystallization from solutions successively poorer in iron, the usual succession red-green from center outwards in the elbaïtes from Varuträsk would indicate reversed circumstances. ...

One finds ... that all green tourmalines contain FeO. All red tourmalines are on the other hand poor in iron in general. ... On an average the green tourmalines contain the same amount of Mn as the red. The red tourmaline holds all Fe as trivalent and some Mn in a higher stage of oxidation. This Mn gives the colouring as evidently is the case in heterosite and purpurite, though here in far weaker concentration. ... The bivalent salts of Mn are however so faintly coloured that the green colouring of FeO would in this case dominate."

Riggs (1889) analyzed lithia tourmalines from Auburn, Paris, and Rumford in an effort to better establish the formula for the tourmaline group. Many of the analyses of Riggs (1889) and Clarke (1900b) (Paris and Auburn) seem a little low in total alkalis, suggesting that the earlier analyses, even by the best chemists, have to be considered in the light of technological progress. Given the current rarity of olenite, few of Maine's specimens will likely require relabeling. The Maine occurrences here will be referred to by the familiar name elbaite without each time using the less precise, but possibly more accurate terms, *elbaite series* or *elbaite/olenite*. Penfield and Foote (1899) wrote:

"There is probably no common mineral whose chemical composition has proved more perplexing and been so little understood as tourmaline."

Reinitz and Rossman (1988) reported on the origin of rubellite color in elbaite:

"To consider the role of natural radiation in tourmaline coloration, two approaches were used. The first was to calculate the theoretical dose a crystal would have received from the host minerals of a typical pegmatite. The second involved actually measuring the radiation level in tourmaline pockets.

The theoretical dose was calculated using Jahns' (1954) description of a typical southern California granitic pegmatite. The crystal was modeled as a sphere 1.8 cm in radius in the center of a 1.0-m radius sphere of composition 60 mol% potassium feldspar, 30% quartz, and 10% albite. Because the pink tourmaline crystals are often in part surrounded by quartz, the calculation was concerned only with ⁴⁰K gamma radiation that is capable of penetrating to the interior of the pocket. From the mass attenuation coefficients for gamma rays (Davisson and Evans, 1952) the half-path length of the 1.5-MeV ⁴⁰K gamma ray through the idealized pegmatite is 5.25 cm. Under the simplifying assumption that the mass density of ⁴⁰K is constant throughout the granite, the calculation indicates that the mineral receives a dose of 30 Mrad over 100 m[illion]. y[ears], the approximate age of pegmatites in the Mesa Grande district (Foord, 1976).

To compare these estimates with the radiation level actually encountered in a pegmatite, a calibrated Geiger counter probe was placed in four tourmaline gem-pockets in the Himalaya mine, Mesa Grande, California, as they were being mined, and in an emptied pocket in the Maple Lode mine, Aguanga Mountain, California. In all cases these measurements indicated that doses of the order of 35 to 45 Mrad would be accumulated over 100 m.y."

Reinitz and Rossman (1988) discussed the role of the radioactivity of potassium in feldspar and its effect on the manganese present in rubellite. The radiation oxidizes Mn²⁺ to Mn³⁺ and the result is a darkening of the pink color. Specimens of Mn²⁺-bearing tourmaline were artificially irradiated by Reinitz and Rossman (1988) and the resulting production of dark pink color was visually identical with colors observed in naturally irradiated samples.

Elbaite - Variety Watermelon Tourmaline

Auburn - Greenlaw Q, Keith Q, Maine Feldspar Q, Pulsifer Q;
Buckfield - Bennett Q; **Georgetown** - Tourmaline P; **Greenwood** - Tamminen Q; **Hebron** - Mount Rubellite Q; **Newry** - Dunton Q; **Paris** - Mount Mica Q; **Poland** - Berry-Havey Q; **Rumford** - Black Mountain Q

Marble (1950a) reported that George Howe first used the term *watermelon* to describe concentrically color-zoned tourmalines, green rind and red core, when he examined Mount Mica quarry specimens (no date given). Perham (1987a) indicated the

original name was used on specimens from the Dunton quarry, Newry. The earliest known **published** use of the name *watermelon* tourmaline appears to be Sterrett (1911): "During the year 1910 a new deposit of tourmaline was opened on the land of F. L. Havey, near Poland, Me. ... Mr. George Howe, of Norway, Me., with the permission of Mr. Havey, has kindly furnished notes on the tourmaline taken from the mine... Some crystals (locally called 'watermelon' crystals) have pink centers and green margins." Watermelon tourmalines are also known from the Pulsifer and Keith quarries, Auburn and the Tourmaline prospect, Georgetown. An obituary for Howe stated: "He also gave the name 'watermelon' to the pink and green tourmalines ..." (Anonymous, 1949a).

The milky opaque watermelon tourmaline found at the Dunton quarry, Newry has been supposed by some collectors to be unique. In Maine alone, similar opaque and frozen-in-matrix watermelon tourmaline, though much smaller in size and far less frequent in occurrence, is known from Mount Mica quarry, Paris; Berry-Havey quarry, Poland; and Greenlaw and Pulsifer quarries, Auburn. The matrix of these milky watermelon tourmaline crystals is usually cleavelandite, but quartz and, rarely at Newry and Paris, pollucite can be the matrix. Relatively poor examples of watermelon tourmalines are known from Black Mountain quarry, Rumford, though multicolored longitudinally zoned fans are well-known. On a worldwide basis, similar specimens are known from Connecticut, South Dakota, many localities in Brazil, Varuträsk, Sweden, and even N'Dorabees, Namaqualand, South Africa (Larry Introna, personal communication, 1990). One importer/explorer of minerals said of the commercial scarcity of such watermelon tourmaline curiosities: "We can never admit to the natives that these curiosities have value otherwise we'd end up escalating the price of everything with the low-quality curiosities being priced at the level that the good specimens formerly were and the good specimens would be priced more exorbitantly."

By comparison of quality and quantity, the Dunton quarry does appear to be the premier locality for such opaque watermelon crystals. The watermelon elbaite from the Clark Ledge locality, Chesterfield, Massachusetts has very dark green rinds and differs from the pastel-colored Maine specimens. Wade (1909) described the Dunton quarry tourmaline: "The gem crystals are peculiar in themselves, for they nearly all consist of two crystals crossed obliquely. They are generally opaque and of a faint apple green color on the outside with a beautiful, clear or green center." Some watermelon crystals from the Dunton quarry have reached 75 x 15 cm. Kunz (1906) noted: "At Newry, a good deal of tourmaline has been found, some of the crystals very large, up to 4 inches in diameter; but at that place the crystals are not in pockets, but traverse the pegmatite in the manner of beryls, and hence liable to much breakage. At this locality pink tourmaline predominates over green." The milky, opaque crystals are not intensely colored, but are bright pastel shades of pink and green. This opaque watermelon tourmaline is usually embedded in cleavelandite, but can be found in spodumene, lepidolite,

pollucite, etc. Watermelon tourmaline crystals from gem pockets are generally glassy, and though not always transparent, possess a marked degree of translucency and so have an obviously higher degree of perfection. Gemmy watermelon-zoned crystals have been thin-sliced perpendicular to their length to show the colors when broken (unterminated) crystals were unsuitable for faceting. Only Mount Mica and Dunton quarry specimens have been so treated, due to the relative abundance of tourmaline from these locations. Even broken crystals are preferable to slices, from low production quarries.

Gemmy watermelon crystals are a little scarcer than the milky watermelon tourmalines. The Maine Feldspar quarry and the Keith (Towne) quarry, **Auburn** have produced nearly identical gemmy crystals with yellow-green to medium green, cracked or fractured rinds (several mm thick) on pink to intense red cores. The crystals are rarely terminated, but a few have pedion terminations. The larger crystals (to 7 x 2 cm) come from the Maine Feldspar quarry.

Rare specimens of Pulsifer quarry watermelon tourmaline can be multiply zoned beginning with a blue core, rubellite zone, and grass-green rind. The interface of the green rind and the rubellite zone can be etched and in-filled by cookeite and/or purple fluorapatite (Ray Woodman, personal communication, 1992).

The Groves quarry (also called "hole-in-the-ground"), Auburn has produced a single concentrically color-zoned gem tourmaline crystal at this writing. It does not have watermelon coloration, but instead is blue on one end and gemmy pink on the other. When viewed along the *c* axis, the blue end of the crystal (to 5 x 1 cm in three pieces) shows a pink rind (~2 mm).

Gem watermelon- and reverse watermelon-zoned elbaite crystals (to several cm) were recovered at the Bennett quarry, **Buckfield** (Dennis and Ron Holden, personal communication, 1993). The watermelon tourmalines were frequently pale in color and some of the pink cores were etched away. The reverse watermelon-zoned gem crystals were more spectacular. The three-faced pyramid terminations were intense crimson to purple with an adjoining achroite zone similar to the pattern of Mount Mica quarry specimens. The color of the new Bennett quarry crystals progressed through variegated green midsections through lightly greenish tinged, nearly achroite broken ends. A cross-sectional view of the broken end revealed a thin pink exterior on the light green core. Flannery (1993a,b,c) figured the crystals in color.

Mount Mica quarry, **Paris** is famous for its watermelon zoned crystals, but they are in fact few in relative number, at least in sizes over 2 x 0.4 cm. The crystals sometimes have a murky thick olive-green rind on pink to red cores, the proportions being about equally divided in cross-sectional area with a frequent preponderance of the green zone. The color plates of Hamlin (1895) are probably surreal when compared with the original specimens. Many of the watermelon tourmaline crystals from the 1989-1992 mining have transparent to subtransparent medium to yellow green rinds which are not appreciably fractured com-

pared with their pink cores. The pink cores almost all have silky tubes developed along their length which renders the core translucent. (Flawless, and even lightly flawed, crystals are rare.) Frequently the tube development is so extreme that the core has a visible tube developed and sometimes virtually all of the pink core has been dissolved away leaving only the green rind. Sometimes the larger tubes are in-filled by cookeite. A few crystals were observed with the etching and dissolution on the outside of the crystal. Most of the watermelon zoned crystals have a pedion termination, sometimes with rounded triangular growth hillocks. Etched low pyramidal terminations were scarce. The color zoning is frequently asymmetrical, with the pink core present only near the unterminated broken end, and the large majority of the length being green and/or bluish green. Some color-zoned crystals appear to be fragments of watermelon tourmalines. The generally much-fractured crystals have a thin green ridge or stripe affixed to a larger pink section. The result is a parallel growth of color rather than a concentric arrangement of colors. The crystals may represent broken crystals which have been fractured longitudinally and have some regrowth. Good faces are scarce on these pieces.

Elbaite - Variety Blue Tourmaline "Eyes"

Auburn - Groves Q, Keith Q, Maine Feldspar Q; Greenwood - Harvard Q; Hebron - Hibbs Q; Newry - Dunton Q; Paris - Mount Marie Q, Mount Mica Q; Rumford - Black Mountain Q

Blue tourmaline "eyes" specifically from Mount Mica quarry, Paris and the Dunton quarry, Newry have long been known. Some collectors have mistakenly believed that the eyes were made of vivianite. At Mount Mica quarry, for example, there is present, in quantity, a peculiar blue tourmaline (indicolite) which surrounds garnet, triphylite, löllingite, and muscovite. The blue tourmaline surrounds garnets in a thin armoring (generally 2-3 mm) and the armoring is consistently thick on 1 cm garnets as well as 7 cm garnets. Similarly, blue tourmaline armors dendritic triphylite grains. Moore and Ito (1973) described similar tourmaline/phosphate armoring and discussed three-dimensionally dendritic phosphate grains: "Rather, the patches of phosphate-silicate assemblages, their crystallographic concordance, the preservation of continuous exsolution profiles, and the morphological outlines suggest a phosphate-silicate eutectoid fluid which, prior to co-crystallization, possessed the property of a smectic liquid or gel permitting crystallographically oriented separation of individual phases like marble cake." The implication is that phosphate-rich fluids can separate from silicate-rich and/or aqueous-rich pegmatite-forming fluids as a separate "bubble." The concept helps to explain the pod-like nature of pegmatite phosphate occurrences.

The blue tourmaline varies from a light blue-green ("Faint Blue," Royal Horticultural Society (1966) #111C), through medium blue ("Oriental Blue," RHS #110A) and a deep Cobalt

Blue (RHS, #101A). Masses of blue tourmaline in the peculiar box-works texture resulting from the armoring of dendritic triphylite can be up to 20 x 20 x 20 cm. The blue tourmaline of this type is found hosted by the coarse cleavelandite variety of albite plates (to 5 x 5 cm). The in-filling minerals are typically fine-grained (1 mm or less), but individual rhodochrosite cleavages to 2 x 5 cm have been observed.

Hamlin (1895) and Bastin (1911) have indicated that a garnet-rich "band" has been consistently found below gem pockets and has been recognized as the limit below which gem pockets have not been found in the Mount Mica pegmatite. Garnet armored by blue tourmaline occurs below and within (to a small extent) the zone containing gem pockets at the Mount Mica quarry. The garnet within the tourmaline armoring is virtually unaltered in every case observed. The triphylite within the tourmaline armoring, while sometimes unaltered is frequently oxidized, replaced, or completely dissolved, with or without in-filling by carbonates, secondary phosphates, clays, etc. Such hollow tourmaline-walled structures also have been called tourmaline "eyes" by collectors.

The "eye" or armoring which coated the triphylite provided a mold within which siderite and/or rhodochrosite (both have been observed) replaced the triphylite. Additionally, late stage fluids in the Mount Mica pegmatite dissolved the triphylite and precipitated secondary phosphates including autunite/meta-autunite, brazilianite?, crandallite, diadochite, eosphorite, evansite?, fairfieldite, fluorapatite, glucine (Paul B. Moore, personal communication, 1990), heterosite, hureaulite, hydroxylapatite, jahnsite-(CaMnMn), kosnarite, laueite, mccrillite, mitridatite, montebrasite, moraesite, "roscherite," stewartite, strunzite, and several incompletely characterized phosphate species. Additionally, halloysite, hisingerite?, kaolinite, löllingite, montmorillonite, muscovite, pyrite, and drusy quartz crystals are found in-filling the tourmaline-lined vugs. (Phosphates known from the Mount Mica Pegmatite which have yet to be observed within the tourmaline armored vugs include: goyazite, hurlbutite?, and hydroxyl-herderite.)

Similarly, tourmaline armoring around triphylite, siderite/rhodochrosite replacements of phosphates, and, occasionally, löllingite or arsenopyrite, has been observed from the Dunton quarry, Newry, Maine; Hibbs quarry, Hebron, Maine; Mount Marie Q, Paris, Maine; Black Mountain quarry, Rumford, Maine; Maine Feldspar quarry and Groves quarry, Auburn, Maine; Harvard quarry, Greenwood, Maine; Bob Ingersoll quarry, Keystone, South Dakota; Victory pegmatite, Custer, South Dakota; Varuträsk pegmatite, Sweden; Viitaniemi pegmatite, Finland; and Sapucaia pegmatite, near Linopolis, Minas Gerais, Brazil. The Keith quarry, Auburn has lithiophilite and its alteration products sometimes encased in blue tourmaline eyes. All of these localities contain very conspicuous amounts of tourmaline (schorl and elbaite/olenite), in addition to the tourmaline armoring, indicating the very boron-rich character of the pegmatite-forming fluid at these localities. The first report of such blue tourmaline eyes was made by Fraser (1930): "Still

another phase of tourmaline is widely distributed at Newry. It is opaque and granular of a bright blue color and always appears as borders about triphylite or in veins cutting it. It is clearly replacing the phosphate. Whether it is formed before or after the associated siderite could not be established." Quensel and Gabrielson (1939) wrote of Varuträsk, Sweden: "Nearly without exception the center parts of the patches, occupied by minerals of the triphylite-varulite series or their oxidation-products, are surrounded and encircled by a rim of light-blue indigolite [sic], seldom exceeding 3-4 mm in breadth. The concentric tourmaline ring is singularly regular in its configuration, conferring to the patches a very characteristic appearance..." Quensel and Gabrielson (1939) noted: "single tourmaline-encircled triphylite aggregates reaching, according to Fraser's description, up to a foot in diameter." While complete aggregates of this size may have existed in the outcrop, available specimens are virtually always half this size (≈ 15 cm) or less. Fraser (1930) indicated only that triphylite masses reached 30 cm and that: "It is generally surrounded by a border of bright blue massive tourmaline which also forms veins and irregular replacement areas in the triphylite." The "veins," however, have a *herring-bone* pattern and probably represent the tourmaline forming a coating and/or replacement of the dendritic phosphate pod surface. The dendritic triphylite pod probably formed in an immiscible phosphate-rich fluid which separated from the silicate-rich and aqueous-rich pegmatite fluids as envisioned by Moore and Ito (1973). The discussion of blue tourmaline eyes has been published in abbreviated form (King, 1991a).

Tourmaline Pockets

Wade (1909) described *Approaching a Gem Pocket*:

"The miner knows he is nearing a pocket by the following changes in the 'mineral sheet.' First, a very curious rock composed of quartz and black tourmaline having the structure of graphic granite is encountered. The tourmaline crystals are all parallel plates or lenses and seem to have been stretched while cooling if they were formed from a fluid magma. They are so close to the pocket, however, and the quartz appears so very much as if it were water deposited, that it is likely that both the quartz and tourmaline crystallized from hot acid aqueous vapor and that the surrounding crystallographic relations were such that the tourmaline was forced to crystallize in one plane.

After the black tourmaline and quartz, lepidolite makes its appearance and runs to the pocket. There is often standing over the pocket large plates of muscovite with radial opaque pink or green tourmaline crystals intergrown between the mica plates. The muscovite often changes on its lower edge to lepidolite when the plates extend into the top of the pocket. Sometimes this lepidolite border will go all around the muscovite plate. I observed one diamond-shaped muscovite plate a foot across with a 4-in. rim of lepidolite around it.

Quartz of a smoky hue is generally associated with the large mica plates. The upper half of the cavity itself is generally quartz, mica and

cleavelandite, the lower half being a porous decayed potash feldspar. The quartz, mica and cleavelandite growing into the top of the pocket are all beautifully crystallized. Pink and green tourmaline crystals are often grown into these quartz points. Most of the gems, however, lie in the mud or clay which partly fills the lower half of the pocket. Though many crystals are broken or badly flawed, others are perfect.

Many of the pockets contain no gems or apatite and are locally called 'dead pockets.' When an excessive amount of lepidolite occurs around a pocket it will be found to contain apatite with little or no gem tourmalines. It seems as if all the lithia was consumed by the mica and none left for any gems. In fact black tourmaline in small crystals is sometimes found in these pockets, which would beyond doubt have become gem or lithia tourmaline could they have secured the lithia."

Description of Specimens

Andover North Surplus

Pink crystal sections (to 3 cm) in quartz and feldspar matrix have been labeled tourmaline from Dunns Notch area, **Andover North Surplus**, but the only specimen observed appears to be pink andalusite.

Auburn

Auburn was an important Maine producer of elbaite tourmalines. At least six major quarries and several minor ones have produced gem tourmaline. The Hatch quarry produced excellent tourmalines as Kunz (1884b) reported:

"Nearly 1500 crystals have been found, from very small ones 10^{mm} to the largest one 105^{mm} long. They differ in general appearance from the other Maine tourmalines, and are as a rule somewhat lighter in color and of more brilliant polish. They are found colorless, light pink, light blue, light puce colored, bluish pink, and light green, and at times nearly all these colors are found in one crystal. As a rule sections show the characteristic variety of color, such as blue and pink, green and pink, colorless and green or pink, or bluish, when viewed through the length of the crystal. Some of the faintly colored crystals afforded gems that deepened very much in color after cutting.

The crystals are generally hemimorphic, terminated with a modified pink cap at one end, and at the other with a basal termination which is often white, and either loose in the cavities, or else on, and oftentimes penetrating, smoky quartz and feldspar. The majority of the crystals were more or less flawed."

Kunz (1885) added: "During the last summer the north side of this locality has been worked by Mr. G. C. Hatch and Mr. T. F. Lamb, and much darker material has been found, especially the green colors, some of which equal anything found at Mount Mica." One Hatch Farm quarry doubly terminated elbaite (about 0.8×3 cm) was color zoned pink on the pyramidal end and pinkish gray on the pedion terminated end. This crystal was

coated by granular to scaly "cookeite" and embedded in a smoky quartz crystal, which had a thin discontinuous "skin" of milky quartz, in such a way as to form an indented, tourmaline-filled notch through the termination and upper prism of the quartz crystal. (This particular crystal was acquired by Clarence Bement in 1889 (Lawrence Conklin, personal communication, 1991).)

Perham (1957a) noted of the Greenlaw quarry, Auburn: "Among many remarkable pockets of stone to go through their shop was the great find, that Greenlaw made at Mount Apatite, of Blue tourmaline." Matrix specimens of Greenlaw quarry elbaite are scarce and are frequently encrusted by cookeite. Most of the single crystals (to 3 x 0.4 cm) are greenish blue to a vivid light blue. They are technically indicolite, and have locally been called *Alice-blue* (Sterrett, 1911). *Alice-blue* originally referred to the color of a light, but not pale, blue ballgown worn by Alice Roosevelt, daughter of Theodore Roosevelt and was the object of a popular song, *Alice Blue Gown*. The majority of the observed Greenlaw quarry elbaite crystals have light, even shades of green and the ditrigonal pyramid is a common terminal form.

Many matrix specimens of elbaite from the Pulsifer and Towne quarries exist. The crystals, generally pink to clear zoned, are flat-lying against quartz crystals and/or attached to lepidolite. Bastin (1911) wrote of the Keith (Towne) quarry:

"At the time of the writer's visit only two gem-bearing pockets had been found. One of these bore dark grass-green tourmalines and the other light-green tourmalines tipped with opaque pink. The largest of the dark-green tourmalines was about three-fourths inch in diameter and 1 1/2 inches long but was badly flawed."

Specimens which are actually labeled Keith or Towne quarry are scarce. Some crystals which are known are a very peculiar grayish purple not too different from some grayish purple fluorapatite, and it is easy to imagine that Pitt Pulsifer was confused by the first discovery of purple apatite on his property. The purple tourmalines should not be confused with apatite as the tourmaline crystals (generally 3 x 1 cm or less) have a basal pedion termination without pyramidal modifications and the combination of several vertically striated prisms yield the rounded triangular cross-section which is typical of tourmaline. Kunz (1885) reported:

"The tourmaline mentioned in Hamlin's 'Tourmaline,' page 72, was found about 1860, by Augustus Lane, at Welcome's Corner, on the Boutelle farm. This specimen was first recognized by Dr. Hoar. The locality is about half a mile from the Hatch farm, and the indications were found by Dr. Hamlin on working, in 1860 and 1862, to be the same as at the Hatch farm."

No specimens are known to represent the Welcomes Corner locality, but the Towne (Keith) quarry and Hatch Farm sites are close to being equidistant between Welcomes Corner and Haskell Corner. Wülfing (1902) reported on the optical properties of Auburn and Rumford lithia tourmaline.

The Pulsifer Quarry, Auburn was always a small tourmaline producer. Szenics (1968) indicated that several interesting colors were found during his mining: "The best of these pink tourmalines are 2 1/2 inches long by 1/2 inch wide, cinnamon-pink in color, all striated and internally flawed, but quite clear." Additionally, emerald-green facetable crystal sections to 55 carats were found. Szenics (1968) illustrated a selection of elbaite crystal sections which seem to have an intense blue component, but the color may be the result of unusual lighting and backgrounds. Several of the "cinnamon" pink elbaites are also illustrated and they appear to have the light "sherry" color of some topaz from Thomas Range, Utah.

The Groves quarry, also called "the hole in the ground," Auburn was prospected in 1992 on the site of the Plumbago prospect. A single remarkable gem elbaite was found in three sections (about 5 x 1 cm). One end was a uniform deep pink while the other end is a medium blue indicolite with a thin (2 mm) red rim. Viewed from the side, the indicolite section does not show any red color. Additionally, translucent to opaque elbaite is conspicuously intergrown in quartz-muscovite pegmatite.

Buckfield

Sterrett (1914) wrote of **Buckfield**: "The Lewis mine [=Dudley Ledge quarry = Westinghouse quarry], worked by Perien Dudley, is about 2 miles southwest of Buckfield. It is in the eastern side, near the summit of a low but steep-faced hill. The work consists of two connecting open cuts extending up and down the hillside for a distance of about 120 feet. ... Orthoclase or microcline occurs in rough crystals several inches across and in graphic intergrowth with quartz. Translucent green and bluish-green tourmaline with occasional pink crystals have been found frozen in the pegmatite along with muscovite, biotite, and cleavelandite. Pockets ranging from small size to 2 feet in diameter are reported to occur scattered irregularly through the pegmatite."

Landes (1925) wrote of the Bennett quarry, Buckfield elbaite: "One of the first pockets opened at Buckfield contained two fine gem crystals of tourmaline, five centimeters long. Many small clear green unattached tourmaline crystals were found later. A few very small crystals also appear among the lepidolite, cleavelandite, and quartz specimens. ... Sometimes very thin needle-like and doubly terminated tourmalines are found in this pocket sand." Many splintery, etched crystals have been found which vary from dark green to a washed-out pink color, usually in combination on a single crystal (to 1 x 0.3 cm). The Bennett quarry produced some very dark green to dark blue to dark violet crystals which are so dark that they appear black. Crystals (to 2 x 1 cm) with pedion terminations have typical rounded triangular cross-sections. Crystals with pyramidal terminations are large (to 7 x 3 cm). The edges of the simple pyramid can be vitreous while the faces of the pyramid appear deeply etched to frosted. When viewed along the *c* axis, such terminations appear as triskelions, or three-rayed stars, bounded by dull, frosted faces which may

or may not have a cream to white clay coating. Pedion terminations are fairly common. A few pseudocubic pyramidal terminations have been observed on Bennett quarry elbaite.

In the 1990 field season, some large greenish black elbaite crystals (to 20 x 4 cm) were found at the Bennett quarry. These elbaites had a fibrous bulbous terminal end. A few grass-green crystals (to 5 cm), complexly sheaved in multi-generation cookeite were also found. The elbaite was frequently etched and had several transverse fractures. Some of the cookeite-encased elbaites are concentrically zoned dark green to green to pink and qualify as highly etched watermelon crystals. As at Mount Mica quarry, the pink core can be selectively etched and sometimes tubes are developed along the length of the core.

Further discoveries of elbaite in 1993 (Ronald E. Holden, Jr., personal communication, 1993) included a large (to about 15 x 10 cm) high lustered rubellite-cored elbaite. This large crystal had a somewhat murky outer skin of brownish-green elbaite, but has relatively smooth faces including vertically striated prisms as well as several trigonal pyramids; some parallel-growth crystals on the main crystal were about one quarter of the volume of the main individual. Some similar smaller crystals (to 4 x 1 cm) had deep red color zones on the termination with light gray shafts. Several crystals had a red termination, nearly achroitic central zone on a green shaft, and very much resembled Mount Mica quarry specimens. Some elbaites in quartz near the margin of gem pockets were color zoned black-smoky green-light olive green-to reddish pink (Ron and Dennis Holden, personal communication, 1993). Some watermelon-zoned (q.v.), as well as reverse watermelon-zoned, elbaite crystals (to several cm) were recovered at the Bennett quarry in 1993 as well as a complete gem elbaite nodule (about 18 carats; 1.5 x 1.4 x 1.2 cm) showing olive to pale blue-green dichroism.

Township D

The Bemis Stream prospect, **TD** has produced fans (to 10 cm) of prismatic unterminating cloudy grass-green, and darker shades of olive-green, elbaite crystals (to 6 x 0.8 cm) in cleavelandite, milky quartz, and blocky perthite.

Dixfield

Putnam and Perham (1969) provided the brief entry for **Dixfield** tourmaline: "Charles Marble said he cut several good pink and green stones from material found during road work." Holman (1965) noted *colored tourmaline* from Little Brown Mountain, Dixfield: "... blue and black tourmaline also some green ..." No Dixfield elbaite known.

Falmouth

Perham (1959) wrote: "H. M. Haven, deceased, formerly of Portland, Maine and an ardent mineral collector, reported verbally to S. I. Perham that pink radiated tourmaline was found

at Falmouth while blasting went on for the new Falmouth High School." No Falmouth elbaite known.

Georgetown

Some very fine bi-colored elbaite crystals have been found in gem pockets from the Tourmaline prospect (also known as the Harvard Cut), **Georgetown** along with transparent spodumene crystals (Raymond Woodman, personal communication, 1974). Some collectors erroneously refer to the locality as the Consolidated quarry. The largest crystal (9.7 x 2.2 cm; HU collection) is unterminating and the fragmented crystal is severely etched along the breakage points. The various crystals known contain large facetable areas of grass green color with irregular color boundaries next to slightly flawed pinkish brown, but also facetable tourmaline.

Schaller (1917b) noted: "Fine pink and green tourmalines were found near Georgetown." The statement apparently was made concerning the Consolidated quarry, Georgetown, but could have referred to the Tourmaline prospect. Green radiating needle elbaite crystals (to 1 x 0.1 cm) have been found in cleavelandite and lepidolite at the Consolidated quarry proper. Morong (1990) wrote: "(colored tourmaline) rarely found, pink to green, but sometimes dark blue; usually as partially decomposed bits, and rarely as good specimens".

Greenwood

The Noyes Mountain area, **Greenwood** is riddled with quarries and prospects, many of which have yielded excellent museum grade specimens. Bastin (1911) wrote of a locality which is now probably referred to as the Harvard quarry:

"A small abandoned mine which has yielded many interesting mineral specimens and some gem tourmalines is situated about three-fourths of a mile east of Hicks Pond in the northern part of the town. The pit, which is 15 feet in width and about 25 feet long, is located on the western slope of a steep forested hillside, near its summit. ...

Pockets are numerous, most of those observed being under 1 foot in diameter. One gigantic one was 7 feet wide and 10 feet long, with a depth of at least 4 feet, the floor being buried under a considerable thickness of detritus; numerous small lobes add irregularity to its form....

The locality has yielded a considerable number of tourmalines of gem quality, but very few have been marketed, much of the material being still in the hands of George Noyes, of Fryeburg, who developed the property. Other minerals occurring here are apatite in small, opaque, olive-green crystals (present in great abundance in some of the fine-grained parts of the pegmatite), opaque, pale lilac-colored spodumene, cassiterite, beryl, hercynite,^a zircon, and phenacite. ...^a[see hydroxylhercynite]"

The Harvard quarry is on the southwestern limb of Noyes Mountain (300 meters from Mud Pond and "three-quarters of a mile"

southeast from Hicks Pond). It is not possible to be 1.2 km east of Hicks Pond and remain on the western slope of Noyes Mountain.

Elbaite, from the quarry later to be known as the Harvard quarry, was actively distributed by Chamberlain (1894): "Cut Tourmalines from Greenwood, Me. 25 C[en]ts. to \$1.00." The tourmaline observed at the locality usually occurs in green shades, but some blue tourmaline eyes are known. Terminated, deep green transparent elbaite crystals (to 3 x 0.5 cm) are found embedded in fine-grained cookeite. The crystals can be variously terminated depending on which end of the crystal is presented. Much fractured to crackled crystals can be found in the cookeite, sometimes with cookeite cementing the fractures, as well as highly etched and dissolved portions of crystals. Hollow "log" crystals are occasionally found. White-cored green tourmaline crystals (to several centimeters) from this locality have been called "cucumber" tourmaline. The cucumber tourmalines are sometimes genuinely color-zoned crystals, but frequently they are hollow "log" crystals which have been in-filled by fine-grained white to pale green or yellow-tinted cookeite. Some specimens have been labeled that the in-filling was a montebrasite-group material, but no data are available and no such specimens have been observed during this study. A few "pocket" crystals are known which have a fibrous to columnar appearance with a sharp triangular cross-section and the crystals have a reverse taper from the point of attachment (e.g. 7-8 mm) and curve or fan-out along their length (5-6 cm) and abruptly become blunt on the termination. The bulbous end of these peculiar crystals can be over 1 cm. A third kind of elbaite is found as thickly grown flat-lying "jackstraw" crystals (to 2.5 x 0.2 cm) embedded in silvery white, slightly undulatory muscovite. Transparent terminated deep green elbaite crystals are also found at the Harvard quarry embedded in cookeite and cleavelandite and associated with occasional cassiterite crystals.

The Tamminen quarry, Greenwood has a small quantity of elbaite which is generally embedded in cleavelandite with thin irregular black staining, quartz, or petalite and frequently in all three. Mottled or irregularly zoned greenish blue, green, and pink non-gem crystals (to 10 x 3 cm) which are doubly terminated are known. Dark green to pink fans (to 7 x 3 cm) have been found. One small pocket was found with beautiful transparent multi-colored needle crystals (about 5 x 0.2-3 cm), but the crystals were lost by a child (Nestor Tamminen, personal communication, 1974).

The recently opened Gross prospect, Greenwood, between the Harvard quarry and the West Hayes Ledge quarry, has produced gem quality elbaite. A pocket opened in 1992 contained many hundreds of carats of facet grade green to blue-green elbaite (Dennis Gross, personal communication, 1992). The crystals (to 4 x 0.5 cm) were smoothly etched and have rounded terminations as well as numerous terraced to scalloped etch features on the surface of the crystals. Sometimes small furrowed "chicken track" etch lines are seen on the prisms. The elbaite in matrix is frequently transversely fractured at regular intervals

along the prism when completely encased in a fine-grained yellow to yellow green cookeite similar to the massive cookeite from the Harvard quarry. The elbaite appear to be gemmy crystal fragments jumbled in the "cement" of the cookeite. Some fractures of crystals are in-filled. (Some of the Gross prospect elbaite was misrepresented, by a mineral dealer, as being from Mount Mica quarry to disguise the new source.)

The Emmons quarry, Greenwood produced some white "cottony" aggregates (to several mm) of acicular elbaite crystals on etched microcline. Green elbaite was found during the 1930's mining episode (Perham Stevens, 1972; Perham, 1987b). A few specimens of bi-colored blue and pink elbaite have also been found (Joseph Pollack, personal communication, 1972). Mining in the 1992 season produced a quantity of small (several mm to 1 cm) blue-tipped rubellite crystals resembling miniature examples of crystals from the Tourmaline Queen mine, Pala, California. The rubellite crystals had a dominant basal pedion with occasional small pyramid faces. The very surface of the basal face varied from dark blue to bright blue. Virtually the entire length of the crystal was rubellite with a rosier to slightly more purple coloration below the blue zone. A few crystals were doubly terminated with a complexly pyramidal murky green-tipped termination opposite the blue one. The prisms of the crystals were frequently coated by muscovite or colorless acicular elbaite. Only one "blue hat" pocket was encountered (Ray Sprague and Tony Wielkiewicz, personal communication, 1992). A few pink to cinnamon pink elbaite crystals (to 2 cm), without other color zones, were also found. Some large multicolored elbaite crystals (to 15 x 2 cm), with gem areas, were reassembled from fragments.

Hebron

Dick Nevel uncovered a small elbaite pocket at Mount Rubellite quarry, **Hebron** in 1934 (Francis, 1985; Priscilla Stearns Bryant Chevarie, personal communication, 1992). The largest three elbaite crystals (HU 94101) consist of gemmy green to gray green prisms with red to purple tips. Formerly, very few gem elbaite crystals had been found at this locality. The majority of elbaite specimens were red fans frozen in matrix, were opaque, and were frequently slightly to completely replaced by mica (lepidolite and/or damourite). Bastin (1911) wrote: "Colored tourmalines have been found at this locality, but for the most part in the solid pegmatite rather than in pockets, so that their excavation without shattering was not practicable. As may be inferred from the name given to the locality, the pink or rubellite variety was of common occurrence." One gemmy red crystal found in the nineteenth century is a less than 2 cm color-zoned rubellite crystal (ruby red top grading into a pinkish red prism) with a basal termination extending out of lepidolite (BM collection). With few hard-won exceptions, the Mount Rubellite quarry was never a major mineral location and much of the locality's reputation is based on its early operation date and its small production of rare

minerals, including being the co-type location for cookeite. Most of the tourmaline fans (to 7 x 15 cm without matrix) had a milky raspberry red color. Infrequently, terminated milky pale rose elbaite crystals (to 7 x 1 cm) were found in quartz. Color zoning was frequent in the Mount Rubellite quarry tourmaline specimens, and many fan-grouped crystals grade from raspberry red through rose pink to a murky pinkish white and occasional light blue. Some gemmy green elbaite crystals (to 3 x 0.8 cm) with dark green pedion termination faces were found in lepidolite (BM collection). Small elbaite crystals (generally less than 1 cm) are pale green and may have pale pink terminations. These small crystals generally show first- and second-order prisms with a ditrigonal pyramid truncated by a trigonal pyramid. Tschermak (1902) reported on damourite (q.v.) and lepidolite pseudomorphs of tourmaline from Hebron.

Two unusual elbaite crystals from "Hebron" deserve mention. The first consists of a smoky green shaft with a light cinnamon tan upper half of the crystal with a steep trigonal termination. An irregular red median stripe bisects the 2.1 x 0.8 cm crystal. A second crystal (2.1 x 1.8 cm) is green at the complex ditrigonally terminated end with a muted gray-pink zone on the fractured end. An unusual feature of the second crystal is the presence of numerous striations "beaded" with elongated and irregular parallelogram etch pits. "These two crystals are unlike any of the few elbaites known from Mount Rubellite" (Jim Mann, personal communication, 1993).

Newry

It had long been rumored that no gem pockets were to be found at the Dunton quarry, Newry, previous to the 1966 pocket of Dick Robinson and, of course, previous to the 1972-1975 episode of mining. The early fame of the Dunton pegmatite rested on its production of rare minerals, including commercially valuable quantities of pollucite, and opaque watermelon tourmaline crystals frozen in pegmatite. Wade (1909) wrote: "The *gem* [emphasis added] crystals are peculiar in themselves, for they nearly all consist of two crystals crossed obliquely. They are generally opaque and of a faint apple green color on the outside with a beautiful, clear red or green center." Bastin (1911) reported of the early finds: "Most of the tourmaline is an opaque dark blue-green, though some is nearly black. Association of this variety with the cleavelandite is particularly common. Other tourmalines of lighter color are also abundant, particularly varieties characterized by pink centers surrounded by borders of light grass green. Some of these crystals are transparent in part and have yielded gem material, but they are inclosed in the solid pegmatite and are difficult to remove without shattering. Some of the pink and green tourmalines are of large size, one being reported as 4 to 5 inches across and about 2 feet long; the larger ones, however, are not of gem transparency. So far as known no pockets have been encountered. ... In view of the fact that no

pockets have yet been found it seems rather doubtful if further excavation will reveal any."

Fraser (1930) said much the same as Wade (1909) and added:

"The tourmaline is at times uniformly colored, pink or clear green throughout and such crystals, although embedded in quartz or spodumene, may sometimes be extracted with distinct termination. In parts of the pegmatite the tourmaline is light to dark blue in clear transparent crystals generally enclosed in quartz or amblygonite. It would appear that such crystals were attached at one end and grew out into an open space or a liquid-filled cavity. The tourmalines are often replaced by later minerals. In several specimens a layer of lepidolite was formed around a tourmaline crystal and in one specimen there were several alternating layers of lepidolite and quartz around a tourmaline crystal.

Another phase of green lithia tourmaline is in slender needles intergrown between the leaves of books of mica both muscovite and lepidolite or in radiating 'sun-bursts' in cleavelandite. ...

Still another phase of tourmaline is widely distributed at Newry. It is opaque and granular of a bright blue color and always appears as borders about triphylite or in veins cutting it. It is clearly replacing the phosphate. Whether it is formed before or after the associated siderite could not be established."

The crystallography of Dunton quarry, Newry elbaite was described and measured by Fraser (1930). The Newry crystals were further generalized by Dunn (1975), but Miller indices were not given by him. Beesley (1975) reported on the optical properties of various colors of Dunton quarry elbaite and noted an unusual faint to moderate chalky blue fluorescence of Dunton quarry elbaite visible under short wave ultraviolet light, but not under long wave ultraviolet light. The largest complete pocket tourmaline from the Dunton quarry is the "Jolly Green Giant" (27 x 10 cm) and is figured by McCrillis (1975), Dunn (1975a) and Perham (1987a). A larger re-assembled green elbaite is also known. The Dunton quarry gem pocket crystals are exceptional for any locality. The transparent green and blue green crystals can be nearly completely transparent (to 4 x 7 cm) and have steep pyramidal development. The prisms are deeply vertically striated. Peculiar light, randomly placed indentations, which resemble straight "chicken track" scratches, are frequently present on the steep pyramidal faces. The terminal faces, especially the steep pyramids, are frequently frosted. Broken crystals (commonly 5+ cm in diameter), show fine to coarse etch hillocks on the fracture surfaces. Watermelon crystals are abundantly represented among the gem crystals. (Cut and polished slices have been made of this material.) The color zones consist of thin rinds (1-5 mm) of light to medium green elbaite overgrown on commonly purple-red, so-called "raspberry jam color," gem quality cores of relatively uniform deep color. The upper third or so of the larger crystals are generally composed of gemmy, non-facetable, medium green elbaite.

A single deep pink, steeply terminated elbaite crystal (about 9.8 x 2 cm) has been found embedded in gray quartz at the Dunton quarry, in contrast to the usual watermelon-zoned specimens.

The Martin quarry, Newry was prospected in 1990 and lies between the Nevel quarry and the tiny Crooker quarry. The Martin quarry has produced some exceptional flawless terminated indicolite crystals (weighing up to 155 carats). Gemstones cut from the indicolite are dark blue, but have been lightened after cutting by heat treatment (Joseph Martin, personal communication, 1992). Cloudy dark indicolite crystals (to 7 x 1.5 cm) from the Martin prospect, frozen in slightly rusty milky quartz, somewhat resemble indicolite from the Crooker quarry. The indicolite crystals embedded in milky quartz from the Crooker quarry can have smooth lustrous faces and the crystals are generally superior to those found in similar matrix, thus far, at the Martin quarry.

Norway

Bastin (1911) wrote: "At Tubbs Ledge, 2 miles northwest of Norway village, a pegmatite mass which has been blasted at several localities in a pasture shows orthoclase, white quartz, rose quartz, cleavelandite, black and green tourmalines, and lepidolite, the latter a granular aggregate of unusually small plates. The presence of lepidolite, colored tourmalines, and cleavelandite shows that the locality is a favorable one for further prospecting for gem tourmalines." Antique specimens from this locality consist of olive-green tourmaline prisms (to several cm) embedded in a fine-grained nearly white to pale lilac lepidolite. The locality is very promising for gem production.

The tourmalines from the BB #7 quarry, Norway are perhaps more notorious in Maine than anywhere else. Except for rarely granted permission and even rarer field trips, few collectors have been to the site. Shaub (1955) wrote of the tourmaline find:

"The site of the immediate operations for the mica was called the B.B. Mine from the initials of the lessors [Mr. Benson and Mrs. Brown].

As operations got under way and considerable mica was obtained, it was discovered that the mineral pollucite was present and associated with cleavelandite. ... Since most of the minerals usually associated with colored tourmalines, especially the pollucite, were present in the mine operated by Mr. Perham, it was to be expected that at least an occasional colored tourmaline might be present. ... Consequently, in the spring of 1954 the mining operations were moved along the pegmatite about 75 yards to a place where the surface showings, after the soil was removed, indicated a more favorable site for commercial muscovite. This site is the B.B. No. 7 pit. ... It was not until Friday, August 13th, that the first small pocket of green tourmaline was found, and it was then definitely established that the pegmatite was of the proper makeup to yield colored tourmalines. ... After the cavity or pocket material was removed from the mine, it was softened by the addition of water. ... The softening was effected quickly so that the tourmaline crystals, even those that were

completely surrounded by the matrix, could be tipped out easily within a few minutes. Many of the crystals contained adhering claylike material which filled the vertical striations. ... Of the No. 7 pit of the B.B. Mine about 14,000 carats of gem variety tourmalines were removed from the pockets...

Many of the better crystals were terminated, although in all cases observed the terminal faces were etched and dull. The prism faces were characteristically striated parallel to the vertical axis. They also showed a general trigonal cross section...

The crystals do not, in general, show marked zoning. They are of a fine bluish-green color normal to the *c* axis with occasional slightly darker color zones, which are barely noticeable... When viewed in the direction of the unique axis, the pleochroic color is a yellowish to brownish-green. Most of the crystals are sufficiently transparent in this direction to produce gems of this color. ...

The largest crystal of gem quality weighed 137.47 carats and was of a very fine color. It was broken in two sections when found. ... One large, odd-shaped, and very irregular crystal, not of gem quality, was found in the pocket. It weighs 147.7 grams (738.5 carats) and is a fine green color; However, it contains numerous minute inclusions and is very imperfectly crystallized. It is indeed unique as a tourmaline crystal composed of many individuals deeply striated and more or less in parallel growth, the small individuals are terminated in a common large trigonal pyramid with numerous small ditrigonal pyramids along the edges of the individual crystals along the periphery of the large unit. ... Only a relatively few pieces of the pink tourmaline were found and these are too small to provide cut gems. The pink tourmaline occurred as cores of other crystals and became separated from the outer (green) shell as the intermediate zone of material had been removed sometime during the late phase of activity of the pegmatite solutions."

A large selection of BB #7 quarry elbaite is on exhibit at Perham's of West Paris gem and mineral store's museum.

Paris

Certainly one of the enduring, world class elbaite localities has been the Mount Mica quarry, Paris. Much has been made of the discovery of this locality and some of the history and descriptions of the early finds are summarized in the quotes which follow. Each episode of mining seemed to reveal a different aspect of the specimens available. Hamlin (1895) recounted that Ezekiel Holmes and his friend, Elijah Hamlin, were walking near Paris village in 1820 near dusk when one of the pair picked up a tourmaline crystal found loose in the soil. As the light of day diminished, a number of green crystal sections were found and only darkness ended the excitement of finding such crystals. During the night, a snow storm covered the area with snow and further collecting had to be postponed until the spring thaw. Hamlin (1870) wrote: "At that time [1820] about forty crystals of tourmaline, some of which were quite perfect in form, of fine color and limpidity, were picked up on top of the ledge, or found in the earth which had accumulated around its base. ... The finest specimens of the tourmaline species known in the world have

been taken from the now exhausted locality at Mount Mica. Some beautiful crystals of splendid color have been found in loose boulders at Hebron, Maine, but the parent ledge has not yet been discovered."

While the pair of friends were students, they were not youths. They were both medical men in their final year of training at Brown University in Providence, Rhode Island. Sturtevant (1948) made a case that the discovery could not have been made during 1820 as it was a serious offense to be away from school and missing even one class was considered grounds for some disciplinary action. The travel time on horseback, between Rhode Island and Maine probably was a journey of a number of days. (Early Brown University catalogs, but not available specifically for 1820, suggest the fall semester ended on or just before Christmas Eve.) Sturtevant (1948) cited Hamlin's (1826) letter written November 30, 1822: "Paris, the shire town of Oxford county, (Maine) has been settled only about 40 years, and the country around it is comparatively yet a wilderness; and until within about a year, there has never been any examination made of its minerals; and the only search that has been made within this time, has most richly rewarded the labour." Q.E.D. the discovery was made in 1821 after the students had graduated and returned to Paris to take up their careers. They would have, however, no longer been students if this were the case. It is not unreasonable to believe that the discovery was made during a semester break in which an unexpectedly late snow storm occurred and "the only search that has been within this time [within about a year]" referred to the ability to effectively look over the deposit in broad daylight at some time in 1821 after the cursory initial discovery made in 1820. The letter would have been correct if: 1) the find was made in 1820 and 2) the first *significant* search made to understand the minerals of Paris was after the spring of 1821. The absence of snowfall and other weather records for the time period preclude the ability to pinpoint the discovery to a particular day.

The earliest published account of the tourmalines from here apparently was made by Webster (1823): "We have lately received very interesting specimens of rubellite from Paris, in the state of Maine. The crystals are of the usual form. They are in a granite, the feldspar of which is similar to that of Chesterfield, (Mass.) and are accompanied with green and blue tourmaline, and lepidolite, of great beauty. The locality was discovered by E.L. Hamlin Esq., of Paris, to whose politeness we are indebted for the specimens."

Elijah Hamlin had written to Benjamin Silliman on November 20, 1822, but an explanation of the tardy 1826 publication date was made that the notice was not published in Silliman's Journal (American Journal of Science) due to its "having been accidentally mislaid, and concealed in the laboratory, till a very recent period."

Hamlin (1826) wrote:

"1. *Green Tourmaline*. - Locality - Paris, one mile east from the court-house, on the road leading to Buckfield, and on the farm of Mr.

Nicolas Chesley. They are there found in cylindrical prisms, striated longitudinally, and in some instances so deeply as to make their surfaces appear acicular. They vary from one eighth to an inch and a half in diameter, and from one to *six inches* in length; no specimen, as yet, but this, has been found with a regular termination, and this is evidently triedral [sic]. Some specimens have been found uncommonly beautiful; they are perfectly transparent, and exhibit colours from the light to the deepest green.

2. *Radiated green Tourmaline*. - Found at the same place in small prismatic crystals, semi-transparent, and of a leek green colour, usually less than an inch in length, diverging from a common centre, attached to an aggregate of mica and quartz, and in some instances are found between the lamina [sic] of a large foliated mica, and spreading into that a fine green colour, where it comes in contact.

3. *Acicular green Tourmaline*. - Found at the same place, in small cylindrical prisms, from one to six inches in length, of a bright green colour, sometimes transparent, and in positions similar to the former.

4. *Acicular green Tourmaline*. - Encompassing a darkish blue crystal, probably the indicolite. Green tourmaline of this character is frequently found forming a kind of incrustation over ill defined masses of black tourmaline.

5. *Acicular Indicolite*. - Similar in all respects to the acicular green tourmaline, excepting its colour, which varies from an indigo blue to a black.

6. *Indicolite*. - Some of its small crystals, that are found in a beautiful granular kind of quartz, exhibit a fine light blue colour, while its larger ones have a deeper colour, passing off into black or brown, and are frequently in connexion [sic] with the red and green tourmaline.

7. Tabular crystals of this kind are mostly found embedded in mica, and are from one to three inches in length, its general appearance being almost a velvet black, except the edges, which are translucent, and transmit a pale green light bordering on blue. Some specimens of this kind exhibit a fine polish, and are extremely handsome.

8. *Rubellite*. - It is mostly found enclosed in crystals of the green tourmaline, or else encrusted with that on its surface, and varies in its colour from a pink to a deep crimson red; some are found very beautiful.

9. *White Tourmaline*. - It has longitudinal striae, and like the others becomes electric by friction; most of them are slightly tinged with red. ...

All these minerals are found at the same place, on the top and declivity of a small hill, its surface measuring perhaps one acre, and elevated not more than forty or fifty feet above the land around it. The base of the whole hill is probably a ledge; but it breaks the surface only on the top, in the space of about four rods square, exhibiting a ledge of coarse granite, thickly filled with mica and tourmalines, of which the black principally predominates. But little search has been made, and only in one place have we gone under the surface, and it was there that we found the best specimens loose in the soil."

Shepard (1830) thoroughly described the various minerals known from Mount Mica quarry up to that time and described working in a "soil" which apparently was a naturally exposed gem pocket of the kind which led to the original discovery of the locality by Ezekiel Holmes and his companion, Elijah Hamlin.

Shepard (1830) correctly described the paragenesis of the minerals of the gem pockets then encountered and gave a lengthy description of the tourmalines:

"The large, loose crystals of Tourmaline affect the general form of trihedral prism with convex faces, which are deeply striated. They resemble each other very considerably, as respects transparency, fracture and color, - being as clear, for the most part, as the intensity of their colors will allow; free from flaws, except for a thin coating at their surfaces; and where the crystal possesses any considerable length, green at one extremity and red at the other. They have a tendency to break across at distances of about the diameter of the prism, and with a highly conchoidal fracture so as to result in fragments almost globular in shape, (*gouttes de suif*.) which are quite free from flaws, and 'of the finest water.' Of these crystals and fragments of crystals, I shall describe a few which appear to me to be the most interesting.

No. 1, is one inch and a half of the extremity of a green Tourmaline, whose diameter equals its length. Its color is an intense grass-green with a tinge of blue. It is regularly terminated by polished faces, as represented in the annexed diagram. ...

No. 2, is a fragment, three quarters of an inch in length, by one inch two tenths in diameter; the extremities of which have been rendered flat by the lapidary. Its colors are faint; and it exhibits the transition of pink into green. Although the green color seems to preponderate when the crystal is viewed in a line perpendicular to the axis, yet, objects seen through it, in a direction parallel to the axis, have a delicate pink tinge. This specimen illustrates with remarkable distinctness the property of double refraction. When it is brought to the eye, in the last mentioned position, and a pin, or slender wire, is held at the distance of ten inches or a foot, two distinct images of the pin or wire become obvious.

No. 3, is a crystal two inches long, by one inch and a half in thickness. Its sides are coated with green Tourmaline to the depth of about a line, - the whole interior, from end to end, consisting of the most beautiful Rubellite. The color is more intense at one extremity, and is deepest throughout at the center. One end is of a dark and exceedingly rich, blood-red color, - becoming slightly amethystine towards the circumference; while the other approaches more the color of a crimson, in which little, if any blue, is discernible.

No. 4, is a crystal two and a half inches, by one inch. Viewed across its axis, at one extremity, it exhibits a fine sea green; while at the other, it is of a rich crimson red. A joint, detached from the green end, presents, when viewed in a line parallel with the axis, a grass-green, boarding on a pistachio-green, color.

No. 5, is a crystal measuring an inch and a half each way; its color, when viewed across the prism, is sea-green with a large proportion of blue; but it passes into a pale rose color at one extremity. A broach was cut from the green end of this crystal, which measures nineteen twentieths of an inch long, sixteen twentieths broad and eight twentieths in thickness. It is cut after the manner of a large emerald. The large plane forming the front face, and which is situated at right angles to the prismatic axis, is two thirds of an inch in length, by a little more than half an inch in breadth. Its color is intermediate between grass-green and pistachio-green, and its transparency perfect. It contains but one

flaw; which is invisible, when the broach is held in ordinary positions. ...

Among the smaller crystals which penetrate the crystallized quartz, a few are perfectly colorless and transparent. Their form is that of the *Tourmaline nono - septmale*, H. [= Haüy?]; and from their exquisite finish, they are well fitted for goniometrical examination. ...

A few crystals of transparent Indicolite, of a deep color, were met with, which were associated with Rubellite, and imbedded in Lepidolite. ... Fragments of a less transparent variety of Indicolite were pretty abundant; also small, somewhat flattened crystals of Rubellite, with one or two polished faces, and possessed of a good color and considerable transparency; and a few transparent prisms of the green Tourmaline, precisely resembling the same mineral from Brazil. ...

The Rubellite, on being heated to redness before the blow-pipe, loses its color; and on increasing the heat, whitens, becomes opaque [sic] and swells, at the same time opening by numerous little fissures. ... The green Tourmaline grows pale on being heated to redness, and on continuing the heat, it becomes milk white, swells, cracks, and vitrifies with less appearance of fusion than the Rubellite. ... The Indicolite retains its color perfectly, when heated to a low redness..."

Leidy (1871) wrote of the Mount Mica quarry after an extensive visit which occurred just after the resumption of mining there:

"The tourmalines are remarkable, being usually partly colored of various shades of green passing into red, and partly opaque to transparent. Small crystals from half an inch to an inch and a half in length, and from half a line to the fourth of an inch in thickness, occur abundantly imbedded in the cookeite. In spongy masses of the latter, they appear closely invested with thick sheaths of the same substance. These smaller tourmalines are usually bright grass-green and transparent, but others are nearly colorless, and green or pink at one end. Frequently they are fissured, partly decomposed, and sometimes the decomposition extends along the axis, so as to render the crystals tubular.

The tourmalines of the pink lepidolite usually occur in comparatively large crystals, firmly embedded or even incorporated with the lepidolite and albite. These are opaque and brittle, and rarely obtained except in fractured specimens imbedded in the inclosing mineral. They are dark indigo-blue, constituting the variety indicolite, but oftener are dark olive-green with a rose-pink exterior, which at times appears gradually to pass into the condition of the surrounding lepidolite.

The largest and finest tourmalines, obtained from the loose material of the pockets previously mentioned, almost invariably occur in a fractured condition. Two pockets exposed in our presence, communicated with fissures of the surrounding rock, and the contents, as raked forth, were observed to be quite moist. During the winter their contents are probably frozen, and the freezing of water in fine fissures of the tourmaline probably accounts for their being usually found in a fractured state.

The tourmalines of the cavities occur from those of a small size up to such as measure three or four inches or more in length, and from half an inch to an inch and a half in diameter, doubly terminated, with

one extremity flat, and the other three-sided, with the angles or borders truncated.

Sometimes the crystals occur opaque, dark green at one end, becoming bright grass-green and transparent at the middle, and passing into cherry or rose-red and transparent at the other end. Occasionally the green color is nearly absent, and we have an achroite with a greenish hue, passing successively into a deeper shade of green and dark green, or into pink and deep cherry-red, usually sheathed with a thin layer of greenish hue at the opposite end.

In a crystal exhibited, measuring four inches in length by three-fourths of an inch in diameter, flat at one end, and three-sided at the opposite end, the first inch is dark, opaque green, the second inch is bright grass-green and transparent, the third inch is pale pink within and pale green without, and the fourth inch is cherry-red within and pale green without. ...

Another specimen exhibited consists of a crystal an inch and a half long and ten lines thick, with a three-sided termination, deeply striated, and of a dark green color. Broken across near the base, the interior exhibits a spherical nodule of transparent achroite the third of an inch in diameter."

Leidy (1883) wrote further on Mount Mica tourmaline and noted: "A dark green three-sided crystal with trilateral pyramid, an inch and a quarter long, and three-fourths of an inch in diameter. The base was occupied with a spherical nodule of achroite, from which was cut a beautiful gem, of brilliant form, flawless, perfectly transparent, and weighing 400 milligrammes. It is nearly colorless, but has a faint pinkish hue."

Hamlin (1873) wrote on the differences and similarities of tourmalines from the Ural Mountains, Russia; Ceylon, Brazil, and Mount Mica quarry, as well as minor localities. The history of the deposit was well covered in both Hamlin 1873 and 1895 along with color plate drawings of some choice crystals. The peculiarity of individual gem pockets was reported by Hamlin (1895):

"In June, 1891, they opened a cavity near the two last found at the bottom of the pit... More than thirty distinct crystals were found in this cavity, some of them of great beauty and perfection of color. Nearly all of them were blue, and exhibited by transparent light a fine tint of sapphire blue. Quite a number of them were tipped with a decided shade of green, or rather the blue changed into green near and at the summit of the crystal. One of these crystals was $5\frac{1}{2}$ inches in length by $\frac{3}{4}$ of an inch in diameter, with both terminations intact. At the base the color was almost black, becoming clearer along the shaft towards the top; in the middle third, the indigo blue becomes of a beautiful sapphire blue, becoming lighter in tint, and finally changing into a clear and beautiful green at the summit of the crystal. This rare and matchless crystal was broken into four sections, but has been restored to almost its pristine beauty. ... Another crystal of the same arrangement of color was found, a little larger in dimensions, but not so fine in purity of tint or in perfection of form. It is 6 inches in length by $\frac{3}{4}$ of an inch in diameter, and is attached to another crystal of indicolite, passing into black, and

of unknown length, as some of its sections have been lost in removing the contents of the cavity. No trace of red or white crystals was found in this cavity. ... In 1893 operations were commenced in July, and some remarkable specimens of tourmalines were discovered, and some very unlike any of those thus far found. A number of them were tipped with red, which is unusual with the crystals of Mount Mica, but common with the tourmalines of Siberia [sic]. Some of them have a well-defined zone of indigo blue a line or more in thickness extending across the shaft of the crystals, which are of clear green, both above and below the intrusion of blue. ...

From the evidence collected by or known personally to us, we believe that Mount Mica has yielded more than one hundred crystals which would be considered as fine and remarkable specimens of the mineral. Of the smaller tourmalines, ranging from one inch down to microscopic size, no correct estimate can be made; but they amount to many thousands. We have seen specimens containing more than fifty distinct and transparent crystals, imbedded in masses of lepidolite, Cookeite and albite. Coarse and opaque, or even translucent, crystals of tourmaline, several inches in diameter and nearly a foot in length, have been found in the great masses of albite and quartz; but all the fine and transparent prisms, with but few exceptions, have been taken from the cavities. These exceptions refer to a few crystals found in portions of feldspar, which are soft and partly decomposed, or in deposits of kaolin.

Sometimes the minute crystals may be seen penetrating limpid quartz, like the specimens found in the Ural Mountains... They then appear like arrows of rutile enclosed in the quartz, but of red and green hues, presenting a beautiful appearance. Well marked specimens of dislocated and curved crystals have frequently been found, and some beautifully radiated tourmalines of a transparent green color - but never red - have been disclosed by rifting masses of mica. And sometimes we observe in the solid masses of quartz or feldspar well defined crystals of tourmaline, articulated like pillars of basalt, and whose sections have been separated at some distance by the intervening rock, as has evidently taken place while the crystal was forming, for the shaft of the prism is often complete and symmetrical, although its sections may be separated at the distance of several inches. This peculiarity is noticed with all of the varieties, and is particularly marked in the black crystals [schorl]. Many perforated crystals of tourmaline have also been found, occurring in thin, glass-like tubes, sometimes more than an inch in length, but generally less. And the interior of these singular tubes is often free from any substance, or it may be filled with tufts of variously colored Cookeite. The sides of these cavities were sometimes beautifully and clearly striated, as though nature had prepared a mould, and had intended to deposit therein the crystals of tourmalines, but had forgotten to do so, or had removed them by some mysterious law. Some of these cavities were studded on the internal side with minute transparent crystals of quartz, partly covering the clearly defined striae.

All the crystals of tourmalines found at Mount Mica do not have perfect terminations, and it is very rare that a perfect prism is found; very often we meet with them without any well-[de]fined faces. Those found in masses of kaolin especially are of irregular forms and terminations, indicating that nature, restrained by disturbing causes, has left her work imperfect, both in symmetry and in color. This hiatus or

peculiarity in the regularity of the deposition and crystallization of this mineral is far more common with the pale pink tourmalines than with any other variety. "

Additionally, it should be mentioned that a few crystals, such as some from the 1904 Merrill pocket, have a peculiar crystal-surface feature which cannot be described as etching though they undoubtedly represent a dissolution phenomenon. Irregular "worm trails" a fraction of a millimeter deep curve and wind around and below the crystal surface forming open troughs. Also, altered elbaite partly replaced by lepidolite or cookeite is present in the rock lining the gem pockets.

Bastin (1911) reported on the variability of Mount Mica quarry tourmaline:

"Most of them range in color from olive green through emerald green to blue green; some are nearly colorless, some show beautiful pink tints, and the central portions of some are a deep ruby red when viewed along the main crystal axis; a few are the color of amber and of port wine; and some are a purplish red. ... A polished cross section of a crystal about three-fourths of an inch in diameter, preserved in the Cambridge Museum of Natural History, shows a blue-green center about one-half inch across, surrounded by a transparent pink border one-eighth inch wide, outside of which is a pale transparent olive-green border about one-sixteenth inch wide. Crystals with pink centers and olive-green borders are not uncommon. One shade commonly predominates in a pocket, but some pockets contain gems of different colors. Some single crystals shade from white at one termination to emerald green, then to light green and pink, and finally to colorless at the other termination. ...

In some pockets the tourmalines when first disclosed lie in apparent perfection of form and color in their clayey matrix, but crumble away as soon as touched. In others certain portions only of the crystals crumble away, leaving a smooth nodule of perfectly fresh tourmaline, usually beautifully transparent and in form resembling somewhat the nodules produced by the etching of quartz crystals with hydrofluoric acid. Some of the finest gems have been cut from such nodules.. Some hollow crystals of tourmaline are found, commonly of small diameter, but including some as much as an inch in length; they were probably produced through disintegration of the core of the crystal. ...

The largest tourmaline [elbaite] ever found at Mount Mica came from the pocket shown in Plate IX, B, and is itself figured in Plate XIV. ... It is 15¹/₂ inches long, 7 inches in maximum breadth, weighs 31¹/₂ pounds, and is valued at no less than \$400. [A price essentially equal or greater than the year's wages of a moderately skilled laborer of the time period.] As shown in the plate, the base is fractured so that the crystal is now in three segments. The crystal is transparent to translucent grass green at the tip, where, too, the prism faces are best developed. The middle and lower flanks of the terminal segment are made up of a mass of small colorless to pale-pink or brownish prisms between one-eighth and one-fourth inch in diameter. many of them set at all sorts of angles to the main axis of the compound crystal. A small crystal of white quartz about 2 inches long is attached to the side of this segment. The basal segments, which are about 4 inches across, show an alternation of small

translucent to opaque pink and green prisms, the colors grading into one another parallel to the prism axes and also across them.

The same pocket contained another compound tourmaline crystal, somewhat similar to that just described in its general form and very similar in coloring, but smaller. Its length is about 10 inches, its maximum width 3¹/₂ inches, and its weight 6¹/₂ pounds. ... In all, there were about 75 pounds of tourmaline crystals in this pocket. The two largest tourmaline groups and most of the others lay loose in the disintegrated cleavelandite and cookeite in the bottom of the pocket. No kaolin was present. Lepidolite occurred around the walls and across the bottom. Many quartz crystals lay loose in the bottom of the pocket, the upper ones having the apices of the crystals downward, showing that they had fallen from the roof. ...

The largest transparent crystal of green tourmaline found at Mount Mica was discovered by Samuel R. Carter in 1886... It is 10 inches in length, 2¹/₄ inches in diameter, and weighs 41 ounces. Both terminations have been preserved, but they are not at all perfect. Although broken into four pieces, the parts have been easily joined by cement. Its middle portion would probably yield some fine gems. This crystal came from an unusually large pocket 4 feet in diameter, along whose sides and at whose bottom, embedded in a sand of decomposed cookeite, lepidolite, etc., were found fragments of certainly 50 well-defined tourmaline crystals.

The most remarkable crystal of white tourmaline or achroite found at this locality is also in the Cambridge Museum of Natural History. It was obtained in 1869 from a large pocket which yielded several other crystals of smaller size. This crystal is transparent, but when viewed in light transmitted at right angles to its axis appears smoky toward the base; when viewed along the axis its hue is crimson. Both ends are tipped with green, but its terminal faces are not preserved. Its length is about 4 inches and its width 1¹/₂ inches.

The finest crystal of blue tourmaline or indicolite found at Mount Mica is in the Hamlin cabinet. It is transparent throughout its entire shaft, although broken into five parts. Both terminations are preserved. The color, when viewed at right angles to the prism length, is a beautiful sapphire blue, changing at the top into a delicate green. It is about 4 inches long and one-half inch in diameter. ...

What is probably the largest flawless piece of transparent tourmaline known is in the possession of L. B. Merrill, its finder, the present operator of the Mount Mica mine. In its uncut condition it weighs 411 carats. It formed the tip of a crystal 8 inches long and 1 inch in diameter, much of which was greatly disintegrated."

For the most part, subsequent mining has not produced better examples of these specimens. The story of Mount Mica's giant tourmaline crystal's miraculous recovery after having remained "lost" for over half a century has been recounted by its re-discoverer, Benjamin Shaub (1987).

The 1990-1991 session of mining at the Mount Mica quarry by the Plumbago Mining company produced a variety of gem and gemmy elbaite crystals though generally of small size (usually 2 x 0.6 cm and less). The colors which usually predominated were evenly distributed greens of the typical grass-green and

blue-green through olive shades: all well known from the locality. The terminations varied from scarce smooth-faces through commonly etched and commonly clay coated etched faces. Terminations on completely green crystals were generally simple steep trigonal pyramids. Watermelon-zoned crystals generally had a muddy appearance with a pedion termination and were frequently hollow where the core had preferentially etched away. Less common were very pale pastel pink crystals (to 3 x 0.8 cm) which had occasional very pastel green zones. These pastel crystals were so faintly colored as to suggest achroite and were reminiscent of some tourmalines from Nepal. Indicolite of facetable grade was well represented during the 1990-1991 seasons, and a few dark, very blue-green zones were seen capping light bluish green crystals. The blue-green zones amounted to about one half of the crystal length (2 cm and less) and the dark zones were terminated by bright, normal low-angle trigonal pyramids. A few pale blue crystals (to 1.5 x 0.6 cm) were also found.

Matrix specimens have not been scarce at Mount Mica quarry, but *fine* matrix specimens have been scarce. The 1990-1991 seasons produced minor matrix specimens that were generally attached to microcline and associated with granular gray-lilac lepidolite or were coated by orange to yellow cookeite on quartz crystals. The matrix crystals frequently are green to blue-green and have dark indicolite caps which have pedion faces somewhat similar to color-zoned crystals from the Cruzero mine, Minas Gerais, Brazil, but are smaller. The matrix crystals are frequently divergently grown and can have some light pink zoning in the middle of the clusters. Cassiterite crystals (to several mm) can be associated. In all episodes of mining, large masses (to 1 m) of fragmented "asparagus green," often distorted elbaite crystals, varying from euhedral to anhedral, have been found very tightly aggregated together in a "mush" sometimes cemented by cookeite.

Some highly altered elbaite was also found in the 1990-1991 seasons. The elbaite seems to have been replaced by fine-grained mica and has a clay-white to tan color. The replaced crystals frequently are curved and show evidence of healed cracks. Some very muddy brownish-green crystals were found which have not been replaced, but some collectors have supposed these crystals were replaced in order to account for the crystals' muddy character.

Hoopers Ledge quarry, Paris has gemmy green elbaite fragments in small vugs in blocky albite (Joe Arens, personal communication, 1993).

Maine abounds in under-exploited pegmatites. While, undoubtedly, it would be a fool's errand to chase down most of the stray reports of gem pockets, the older deposits which were only worked using hand tools have provided new finds with the use of power equipment. The original Number 4 Hill quarries (=Mills quarries), Hebron are now in the town of Paris due to a boundary shift and are in a pegmatite well worth prospecting. Though it has produced so few specimens that it is no longer possible to find a specimen from the locality in public or private collections, the reports by Bastin (1910, 1911) are intriguing:

"Mills feldspar quarry. - A small abandoned feldspar quarry on Number Four Hill, near the Paris - Hebron line, was visited by the writer in August, 1906. The quarry was worked by the Mount Marie Mining Company in 1901 but was soon abandoned. The principal pit is about 75 feet long by 30 feet wide and 10 feet in maximum depth. A second pit close by is about 30 by 30 feet and 10 feet deep. ... The coarsest and most highly feldspathic portion of the deposit exposed in the larger pit contains some cleavelandite and granular lepidolite and a few colored tourmalines, of pink and green tints, which are translucent to opaque. Several small pockets less than a foot in diameter were exposed at the time of the writer's visit. In some of the pockets a few transparent tourmalines of gem quality were found in the course of the mining operations." The quarry was apparently worked for feldspar, not for gems, and miners were notorious for avoiding pocket zones in Maine pegmatites as feldspar production fell off sharply in the effort to work such units. The few gems found at that time did not warrant shifting mining objectives to concentrate on gems. Sterrett (1914) noticed the Mills quarries: "Gem tourmalines appear to have been found only in the northwest opening, the other pit yielding, besides the feldspar, only opaque beryl and bunches of wedge-shaped mica crystals. ... A few colored tourmalines, mostly opaque, are scattered through parts of the pegmatite, the majority being inclosed in or associated with muscovite and lepidolite." Augustus Hamlin noted in his diary having purchased faceted green tourmaline gems (1-2 cts) from Number Four Hill from Loren Merrill in 1901 and 1902. (Number Four Hill was renamed Mount Marie and another hill to the north is now called Number Four Hill [Dennis Durgin, personal communication, 1993].)

Poland

The Berry-Havey quarry, **Poland** has produced some exceptional elbaite of as fine a green color as is known from Maine and probably as fine as from anywhere. On September 4, 1910 it was reported in the *Boston Sunday Post*: "Chance Blast Reveals \$100,000 in Gems and Makes Tourmaline Mine Treasure Store." However, the total value was apparently based on the erroneous assumption that the tourmaline could be converted, without loss, directly into gems, whereas most gem cutters feel that "high yield" gemstock would yield only 20-30 % gemstones of the total rough weight. The story continued: "In all not less than 8000 carats have been taken out by this young miner within the last few days, and the lowest price at which these fine gems sell is \$15 a carat." It is unlikely that Havey realized much money from the find as his existing collection contains 63 major crystals (to 7 x 4 cm) and 33 minor ones (to 2 x 1 cm). While this selection probably is a composite of Havey's mining effort and was donated from his estate, Havey's collector instinct, undoubtedly, kept him from cutting any but untermated crystals. The Berry-Havey quarry tourmalines are basically green tourmalines with several color variations. The suite of 33 minor crystals are seemingly all from the same pocket. They frequently have a

clay-coated tip and possess a beautiful medium blue-green color and have very few internal flaws.

Sterrett (1911) wrote: "During the year 1910 a new deposit of tourmaline was opened on the land of F. L. Havey, near Poland, Me. The deposit is on land adjoining the Berry property, where feldspar and tourmaline have been mined. Mr. George R. Howe, of Norway, Me., with the permission of Mr. Havey, has kindly furnished notes on the tourmaline taken from the mine during the time of operation from July to October, 1910. The features of these tourmalines are the prominence of green and the fine quality and clearness of the gem material. Some fine rich blue (locally called *Alice-Blue*) tourmaline is also obtained. Rubellite and achroite terminations are present on both the green and the blue crystals. Yellowish-green and yellow colors also occur. Some crystals (locally called 'watermelon' crystals) have pink centers and green margins. Of a representative collection containing 108 crystals, chosen from the output of the mine, 98 crystals are gem quality and weigh 3,231 carats. It is estimated that this should yield 1,000 carats of cut gems." Sterrett (1912) indicated further tourmaline finds were made.

Sterrett (1914) summarized: "The best gem discoveries were made in 1910 to 1912 by F. L. Havey, of the Maine Feldspar Co., who worked a part of the Berry quarry on a lease. Several pockets yielding tourmaline of especially fine quality were found. From the last pocket, opened in October, 1912, 11 pounds of crystals were obtained. Sufficient tourmaline was obtained by Mr. Havey to arrange several characteristic collections showing the variations in crystal development and color with gem and semigem material and to supply an abundance of material suitable for cutting into gems of fine quality. The crystals grade from small size to those more than an inch thick and several inches long. Some have nearly hexagonal outlines, but the majority are more triangular with rounded cross section. The terminations are present on the end of the crystals only in most specimens and consist of scalenohedrons capped by rhombohedrons. Most of the crystal faces do not show a high polish but are slightly etched and pitted. Green is the predominant color of the tourmaline, and many of the crystals are rich bluish to nearly emerald-green. The crystals from the last pocket opened were said to be darker and to have more of an olive-green color than those from pockets found earlier. A few of the crystals are pink; but where pink is present in the tourmalines it occurs for the most part only in the terminations. The crystals from the last pocket opened have less pink than those taken from the earlier pockets and some of them are salmon-pink."

The major crystals from the Havey assortment are diverse in character. Some have a prismatic habit with a normal low pyramidal termination. The crystals are blue-green to blue-gray, have a large number of internal flaws, and a pink color zone which covers part of the prism as well as the termination and are not dissimilar to some tourmalines from the nearby Greenlaw and Towne quarries, Auburn. A few have complex combinations of pyramidal forms on the terminations and are medium to dark grass-green, but have a dark red gemmy watermelon base of the

crystal not dissimilar from some of the Dunton quarry, Newry tourmalines. A third habit, peculiar to the locality, consists of medium to dark grass-green crystals which have a "scalenohedron" tipped by a small trigonal pyramid. Various tourmaline specimens from the pocket-lining zone have blue, blue-green and pink and green "sprays" embedded in cleavelandite as is present at virtually every gem tourmaline producing locality in Maine.

Elbaïtes of a different character were found during the Terry Szenics episode of mining in the mid-1970's. Green to blue-green crystals with pink pyramidal caps were found, as were remarkable cinnamon pink crystals. The uniformly colored "cinnamon" elbaïte crystals were up to 5 x 1 cm and quite free from flaws. No dark grass-green crystals were found by Szenics which had the peculiar "scalenohedral" terminations.

Roxbury

Clarke (1887a) noted of **Roxbury**: "The northernmost locality is that on Black Mountain, in Rumford; but a few fragments of inferior green tourmaline have been found about five or six miles farther north, in Roxbury, a fact which indicates a prolongation of the belt in that direction." The report concerns an early outcrop perhaps found by Edmund Bailey, which is now lost. The report may have meant the Bemis Stream prospect, TD even though it is nearly three times the indicated distance away.

Rumford

The earliest account of tourmalines from Black Mountain quarry, **Rumford** was by Kunz (1886b): "The lepidolite found here is finer grained than that from the other Maine localities. One form is in scales not over 1 mm across, quite compact, and occurs in large masses of a beautiful lilac color, closely resembling the mineral from Altenberg, Saxony. A characteristic form is of a light lavender color, very compact, and has scales not more than 1 to 25 mm. in width, penetrated in every direction by crystals of rubellite, which are of a light or dark shade of red. This association is very similar to that from the well-known locality of Rozena, in Moravia.¹ Rubellite, indicolite, and the green tourmalines, are the common varieties at this locality. Both these minerals exhibit a tendency to radiate, assuming this form also when they occur side by side in one radiation. Perfect crystals are exceptional. Masses of rubellite 8 cm. long and 4 cm. thick are found. One section of a rubellite crystal with a centre of a lighter color, was terminated almost entirely by a large o[] plane. Small green crystals with red centres and red crystals with green centres 1 cm. across were observed, and also flattened crystals between plates of a beautiful, silvery muscovite. Fine colored rubellite, almost fit for gems, at the juncture with and in white quartzite [sic]. Dark indicolite, in short, imperfect crystals 4 cm. long and 3 cm. thick, was found...¹These forms are so compact that they could be used for ornamental purposes." Not much has changed or has to be added to the description except to note that divergent sprays of pink elbaïte (to 30 x 20 cm) have

been recovered frozen in quartz, cleavelandite, and lepidolite matrix. The dark red elbaite crystals with well-defined prism (to 8 x 3 cm) and, rarely, simple pyramid can be frozen in quartz, coarse lepidolite (to several cm), cleavelandite, spodumene, etc. matrix. The elbaite can be straight or healed with kinks and bends in the crystal. The pink to true rubellite red fans show extreme color gradation and can vary from milky red or pink through white, and sometimes have green or blue streaks.

Hess et al. (1943) chemically analyzed elbaite from Black Mountain quarry: "Along one of the cracks was (September 19, 1942) a remarkably pure lens of lilac lepidolite which as exposed along the dip was 19 feet wide, and 5 feet thick in the middle. At the upper end a few cubic feet of the lepidolite was white. In spite of the movement of solutions that replaced the quartz by this large mass of lepidolite the crack with others of the same age is still open. Buried in the lepidolite are a few crystals of spodumene of which the largest seen was about 8 inches long, 7 inches broad and 1 inch thick. Here and there are bundles 1 to 3 inches thick of tourmaline crystals 1/8 inch in diameter. Most of the bundles are 4 or 5 inches long and part have a gray or almost colorless center in the smaller end that grades into red toward the outside of the bundle and toward the other half of its length. In the quartz outside of the lens similarly colored sheaves of tourmaline 16 or 18 inches long and 8 inches in diameter have been seen. Some of them had been broken while still growing and had formed knee - shaped angles along their length. ... Some of the mica has green tourmaline between the leaves and in places it appears to be replaced by blue tourmaline."

The green elbaite embedded in muscovite sheets can be up to 5 by 1 cm, but, except for the slightly yellowish tint, Black Mountain quarry elbaite in muscovite is identical with the same material from Keith quarry, Auburn; Dunton quarry, Newry; Mount Marie quarry and Mount Mica quarry, Paris; Berry-Havey quarry, Poland; and other Maine localities. The large clusters of pink tourmaline fans embedded in quartz, cleavelandite, and lepidolite matrix rarely show prism faces. The "fans" are essentially fractures through composite crystals and the surface of the fans shows a corrugation indicating the boundaries of the tourmaline sub-units. Pink tourmalines from Black Mountain quarry, embedded in fine-grained lepidolite, are rarely of the quality found at the Stewart mine, Pala, California, but were a sensation before that western locality started production. Significant gem pockets have yet to be found at Black Mountain, although some small pockets with poor quality green tourmaline needles have been found (Joe Martin, personal communication, 1992).

Standish

Kunz (1892a) indicated: "Mr. Lucien Holmes, of Standish, Maine, found crystals of green, red, and blue tourmaline on the Hussey farm, but they were not of gem quality, although very good as crystals. The specimens at Bates College, Lewiston, Me., labelled [sic] 'Baldwin,' are supposed to have been found at this locality." Morrill et al. (1958) placed the "Old Spar Mine" in

Standish near the Baldwin town line: "1/2 Mi N of Steep Falls and 1/4 Mi E of Rte 11." It is uncertain if the Steep Falls of the Saco River was indicated or the village of Steep Falls in Standish was intended: both locations are geometrically possible. Dolloff (1936) noted of the Oak Hill prospect, near Standish village: "Dark, greenish-blue tourmaline was found associated with albite. This mineral is not consistent in its color, varying from almost black through dark green and dark greenish blue to light green. Neither is it consistent in its shape, varying from irregular masses to fan-shaped aggregates when it is usually associated with muscovite as well as albite." Terry Szenics (personal communication, 1974) indicated that he had found signs of colored tourmalines at a small prospect on Oak Hill while he was looking for the "lost" columbite locality.

Stoneham

A single crystal-pocket elbaite/olenite specimen is known from Lord Hill quarry, **Stoneham** (AMNH collection). The transparent, dark grass green 1.5 x 0.3 cm crystal is attached on its base to a slightly flattened and twisted 1.5 x 5 cm milky quartz "crystal" composed of three terminated sub-parallel crystals. Several smoky green acicular elbaite crystals (to 1 x 0.2 cm) have been found interlaminated in muscovite from the Lord Hill quarry.

Topsham

Bastin (1910, 1911) reported on an elbaite/olenite find at the Trenton quarry, **Topsham**: "In a few of these cavities transparent green tourmalines and aquamarines (beryl) of gem quality have been found." No specimens known.

The Fisher pocket of the Fisher quarry, Topsham produced an abundance of small blue tourmaline crystals (generally 1 x 0.2 cm) in matrix. Burbank (1934a) reported: "Lepidolite and sericite shells were well penetrated by blue tourmaline crystals of knitting needle size. Clear and perfectly terminated crystals were very common. Filling all the space between the larger fragments and crystals was kaolin, a very white pasty clay, which was filled with thousands of tiny loose tourmaline crystals, some two or three inches long and up to an eighth of an inch in diameter. A few topaz fragments were found in this clay, but the largest pieces were found in the crevices in the cleavelandite at the very bottom of the pocket, along with some deeply etched beryl." The crystals are generally terminated by several pyramids and are variously color-zoned in shades of blue to blue-green. Crystals to 6+ cm are known, but the thickness of such crystals rarely exceeds 3 mm. (The "knitting needle" reference was used to indicate maximum thickness, not length, even though knitting needles come in a variety of graduated sizes.)

Thompson (1991) noted: "A pink tourmaline specimen said to have come from the Square Pit would be one of the very few elbaite occurrences in the Topsham Quarries." No Square Pit elbaite available for verification.

West Paris

The Cobble Hill quarry (Ski Pike quarry), **West Paris** has produced a few specimens of bicolored elbaite (Raymond Sprague, personal communication, 1991). The crystals are quite distinct in Maine as these crystals (to 5 x 0.8 cm) tend to have a milky appearance reminiscent of the milkiness of rose quartz. The color is a dark yellowish green with irregularly distributed pink patches near the base of the crystal. The terminations consist of several low angle pyramids in combination. Additional specimens known from Cobble Hill quarry include a gemmy, light green to achroite elbaite crystal (1.1 cm) with a clay coated, corroded complex termination, and a green elbaite crystal (2.5 x 0.9 x 0.6 cm) with a pink-to-pale purple three-face termination.

Cloudy gray, rubellite-tipped elbaite crystals (to 4 cm) with untinted shafts have been found at the "Allen Pike Ledge," West Paris (Carl Howard, personal communication, 1993). The locality is "lost," but might have been a synonym for the Ski Pike quarry (= Cobble Hill quarry).

Dick Nevel (written communication to Wallace Richmond, May 25, 1938, HU) noted elbaite from West Paris:

"Tourmaline, suite of three xls. Paris, near Woodstock line. Lot, \$3.50[.] Gem from nodule found in same cavity, flawed, 3 or 4 cts. \$4.

Three crystals of delicate tints merging from one to the other. This find was made just a few years ago in a narrow pegmatite vein in the northern limits of the town of Paris [West Paris as of 1957]. No indications of lythia [sic] minerals were encountered until the cavity, about 18" [45 cm] diameter, was opened in which were just a few small pieces of lepidolite. The Finlander [sic] from whom I bought this suite told me they were as good as any that were found as to clearness. Near the base of the largest crystals was an apricot-colored zone and from a nodule of this shade I had a stone cut which adds to the completeness of the find. It finished a deep apricot color."

emerald? - old identification for ordinary green beryl or misidentification of tourmaline

Newry?; Paris?; Topsham?

Emerald has been reported from Maine many times. The first reports (Topsham) came from Maclure (1809), Bruce (1814), and Cleaveland (1816, 1822). Taber (1840) probably based his remarks on the occurrence of emerald in Maine on these earlier authors' information. Hall (1824) listed emerald: "*In Paris, Maine, in Granite.*" Kunz (1885) wrote: "Prof. Parker Cleveland [sic] (1822) mentions having seen several emeralds from Topsham, Maine, of a lively beautiful green color, scarcely, if any inferior to the finest Peruvian emeralds... As no true emeralds are in existence from Haddam or Topsham, these may really refer to very dark green beryls." Sinkankas (1981) and Schuh (1990) have reviewed the beryl/emerald nomenclature and show that the names have been used synonymously and imprecisely and in the early nineteenth century, beryl was con-

sidered to be a variety of emerald. Jackson (1838a) wrote: "Beryl, a sub-species of the emerald, occurs in Maine..." Hamlin (1870) wrote: "With the exception of the emerald, all of the gems in more or less perfection are found within the limits of the United States." (True emerald was subsequently found in North Carolina, however.) Recent field identifications of Maine emerald are invariably green tourmaline or dark green beryl, with a few wilder guesses included. No true emerald is known from Maine. No specimens are known in their matrix to substantiate or justify the identification. While many green beryl locations are known in the state, ordinary green gem beryl is not emerald. The transparent green beryl which is known as emerald, from other world locations, has a very particular range of green shades not found in Maine which are caused by varying amounts of vanadium or chromium. Marble (1948) wrote: "I keep looking for the true Emerald in Maine, but I cannot find any evidence of its occurrence."

Wheeler and Wheeler (1878) wrote of Topsham: "The EMERALD is said to have been found in a cut near the upper fishway, in Topsham." Though chromium-bearing fuchsite (q.v.) is known from across the river in Brunswick, there is no evidence that beryl was found in that association either.

Numerous verbal reports abound of emerald from various Maine pegmatites, particularly Newry. All Maine "emerald" specimens which have been observed by the authors are green tourmaline. The conclusion is that emerald, as it is now known, has yet to be found in Maine.

emery?

Andover?; Arrowsic?; Greenwood?

True emery is a mechanical mixture of corundum (q.v.) and magnetite. It has been used as an abrasive since ancient times. No true emery is known from Maine, though several reports suggest that an abrasive was made from Maine rocks thought to be emery (Perham, 1987a; Morrill et al., 1958; Burr, undated b; and True, 1869). Burr (undated b) indicated that **Arrowsic** "emery" is garnet. Recent field study by Arthur Hussey (personal communication, 1992) re-verified that the material in question is garnet from a coticule member of the Cape Elizabeth Formation. (See corresponding discussion under magnetite.)

ENARGITE

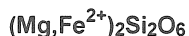
Cu₃AsS₄

T12R8 WELS - Bald Mountain M

Enargite occurs as black grains (less than 1 mm) embedded in chalcopyrite and pyrrhotite ore at the Bald Mountain mine, **T12R8 WELS**.

enigmatite = variant spelling of aenigmatite

ENSTATITE (Pyroxene Group)



Addison - Black Diamond Q, Pleasant River Q, Thornberg Q; **Alfred** - Alfred Complex; **Baileyville** - Hall Q, Tarbox Q, Woodland Dump gabbro; **Calais** - Gardners P, Mingo-Bailey Q, Red Beach A; **Camden** - Bald Rock Mountain norite; **Carrabassett Valley** - Spring Farm A; **Chapman** - Edmunds Hill A; **Columbia Falls** - Tibbettstown A; **East Moxie** - Black Narrows; **Flagstaff Lake pluton** - Coplin, Dallas, Davis, Eustis, Lang, Rangeley; **The Forks** - Black Narrows; **Katahdin Iron Works** - Katahdin Iron Works M; **Liberty** - Lincoln Sill; **Lincolnvile** - Heal Q; **Linneus**; **Monhegan** - norite; **Moxie pluton** - Big Squaw, Cove Point, Harfords Point, Little Squaw; **Penobscot** - shore east of Pumpkin Island; **Saint George** - McConchie Q; **South Berwick** - Tatnic Complex; **Union** - Harriman P; *unnamed gabbro* - Calais, Charlotte, Robbinston; *unnamed garnet granofels unit* - Dallas, Davis, Lang, Rangeley; **Vinalhaven** - Bodwell Q; **Warren** - Warren Nickel P; **Wells** - Tatnic Complex; **T16R6 WELS**

Enstatite is an inconspicuous mineral. It can be a component of gabbro, norite, etc. Most of the Maine occurrences are known from microscopic examination of thin sections. Hypersthene and bronzite are varietal names for enstatite. Enstatite forms a series with ferrosilite (q.v.).

Smith (1923) said of the Pleasant River quarry, **Addison**: "This rock... is an hypersthene-olivine gabbro of almost black shade and of medium ophitic texture, with black particles up to half an inch and slender whitish crystals. ... Under the microscope this rock consists, in descending order of abundance, of slender whitish transparent crystals of a feldspar (with both lime and soda, andesine-labradorite) intricately interlaced, the spaces between which are filled with a dark-brownish diallage ..., black mica (biotite), a little hypersthene, and greenish olivine, together with secondary magnetite, a white mica, and calcite. The diallage is altered along its edges to hornblende."

Smith (1923) and Dale (1907) reported hypersthene from many of Maine's "black granites." They noted hypersthene at the Hall and Tarbox quarries, **Baileyville** and Ludman and Hill (1990) have listed enstatite in the Woodland Dump gabbro.

Espenshade and Boudette (1967) described enstatite and ferrosilite (q.v.) from the Moxie pluton exposed in **Big Squaw**, **Cove Point**, **Harfords Point**, and **Little Squaw**: "Orthopyroxene occurs in several forms. In norite, where it is most abundant, it is generally in elongated euhedral to subhedral crystals as much as 3 mm long, or in elongated clusters of grains, and it appears to be about contemporaneous with plagioclase. Where less abundant, as in some troctolite and gabbro, it commonly forms poikilitic crystals as much as several centimeters in diameter, which may enclose olivine, plagioclase, and opaque

minerals. Where present in very small amounts, orthopyroxene may simply form thin mantles on olivine crystals. Thin lamellae parallel to the (100) plane are common and probably represent exsolution of clinopyroxene. Orthopyroxene with this feature is called orthopyroxene of the Bushveld type by Hess (1960). Some of the orthopyroxenes are nonpleochroic, and others have distinct pink to green pleochroism. The orthopyroxene in this part of the Moxie pluton also has two compositional groups, one ranging from 35 to 49 percent enstatite and one from 60 to 80 percent." In the parlance of mineralogists and petrologists, a small percentage of one end-member's composition means there is a large percentage of the other end-member. The material with "35-49 percent enstatite" would be called ferrosilite (q.v.).

Amos (1963) and Abbott (1986) analyzed (En₆₅₋₇₁) and mapped an unnamed enstatite-bearing gabbro which extends through **Calais**, **Charlotte**, and **Robbinston**.

Griscom (1960) noted of the Spring Farm area, **Carrabassett Valley**: "Norite outcrops in the river under the bridge show compositional layering, including thin layers of anorthosite. Some layers contain poikilitic hypersthene crystals up to two inches long."

Terzaghi (1946) wrote of **Columbia Falls**: "The hypersthene hornfels which outcrops near Tibbettstown, Cherryfield quadrangle¹ [Not to be confused with a village of the same name in the Columbia Falls quadrangle.], is fine-grained and compact, showing little tendency to break parallel to the banding. A fresh surface is black, streaked with comparatively coarse yellowish-gray bands which form the ridges on the weathered surfaces. Under the microscope, the coarser light-colored bands are seen to consist chiefly of perthite, with about 25 per cent of hypersthene and a few grains of oligoclase. Most of the hypersthene is distributed along planes parallel to the banding, but an ordinary microscopic examination does not reveal any preferred crystallographic orientation of individual grains. The grain size in these bands averages about 0.3 mm. The bands vary in width from 0.3 mm to 4 mm."

Moench and Pankiwskyj (1988) mapped a garnet granofels, **Dallas**, **Davis**, **Lang**, and **Rangeley** which Nielsen et al. (1989) called a garnet tonalite (with or without enstatite). Boudette (1991) mapped the enstatite-bearing garnet granofels and mapped the Flagstaff Lake pluton which contained norite, gabbro, and troctolite with as much as 52% enstatite (in the troctolite). Additionally, Boudette (1991) mapped an epidiorite in the same area with: "... 35 percent brown hornblende with pyroxene cores (hypersthene or diallagitic augite) ..."

Houston (1956) described enstatite in general from Black Narrows, **East Moxie** and **The Forks**, Katahdin Iron Works mine, **Katahdin Iron Works**, and Harriman prospect, **Union**: "Orthorhombic pyroxene, chiefly bronzite, occurs in several different ways in the mafic rocks. In certain phases of the norite at Katahdin large crystals of orthorhombic pyroxene up to 2 mm. in diameter are noted which contain inclusions of euhedral olivine and plagioclase. The texture is typically poikilitic. In other phases of the norite, orthorhombic pyroxene occurs as

ehedral crystals in much the same way as olivine. The orthorhombic pyroxene crystals lie in a matrix of plagioclase crystals which appears to have developed around the euhedral pyroxene. The shape of the plagioclase crystals conforms to that of the orthorhombic pyroxene. In the peridotite, where olivine is the dominant mineral, the orthopyroxene usually occurs as anhedral interstitial masses which conform to the olivine crystal outlines."

Enstatite occurs sparingly in the Lincoln Sill, **Liberty** (Arthur Hussey, personal communication, 1992).

Lord (1900) wrote of **Monhegan** enstatite:

"Hypersthene is a constant accompaniment of the olivine in the Monhegan norites. It occurs, either in the form of irregular grains, often surrounding the olivine, or as well developed crystals evenly distributed through the rock. The granules are in some instances associated with the olivine in such a manner as to suggest a resorption rim, but careful examination leads to the conclusion that the minerals are of separate origin, and their proximity due simply to mechanical segregation during the solidification of the rock.

In the norite proper the orthorhombic pyroxene is the pre-dominating ferro-magnesian constituent. It occurs here in well developed prismatic crystals with distinct cleavage parallel (100)(010) and (110) and strong pleochroism; parallel (a) purplish to reddish brown, parallel (b) light brownish yellow.[sic] parallel (c) pale green. It is, furthermore, easily recognized by the characteristic metallic luster (schillerization) produced by original inclusions of thin, rectangular plates of brown titanite iron ore, arranged parallel to the brachypinacoid (010), with their longer sides coinciding with the axis a of the hypersthene. ... The hypersthene is not infrequently surrounded by a fringe of uraltic hornblende, which in many cases, replaces the entire crystal, and is optically hardly distinguishable from the actinolite resulting from the olivine."

Smith et al. (1907) reported enstatite from South Penobscot, **Penobscot**: "One of the freshest specimens of gabbro occurs on the shore of Bagaduce River just east of Pumpkin Island. It shows under the microscope a granitic texture, with enstatite and pale-green to brown hornblende as its most abundant and coarsely crystallized constituents. Pale-brown biotite is also abundant and some olivine occurs in widely scattered, irregular grains, in general partly or completely inclosed by enstatite."

Rainville and Park (1976) reported on enstatite from **Union** and **Warren**: "Pyroxene is generally subhedral and interstitial to olivine but occasionally partially or totally encloses olivine. The primary pyroxenes are bronzite (En₈₀) and very minor augite. Bronzite surrounds olivine in thin bands seldom exceeding 100 µm; it grades into light-brown hornblende in contact with plagioclase. A similar multi-layered corona was described in detail by Spry (1969, p. 105). This was recognized by Bastin [1908a] and probably represents equilibrium of the iron and magnesium-rich minerals with the sodium- and calcium-enriched residual silicate liquid." (The abbreviation En₈₀ is used in the same sense as An_{xx} for plagioclase (q.v.).)

Hussey (1962, 1985) noted enstatite from the Tatnuch Complex, **Wells** and **South Berwick** and from the Alfred Complex, **Alfred**.

EOSPHORITE (Childrenite Group)



Auburn - Wade Q; **Buckfield** - Bennett Q; **Georgetown** - Consolidated Q; **Greenwood** - Emmons Q, Tamminen Q?, Waisanen Q?; **Hebron** - Mount Rubellite Q; **Newry** - Bell Pit, Dunton Q, Martin P, Nevel Q, Rose Quartz Crystal L, Scotty Q; **Norway** - BB # 7 Q; **Paris** - Irish Q, Mount Marie Q, Mount Mica Q, Ryerson Hill Q; **Poland** - Berry-Havey Q; **Rumford** - Black Mountain Q, lower prospects at Red Hill Q; **Stoneham** - Lord Hill Q

Eosphorite is well-known from Maine. There are many locations and several have produced prolific or exceptional specimens. Several eosphorite specimens were called childrenite before eosphorite was known. Virtually all specimens of the childrenite group from Maine are manganese-rich and are eosphorite. Childrenite (q.v.) from a Red Hill quarry is the only known exception, but a survey of Red Hill specimens (this study) revealed manganese-rich compositions. Eosphorite occurs in many colors in Maine, even at a single locality. A survey of many specimens shows that almost all such variations are still very manganese-rich, but a few specimens show minor substitution by calcium. No systematic calcium vs. color variation was evident.

Tiny light amber eosphorite crystals (to 0.1 mm) form a thin druse in crevices of etched colorless spodumene from the Wade quarry, **Auburn**.

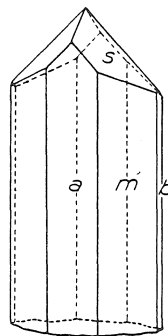
The Bennett quarry, **Buckfield** has produced at least two habits of eosphorite. Cavities in rhodochrosite cutting montebrasite contain golden yellow-brown radial clusters of almost acicular eosphorite crystals (to 3 mm) associated with carbonate fluor-hydroxyl-apatite, fairfieldite, and other phosphates as well as smoky quartzoid-shaped quartz crystals (to 2 mm; AMNH collection). Prismatic orange to orange-brown eosphorite crystals (to 4 mm) are found embedded in a clear mineral with perfect cleavage. Exceptional eosphorite crystals have been found at the Bennett quarry in vugs in rhodochrosite and the highly elongated eosphorite crystals (to 25 x 0.3 mm [world record size until 1941]) can be bunched in sub-parallel to "jack straw" groups (to 30 x 10 mm). Landes (1925) reported a chemical analysis and indicated eosphorite's intergrowth with rhodochrosite.

A few chestnut-brown to tannish brown eosphorite crystals (chemical analysis, this study) (to 5 mm) which have tan cores have been found in crystallized albite and cleavelandite vugs at the Consolidated quarry, **Georgetown**. Occasional fracture surfaces in tan albite widen into vugs and are covered with light tan, vertically striated eosphorite crystals (to 3 mm) associated with cream-colored botryoidal carbonatite fluorapatite.

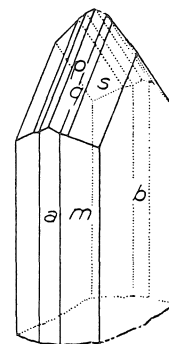
Morrill et al. (1958) listed eosphorite from the Tamminen quarry and Frew (1958) listed it from the Waisanen quarry, **Greenwood**, but no specimens are known.

Very unusual dark brown to amber calcian eosphorite has been found as brecciated terminated and unterminated vertically striated prisms (to 3 x 0.5 mm) sparsely embedded in massive white hydroxylapatite/muscovite matrix with cleavelandite at the Emmons quarry, Greenwood.

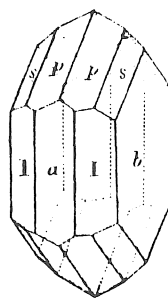
The first locality for eosphorite in Maine was Mount Rubellite quarry, **Hebron**. The material was also the first discovery for the species in the world, but that fact eluded observers until Hurlbut (1950) proved that the material was eosphorite. Larsen (1921) suggested that the Hebron material could be eosphorite. The mineral was first called "childrenite" by Brush (1863a,b) as there was no eosphorite known at that time. Cooke (1863c) revealed the crystallographic similarity of the Hebron crystals to childrenite. Brush and Dana (1878) later named the mineral eosphorite from Branchville, Connecticut and reviewed the crystallographic similarity of the new species to "childrenite." The Mount Rubellite quarry material must have been regarded as quite precious, as Brush would certainly have wanted to quantitatively analyze the Hebron material after he had discussed the new mineral from Branchville. Sufficient material exists in the Brush Collection at Yale to have done so, using nineteenth century techniques. Childrenite is iron-dominant, while eosphorite is manganese-dominant. Brush based his original "childrenite" determination on a qualitative analysis only: "In an article on the occurrence of *amblygonite* at Hebron, published in this Journal, vol. xxxiv, p. 243, 1862, I mentioned that it was sometimes associated with a peculiar compact variety of apatite, containing minute prismatic crystals of a hair-brown mineral. The small amount of this hair-brown mineral, at that time in my possession, prevented me from determining fully its specific characters; but subsequent explorations of the Hebron locality, made by Mr. Oscar D. Allen, have furnished a sufficient quantity of the substance for examination, to lead to the conclusion that the mineral is probably a variety of *childrenite*. ... Qualitative analysis proved the mineral to be a hydrous phosphate of iron, alumina and manganese." Cooke (1863c) demonstrated the crystallographic similarity of the Hebron mineral with the childrenite of Tavistock, Devonshire, England. Cooke (1863c) did say: "Although there is a difference of over half a degree in one of the fundamental angles, yet the general crystallographic characters of the two sets of crystals (the striation and lustre of the different faces) are so nearly the same, that there can be no doubt that the Hebron crystals are a variety of childrenite, differing perhaps from the English childrenite in some not fundamental point of chemical composition." By the time of the Brush and Dana (1878) paper, a Hebron "childrenite" crystal drawing had been produced. Penfield (1880) and Brush and Dana (1880) further reviewed the chemistry and crystallographic similarity of eosphorite and childrenite, but no chemical analysis of Hebron material was reported. Brush and Dana (1880) wrote, reflecting that era's conservative attitude about erecting new names: "Eos-



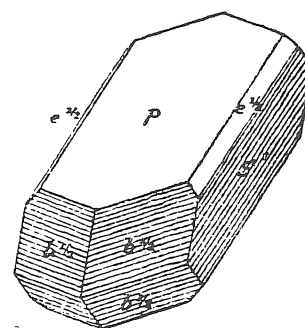
Bennett Q, Buckfield
(from Hurlbut, 1950)



Mount Rubellite Q, Hebron
(from Hurlbut, 1950)

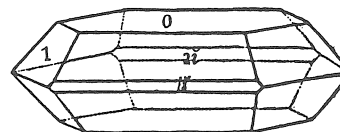


(from Brush and Dana, 1878)



(from Goldschmidt, 1913)

Mount Rubellite Q, Hebron



(from Cooke, 1863c)

Eosphorite

phorite then should be considered merely as a sub-species under childrenite, related to it in the same way that the lithiophilite from the same locality is to triphylite." Modern quantitative partial chemical analysis (Hurlbut, 1950) indicated that the Hebron eosphorite is now correctly named. Barnes (1949) reported on a beginning survey of the series and reported data on worldwide childrenite. After the publication of Hurlbut (1950) announcing twinning in eosphorite, based on Dunton quarry, Newry specimens collected by the 1949 Harvard University episode of specimen mining there, and a revised chemical analysis based on re-examination of "original material of Palache and Shannon (1928)," Barnes and Shore (1951) indicated that there was an inconsistency in the structural data presented by Hurlbut (1950)

based on their study of Buckfield, Newry, and Black Mountain quarry, Rumford eosphorite.

The Mount Rubellite quarry crystals (to 8 mm) are red-brown to chocolate-brown and are nearly opaque. The individually grouped crystals are thickly grown on fine-grained cookeite and coarse lepidolite.

The principal quarries on Halls Ridge and Plumbago Mountain, Newry: Bell Pit, Martin prospect, Nevel quarry, Dunton quarry, Scotty quarry, and Rose Quartz crystal area as well as some of the unnamed lower prospects on the mountain have yielded excellent eosphorite.

Red-brown-stained brown eosphorite (to 4 mm) are found in crystallized albite vugs in the lower prospects along the "Perham" road, Newry-Rumford town line area.

Bell pit eosphorite is found in the siderite assemblage and in etched seams in quartz. The golden-brown crystals can be individually grouped in vugs or present in radial clusters of slightly etched crystals (to 5 mm each in up to 1 cm groups). The color of Bell pit eosphorite varies from pale yellow-brown to dark brown. Some sharp color-zoned crystals (to 2 mm) have a slightly greenish brown shaft with medium red-brown terminations.

Nevel quarry, Newry eosphorite presents considerable variety of appearance, despite the consistently simple crystal habit. Orange-tan eosphorite crystals (to 3 mm) are found on tan "pagoda" siderite crystals (less than 1 mm) lining vugs in albite. Some tan to brown crystals and fans of crystals line the interstices in cleavelandite sometimes on thin snow-white coatings of carbonatian fluor-hydroxyl-apatite. Very small (less than 1 mm) tan crystals with adamantine luster can completely line cleavelandite voids, while larger (1-2 mm) crystals can be found in orange-brown clusters (to 7 mm) on the white cleavelandite. Particularly flat salmon-colored eosphorite blades (1 mm) also line cleavelandite vugs. Vugs with frosted quartz crystals produce lovely amber, transparent eosphorite crystals (to 7 mm) sometimes with white carbonatian fluorapatite on the tips. Occasionally, drusy quartz coatings on eosphorite terminations (to 8 mm) can be found individually grown in cleavelandite voids. Brown eosphorite crystals to 6 mm can be found as well. Associated species with Nevel quarry eosphorite can include vivianite, pyrite, fairfieldite, cookeite, roscherite, and, in one case, purple gainesite. Tiny (to 1 mm) peculiar groups of eosphorite from the Nevel quarry can resemble mushroom-profiled "sprigs." These amber to brown sprigs can be tightly grouped in albite crystal- and/or muscovite crystal-lined vugs or found in the interstitial cavities in cleavelandite, sometimes associated with tiny pyrite crystals (less than 1 mm).

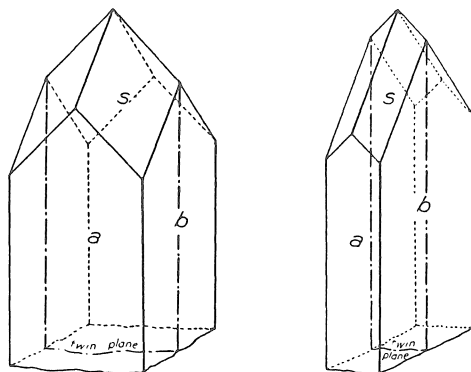
Dunton quarry, Newry, eosphorite shows considerable variety of associations and color. Crystal shape remains relatively consistent, however. The variety of specimens has virtually the same habit and appearance as at the Nevel quarry. In addition, clusters in cleavelandite can be a rosy pinkish-brown through a very light tan. Parallel growth eosphorite is scarce at most localities, but is seen in some of the Dunton cleavelandite. Brown

to dark brownish-green botryoidal clusters (to 6 mm) of eosphorite with "beaded" rows of terminations have been misidentified as wavellite. Associated species at the Dunton quarry include carbonatian fluorapatite, fluorapatite, pyrite, cookeite, beryllonite, "roscherite," hydroxyl-herderite, crandallite, quartz, elbaite, fairfieldite, etc. Sometimes the red-brown eosphorite crystals (to 1 cm) are surrounded by a snow-white carpet of carbonatian hydroxylapatite in vugs in cleavelandite. Poor quality, dark brown wide blades of eosphorite (to 2 x 4 mm) can form radial clusters (to 1 cm) on pink and green elbaite. Palache and Shannon (1928) produced crystallographic drawings for the species which reflect the common habit from many localities in Maine.

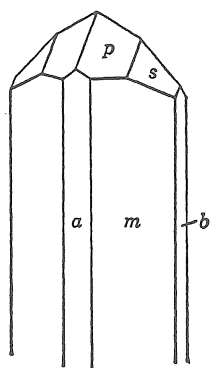
The Dunton quarry eosphorite crystals (15-25 mm) were individually grouped on coarse "brecciated" cleavelandite that was coated by botryoidal, snow-white carbonatian fluor-hydroxyl-apatite. Holman (1935) may have been describing "roscherite" when he reported: "Specimens of eosphorite were obtained showing compact masses of a brownish gray color imbedded in cleavelandite and others, showing implanted globules made up of radiating fibers, dark gray on the exterior and yellowish brown within. This rare mineral has been found in well defined crystals at this locality, but none were obtained on this trip." Fraser (1930) reported: "Eosphorite is one of the commonest phosphates at Newry. It occurs as a pocket mineral, sometimes formed on quartz crystals in the open cavities, sometimes as a fan-shaped aggregate on albite and occasionally it may be seen cutting across beryllonite crystals. The color varies from opaque brownish black to a transparent light brown and almost to a yellow." Palache and Shannon (1928) analyzed Dunton quarry eosphorite and reported: "It is always in free crystals implanted on quartz in open cavities or forming fan-shaped groups on albite. The crystals are of simple form, showing the unit pyramid and the two pinacoids a (100) and b (010). They show prismatic development with an almost square cross section. In color they vary from opaque blackish brown to transparent hair brown." Dunton quarry eosphorite was uncommon during and after the 1972 mining episode, but appeared in a unique association. The dark brown eosphorite was found in radial clusters (to 2 cm) of bladed crystals (to 3 x 8 mm) on pink elbaite and cleavelandite.

The eosphorite from the Scotty quarry, Newry is composed of tan, lustrous crystals (less than 1 mm) with tiny pyrite crystals, all coating albite crystals.

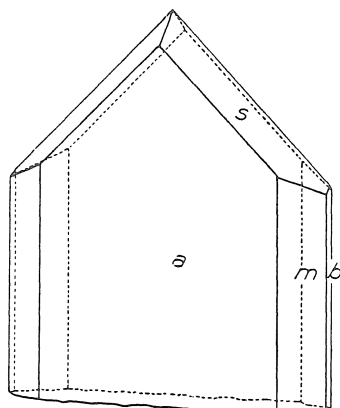
Eosphorite is abundant at the Rose Quartz Crystal location, Newry. The eosphorite is frequently found on rose quartz crystal clusters, muscovite crystals, and albite crystals. The dominant habit of the eosphorite consists of radial or stellate planar clusters (to 1 cm) which vary from transparent straw-yellow (in 1 mm crystals) to dark brown (in 6 mm crystals). Associated species include carbonatian fluor-hydroxyl-apatite, hydroxyl-herderite, "roscherite," montebasite, etc. (Many eosphorite specimens have been destroyed from this location by their being soaked in oxalic and stronger acids to remove various stains from the



Dunton Q, Newry
(from Hurlbut, 1950)



Berry-Havey Q, Poland
(from Palache et al., 1951)



Black Mountain Q, Rumford
(from Hurlbut, 1950)

Eosphorite

associated rose quartz crystals. Frequently, the eosphorite and other phosphates were more valuable than the quartz.)

Mount Mica, **Paris** has eosphorite associated with eyes of indicolite tourmaline, "kaolinite," cleavelandite, quartz crystals, cookeite, and white to tan botryoids of carbonatian fluorapatite. The color of the eosphorite can vary from golden-brown to pinkish-brown. Mount Mica eosphorite crystals can have prism faces as well as pinacoids.

Ryerson Hill quarry, **Paris** eosphorite is listed by Morrill et al. (1958), but only one specimen is known (AMNH collection). It consists of dark brown eosphorite crystals (to 1 cm) in a radial pattern and partially coated by rusty-stained botryoidal tan carbonatian fluorapatite in a quartz vug.

Brown "bow tie" clusters (to 6 mm) of eosphorite are sometimes found on fracture surfaces in albite associated with botryoidal (to 2 mm) carbonatian fluorapatite at the Berry-Havey quarry, **Poland**. Brown eosphorite (to 3 mm) is found in siderite/rhodochrosite with whitlockite.

Red Hill quarry, **Rumford** eosphorite varies from dark pinkish-brown to tan, and from simple pinacoidal and pyramidal

to combinations with the prism. The eosphorite can form large patches (to several centimeters) covering recrystallized albite fracture surfaces, rarely associated with pale rose quartz crystals. Eosphorite in black-stained siderite can appear to be etched due to dissolution. Hurlbut (1950) found that some Red Hill quarry eosphorite was compositionally zoned and iron-rich enough to qualify as childrenite (q.v.)

Verrow (1941) reported on Black Mountain quarry, **Rumford** eosphorite: "Exceptionally fine groups were found by the writer during the summer of 1940. One of the largest groups of crystals found is 6x7 inches and rests on a feldspar matrix measuring 11 x 12 inches. There are hundreds of crystals on this specimen, the largest crystal being over an inch in length and is doubly terminated. The crystals are brown in color and have a thin coating of francolite." These largest crystals of eosphorite from Maine are actually 37 mm (Bjareby, 1965a). The brown crystals are in a 15 cm vug in albite filled with dozens of eosphorite crystals not significantly smaller than the largest. This specimen held the world's record for the species until the huge eosphorites were found at Linopolis and Mendosa Pimental, Minas Gerais, Brazil. Crystals weighing up to a kilogram and tens of centimeters in length were not unknown in Brazil in the mid-1960's. The color of the Black Mountain quarry eosphorite varies from amber through a red auburn-brown. The clusters of crystals can be planar radial, fan-shaped, or individually prismatic. A striking feature of many Black Mountain quarry eosphorites is the small secondary growth crystals which grow projecting away from much larger "primary" crystals, much the same way that pins project outward at varying angles from a pin cushion. Frequently, a slight iridescent luster is seen on the eosphorite from this locality. The matrix is exclusively cleavelandite and associated species include "roscherite," hydroxyl-herderite, carbonatian fluor-hydroxyl-apatite, rhodochrosite, etc. Partial and complete coating of eosphorite by carbonatian fluor-hydroxyl-apatite are common at Black Mountain.

Lord Hill quarry, **Stoneham** has produced eosphorite only rarely. The beautiful amber crystals (1-3 mm) are thickly grown together in vugs with quartz crystals, muscovite, pyrite, albite, columbite, beryllonite, hydroxyl-herderite, etc. Some small amber-brown to peach-brown crystals (to 1 mm) resemble "paint brush" sprays in cleavelandite at the Lord Hill quarry.

EPIDOTE (Epidote Group)



Addison - Pleasant River Black Granite Q; **Alfred**; **Baileyville** - southwest base Staples Mountain A; **Bar Harbor** - Schooner Head Q; **Belgrade**; **Bethel**; **Bridgton**; **Brunswick**; **Bryant Pond** - Bryant Pond Granite Q; **Calais** - Maine Red Granite Q, U.S. Route #1 road cut; **Camden** - Marine Street beach; **Carmel**; **Centerville** - Mitten Mountain A; **Chain of Ponds** - eastern talus Bag Pond Mountain; **Charlotte** - Leighton Formation (basalt member); **Cornish**; **Cutler** - Cutler Diabase, Norse Pond A; **Deer**

Isle; TDR2 WELS - Dunn Brook keratophyre; **Eastport** - Moose Island A; **Frankfort** - Mosquito Mountain; **Franklin; Freeport** - Pound of Tea Island A; **Gouldsboro** - Gouldsboro M; **Isle au Haute; Jim Pond** - Route #16 outcrops; **Jonesboro** - Bodwell Q, Blaisdell Q, Fish Q, Havey and Robertson Q, Look Head A; **Jonesport** - Ikes-Gay Hill A; **Lovell** - road cut; **Lubec** - Lubec Lead M; **Machiasport** - vesicular andesite Nepp Point A; **Marshfield** - Machias Granite Q, Marshfield Granite Q; **Minot; Mount Desert** - Allan Q, east shore A and Sea Cliff Drive A, Somesville A; **Mount Katahdin township** - Chimney Pond A; **Norridgewock; Norway; Pembroke** - U.S. Route #1 road cut; **Phippsburg?** - The Basin=clinozoisite; **Portland; Raymond** - Great Rattlesnake Pond A; **Rockabema quartz diorite** - **T5R7 WELS, T6R6 WELS; Roque Bluffs** - Nepp Point A; **Sanford?** - Webster P, 200 M L; **Searsport** - Bog Hill Granite Q; **South Thomaston** - Spruce Head Granite Q; **Stonington** - Crotch Island Q, Goss Q, Sherwood Q; **Sullivan** - Dunbar Brothers Q, Milton M, Pine Tree M; **Topsham; Tremont** - Sebec Cove Granite Q; **Wayne; Whitefield** - Jewett Black Granite Q; **Whitneyville** - Whitneyville quartz diorite; **Winter Harbor** - Schoodic Point A; **Woodstock; York** - Cape Neddick A; **T3R11 WELS** - Ripogenus Dam outlet A; **T5R1 NBPP** - Whitney pegmatites; **T5R7 BKP WKR; T7R11 WELS** - Carpenter Pond Formation; **T9R13 WELS; T10SD** - Catherine Hill P

Epidote forms a series with clinozoisite. The substitution of iron for aluminum makes the epidote vary through shades of green, while clinozoisite varies from gray through muddy gray green. Color alone does not distinguish the intermediate compositions. Epidote is a very common mineral found in joint and fracture surfaces in granite and other plutonic rocks as well as forming veinlets in basalt dikes. It is a mineral so widely distributed in Maine that it can be found in hundreds of locations as a fracture filling in almost any kind of rock, but seldom is found in terminated crystals. Many Maine "granites" contain contact zones with minor volcanic dikes and intrusions and collectors have called these epidote-bearing rocks by the name *unakite*. Epidote/clinozoisite occurs in a host of metamorphic rocks. Many green tourmaline reports from non-pegmatite locations in Maine seem to be misidentified epidote. Epidote is frequently found as dark pistachio green radiating fans (to 5 cm) of unterminated crystals in miarolitic granite. Notable localities include granites in the Hall Quarry (village), Mount Desert, Crotch Island, Stonington, and Jonesboro quarries.

Some of the largest epidote prisms (to 5 x 1 cm) from Maine are found in milky quartz at a talus on the eastern slope of Bag Pond Mountain, **Chain of Ponds** (Earl Meyer, personal communication, 1990).

Ludman and Hill (1986; and worded almost exactly the same in 1990) wrote of the basalt member of the Leighton Formation, **Charlotte**: "Small ovoid vesicles 1.0 to 2.5 mm in diameter and larger 'vugs' up to 2.5 cm across are present in some of the fine-grained basalts. Both are filled and most of the fillings are well zoned. Very fine grained (chilled) plagioclase laths

surround each vesicle, followed by an outer lining of interlocking epidote crystals and successive zones of epidote + actinolite, coarse actinolite, and coarse sulfide +/- an isotropic mineral as yet unidentified."

Gates (1961) reported many occurrences of epidote in a variety of rocks in the **Cutler** area. He said of the metamorphism of the Cutler Diabase: "The epidote that is disseminated through a rock, in contrast to that concentrated in clots and veins, presumably grew during the first stage of metamorphism. Its distribution is erratic. It most commonly replaces albite as small anhedral grains whose distribution does not reflect the zoning in anorthite content of the original labradorite; yet in many samples albite is devoid of epidote. It is next most common as replacement of chlorite, particularly in interstitial areas and in rocks in which there is little or no hornblende. It is least common in pyroxene. Some rocks thoroughly altered to chlorite and albite contain no epidote; others have epidote in chlorite, pyroxene, and albite; and in still others, epidote is restricted largely to just one of these minerals. In addition it fills vesicles in basaltic tuffs and lavas."

Pavlidis and Milton (1962) wrote of the Dunn Brook (keratophyre) Member of the Hovey Group, **TDR2 WELS**: "Epidote, in addition to being intimately associated with albite, also occurs as finely granular material in pygmatic veinlets, which cut across all the textural and structural features of the rock including the amygdules. The amygdules are filled mostly with chert. Some of the smaller amygdules are partly or completely filled with a pale yellow-green aggregate the grains of which have a blue interference color and fibro-lamellar to flaky habit and may be penninite. Where epidote veinlets cut the chloritic amygdules, the epidote is well crystallized and tabular adjacent to the contacts with chlorite and finely granular within the veinlets. The well-crystallized epidote is colorless and has strong to moderate interference colors in yellow, orange, and blue."

Outstanding transparent grass-green to pistachio-green epidote crystals (to 3 mm) are found in a quartz vein cutting an outcrop above the beach on Pound of Tea island in Casco Bay, **Freeport** (Zodac, 1949, 1950b, 1950c).

Terzaghi (1946) described the amygdaloidal rocks on Milton Mountain and on Ikes and Gay Hill, **Jonesport**: "The vesicles are filled with calcite and epidote; the latter is confined to the peripheral portions of each vesicle." Epidotized rocks were reported over the coastal area from Sandy River Beach to Natt Point, Jonesport as well as less specifically on the Look Head area, **Jonesboro** and the Nepp Point area, **Roque Bluffs**.

Hitchcock (1862b) wrote on geological observations near **Machiasport** and described epidote veinlets in rock 903 feet north of the Point of Main(e) plus "... a considerable distance, which we neglected to estimate..." along the shore.

Dale (1907) and Smith (1923) reported many epidote locations in granite quarries. The two most interesting entries include the Allan quarry, **Mount Desert**: "There are geodes of pink feldspar, quartz, and epidote." and for the Bodwell-Jonesboro quarry, **Jonesboro**: "There are geodes and short veins, contain-

ing quartz, epidote, and calcite." Smith (1923) further reported of Jonesboro and **Marshfield**: "Small cavities lined with crystals occur in granite. They are uncommon in the New England quarries, but at the Bodwell Granite Co.'s quarry, near Jonesboro, Maine..., there are several about a foot in diameter, lined with quartz crystals and epidote. The center of some of these is filled with calcite in very obtuse rhombohedra half an inch across. The large aplite vein at the same quarry has many irregular openings lined with crystals of feldspar and muscovite. At the Machias Granite Co.'s quarry, near Marshfield, Maine..., there are several geodes up to 6 inches in diameter, lined with crystals of feldspar and amethyst, with the central space filled with chlorite, epidote, fluorite, and calcite." The "geodes" are more likely solution features along joint surfaces rather than primary features of the granite as suggested by Dale (1907) and Smith (1923). Numerous joint faces at the Bodwell quarry show crystallized patches of quartz and occasional epidote shards, but no indication of the crystallized surfaces revealed during quarrying.

Bailey (1837) noted epidote in the rocks of the Chimney Pond area, **Mount Katahdin**.

Epidote was reported by Clarke (1894) based on a chemical analysis which would be better interpreted as a ferroan clinozoisite (q.v.) from The Basin locality, **Phippsburg**. The previous identification was axinite.

Webster (1848) reported on the **Sanford** vesuvianite locality and stated: "Here and there I found molybdenum [sic] and epidote in the masses." At the two prospects, the Webster prospect and "200 meter locality," a medium green granular diopside is found at the localities and resembles epidote closely enough that it is probably the mineral mentioned by Webster. Gray clinozoisite, however, is known from the area, and that may have also been the source of the misidentification.

Tiny (1 mm) crystals in veinlets and fracture surfaces near and in basalt dikes are abundant in the Schoodic Point area, **Winter Harbor**.

Neuman (1967) noted many epidote alterations and veinlets in the Shin Pond and Stack quadrangles. In particular, he noted of the Rockabema quartz diorite, **T5R7 WELS** and **T6R6 WELS**: "Chlorite and epidote aggregates, no more than 4 mm long, are pseudomorphous after biotite and form about 5 percent of the phenocrysts."

Hall (1970) noted unusual epidote in the Carpenter Pond Formation of volcanic rocks, **T7R11 WELS** (and elsewhere): "Commonly they contain amygdules with chlorite centers and epidote (pistacite) rims."

Yellow-green "matchstick" epidote crystals (to 2 mm) occur in vugs in granite at the Catherine Hill prospects, **T10SD**.

erythrite?

Castine - Emerson M

Morrill and Hinckley (1959) listed erythrite and a cobalt silver arsenide from the Emerson mine, **Castine**. No specimens

or descriptions known. Young (1962) found only pyrite at the locality.

essonite = red to brown grossular

EUCLASE

BeAlSiO₄(OH)

Albany? - *Bumpus Q; Topsham - West Fisher P*

Morrill et al. (1958) reported euclase from the Bumpus quarry, **Albany** with the cryptic, yet suggestive annotation: "6 mm lg." No specimen is known.

Drusy angular euclase crystals (to 2 mm) form a colorless coating on quartz crystal faces (to 1 x 1 cm) and crystallized albite crystal clusters (to 3 x 4 cm). The mineral was found by Cliff Trebilcock and Don Swenson and identified by Al Falster (XRD, personal communication, 1994). The locality is a small woods mine dump just west of the Fisher quarry, **Topsham**.

eucryptite?

Newry? - *Dunton Q, Plumbago Mountain A*

Eucryptite can crystallize as a primary mineral or be formed by the replacement of pre-existing material such as spodumene. Holman (1935) reported of a specimen from the Dunton quarry, Newry given to him by Charles Marble: "It shows a thin coating of pollucite on a mineral that was originally pronounced eucryptite by a prominent authority but which later was identified as spodumene by Mr. Berman of Harvard. This specimen of spodumene shows a sort of columnar structure which I have not seen exhibited before by this mineral." It is clear, from this explanation and from observations of private collections, that Newry cymatolite (q.v.) was once commonly called eucryptite.

A tradition on the occurrence of eucryptite was reported to Yedlin (1967) by Alden Harriman: "We were trying to drive up to the old rose quartz area. No go. Since we were that far back in the woods we thought we'd check out the old prospect in back of Plumbago Mt. There's supposed to be a bed of eucryptite some place in the vicinity. We failed to find it. In fact we couldn't find the old prospect. There was a foot of snow on the ground and that didn't help. (Ed. note [Rocks and Minerals editor]. Anybody can find eucryptite when there's no snow cover.) A spring freshet had washed an area several feet wide along the mountainside, exposing spodumene 'planks' several feet long and a couple of feet wide." Some Maine "eucryptite" has been shown to be misidentified cymatolite samples and the prior source report has not been located. No correctly identified specimens are known. Most eucryptite fluoresces dull red in long wave ultraviolet light. Misidentification is easy when the purple of the ultraviolet light

source is seen reflecting from a non-fluorescent sample and then is assumed to be a faint fluorescent response.

evansite?

Paris? - Mount Mica Q

Evansite was observed in a thin section of siderite-albite pegmatite associated with "brazilianite," "hisingerite," and

"palermoite." "Isolated from the siderite are patches of very coarse, finely twinned oligoclase riddled with irregular stringers of quartz. The oligoclase is studded with wedge-shaped euhedra of brazilianite that show some marginal decay to palermoite, further to an irregular network of evansite seams. The final alteration assemblage includes kaolin and hisingerite" (Sidney A. Williams written communication to Richard Thomsson, 1985). The "evansite" consists of intergranular films which could not be identified (this study).

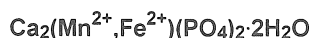
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fahlunite = clinocllore

Unity?

Morrill and Hinckley (1959) noted fahlunite variety of chlorophyllite from Unity (see cordierite). No specimens known.

FAIRFIELDITE (Fairfieldite Group)



Buckfield - Bennett Q; **Greenwood** - Emmons Q, Harvard Q, Tamminen Q; **Hebron** - Mount Rubellite Q; **Newry** - Bell Pit, Duntun Q, Nevel Q, Rose Quartz Crystal L?; **Norway** - BB #7 Q; **Paris** - Mount Mica Q; **Poland** - Berry-Havey Q; **Rumford** - Black Mountain Q, Ford Hill Q, Goddard Ledge Q; **Stoneham** - Cole Q

Though a complete variation exists, worldwide, in the fairfieldite / messelite series, most of the Maine occurrences are in manganese-rich assemblages and thus are fairfieldite proper. A qualitative chemical survey (this study) indicates most Maine fairfieldite specimens are correctly identified.

Landes (1925) chemically analyzed and described an occurrence of fairfieldite from the Bennett quarry, **Buckfield**. He figured a 2.8 x 0.8 cm crystal (HU #86794) which is still a world record size for the species and perhaps for the entire group of similar species. Landes (1925) said of the Bennett material:

"Straw colored plates here and there among the Class III minerals were found to consist of small crystals of fairfieldite. These are triclinic, have one perfect cleavage, and in thin plates are absolutely colorless and transparent.

Crystals of simple form were seen but proved to be too dull for measurement. The largest crystal, shown in plate III, A, and nearly 3 centimeters long, is entirely coated with dahllite.

Fairfieldite from the zone of oxidation is white and opaque and often coated with manganite. The nature of the alteration may be seen under the microscope. A white opaque mineral which may be kaolin has commenced to attack the fairfieldite, working first along the cleavage cracks and from them laterally into the mineral. Sometimes a yellowish to olive green alteration product is present but chemical and optical tests on this mineral were hopelessly complicated by the unfailing presence of residual fairfieldite. ... An analysis by Miss Vassar follows... The lowest percentage of iron in previously analyzed fairfieldite was 3.42 per cent, in a specimen from Branchville. ... Fairfieldite was deposited after eosphorite. In some instances eosphorite crystals cut through

fairfieldite and appear later in age, but a close examination shows that the cleavage directions in the fairfieldite on opposite sides of the eosphorite are never parallel. The latter does not divide single individuals, but merely lies between separate crystals, of later age."

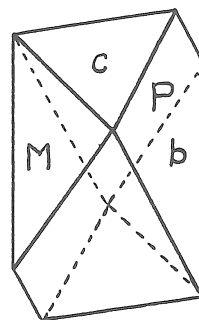
Wolfe (1941) reported on the unit cell dimensions of fairfieldite and provided a crystallographic drawing of material from the Bennett quarry.

White to clear foliated blades (1 mm) of fairfieldite are found with landesite, stewartite, rockbridgeite/frondelite, moraesite, mitridatite, jahnsite-(MnMnMn), earlshannonite, etc. in phosphate nodules in quartz at the Emmons quarry, **Greenwood**.

One exceptional fairfieldite specimen (X-ray diffraction, this study) has been found at the Harvard quarry. The fairfieldite consists of transparent, sharply terminated crystals (to 5 x 2 mm) sprinkled on lilac fluorapatite crystals (to 1.5 cm) on drusy quartz and cleavelandite.

Mount Rubellite quarry, **Hebron** fairfieldite is seen as 1-2 mm feathery to foliated snow-white clusters embedded in pink rhodochrosite with olive-green dickinsonite, fine-grained white montebrazite, short (less than 1 mm) strunzite needles, and thin intergranular blue films of vivianite.

Newry was formerly the prime locality to obtain fairfieldite before the transparent crystals of the Foote quarry, Kings Mountain, North Carolina were found in the 1960's, but the best of the Nevel quarry specimens nearly equal the best of the Kings Mountain specimens. Large milky white clusters (to 5 x 10 cm) of foliated fairfieldite crystals to 8 mm in clusters (to 10 x 10 cm) were found in pockets in quartz-muscovite pegmatite at the Nevel quarry. Some fairfieldite crystals formed "toothy" clusters and coarse rosettes of white to cream-white crystals frequently



Fairfieldite, Bennett Q, Buckfield (from Wolfe, 1940)

associated with tan to golden brown eosphorite (1-3 mm) and, occasionally, pyrite crystals (less than 1 mm). The fairfieldite can be clear or milky white to gray and found as individual crystals (to 2 mm) in voids in cleavelandite along with peculiar red eosphorite crystals (to 4 mm). Coarsely bladed, tapering, jack-straw, milky-white fairfieldite crystals (to 2 mm) can be found as irregular to radial aggregates inter laminated in muscovite at the Nevel quarry, but the delicate circular, radially fibrous fluorapatite inclusions should not be confused with fairfieldite. Identical radial inclusions of fluorapatite can be found in muscovite at the Dunton quarry. Vivianite can be associated. Rare exceptional lustrous botryoidal clusters (to 1.5 cm) of cloudy translucent fairfieldite crystals have been found at the Nevel quarry on quartz crystals (AMNH collection). Vivianite crystals (to 5 mm) can be associated with the translucent fairfieldite.

Additional variety is provided by specimens from the Bell Pit, Newry. Fairfieldite can be found as small tan to milky white nodules (1+ cm in 8 x 8 cm clusters) in quartz and muscovite matrix. The nodules contain "rough" to "toothy" foliated botryoids of fairfieldite with infrequent massive mitridatite and/or tiny strunzite crystals (less than 1 mm). Individual fairfieldite crystals (to 1 mm) can be found in etched or unetched siderite, usually with eosphorite crystals. Fairfieldite can be associated with a rich assemblage of minerals including: strunzite, triphylite, vivianite, sphalerite, rockbridgeite, mitridatite, beraunite, montebrasite, diadochite, pyrite, etc.

Fairfieldite occurs at the Dunton quarry, Newry. Formerly, the relatively common rosettes of crandallite (q.v.) were incorrectly called fairfieldite (King, 1975b). True fairfieldite, from this locality, is platy milky-white, without being in a symmetrical rosette, and rarely forms a "sheaf" of terminated crystals. Fairfieldite is usually embedded in manganian siderite in blue tourmaline "eyes" and lustrous fairfieldite cleavages can be apparent in the broken rock. The waxy fairfieldite can have a light dusting of green beraunite and be associated with tiny strunzite crystals (less than 1 mm) or found in black-stained phosphate matrix. The beryllonite association of minerals rarely includes fairfieldite. Rosettes in the beryllonite association, however, are usually crandallite. One, untested, milky-gray rosette of fairfieldite (2 mm) with relatively thick individuals was observed in a void in cleavelandite with autunite at the Dunton quarry.

The fairfieldite from the Rose Quartz Crystal locality, Newry is probably misidentified. Observed specimens consist of rosettes of muscovite (to 2 mm), frequently coated by drusy quartz. Additional rosettes consist of crandallite. No verified fairfieldite specimens known.

Fairfieldite from the BB #7 quarry, Norway is probably from the nearby BB #6 quarry, as this produced the most phosphate material (Neil Wintringham, personal communication, 1990). The entire area has now become known as #7 quarry, as that is the pit that produced gem tourmaline and thus became the best known of the connected series of pits. The fairfieldite is seen as waxy, snow-white foliated botryoidal masses (to 1 cm). Crystals can show perfect cleavage. The surfaces of the botryoids are

composed of lamellar stacks of crystals (to 2 mm) which have a similar rosette structure as some worldwide barite specimens. The fairfieldite usually has a patchy yellow discoloration or stain and the crystals frequently have silky to splintery strunzite needles (to 1 mm) and tiny (much less than 1 mm) botryoids of resinous butterscotch-colored diadochite on it in the vugs. Amber-brown equant to prismatic crystals (very much less than 1 mm) from the jahnsite group are also associated. Siderite-rhodochrosite masses (to 2 mm) form the matrix as well as muscovite.

Mount Mica quarry, Paris fairfieldite forms cream-white botryoidal groups (to 3 mm) which have a "toothy" or serrated surface and are found in blue elbaite "eyes". The matrix consists of manganian siderite with vugs lined by colorless fluorapatite crystals which are tightly clustered and almost approach being botryoidal. Rose red to tan eosphorite crystals (to 2 mm) can be associated (Gene Bearss, personal communication, 1991).

Some of the Berry-Havey quarry, Poland fairfieldite forms cauliflower-like botryoids (to 5 mm) of white crystals (to 2 mm) which are sometimes coated with earthy light avocado-green mitridatite. Individual steep isosceles-triangular fairfieldite crystals (to 2 mm) can be found in vuggy rhodochrosite/siderite. Strunzite crystals (to 7 mm!), pink scalenohedral rhodochrosite crystals (to 3 mm), and diadochite botryoids (to much less than 1 mm), dickinsonite masses (to several millimeters), massive brick red to pink triplite (to 1 cm), fine-grained montebrasite (to several centimeters), tiny vivianite stains (to 1 mm), massive blue tourmaline (to 1 cm), resinous golden brown to black color-zoned massive microlite? (to 3 mm), and massive löllingite (to 1 mm) are all found enclosed in massive quartz and albite. Berman and Gonyer (1930) wrote: "Fairfieldite occurs as white foliated plates in rhodochrosite, and, in one specimen, as a pseudomorph after rhodochrosite. As stated above it also is found as a soft platy mineral on dickinsonite, probably as an alteration of the latter."

Fairfieldite is very scarce from the Black Mountain quarry, Rumford and no specimens were available for examination. Marble and Morrill (1945) first listed the species: "One specimen of fairfieldite was found which consisted of white botryoidal fillings in vugs," but gave no details. Fairfieldite was further listed by Morrill et al. (1958), Gregory (1968a), Thompson et al. (1988, 1991), and Francis et al. (1993). No specimens known.

Fairfieldite is found at Ford Hill quarry, Rumford as milky-white, rounded radial clusters (to 5 mm) with small individual crystal points projecting from the clusters of 1-2 mm elongated "rice grain" crystals in siderite and quartz matrix.

FAYALITE (Olivine Group)



Agamenticus Complex - Berwick, Wells, York; Cashes Ledge; Moxie pluton - Big Squaw (including Black Sand Island), East Bowdoin College Grant, Harfords Point, Little Squaw,

Squaretown, West Bowdoin College Grant; Newfield - Symmes Pond syenite stock; Shapleigh - Abbot Mountain syenite stock; Tunk Lake pluton - Cherryfield, Franklin, Steuben, T10SD; T5R9 WELS - Traveler Rhyolite

Fayalite is the iron analog of forsterite (olivine group). Ferrohortonolite is a variety of fayalite.

Toulmin (1957) discovered fayalite in a thin section of a grab sample broken from the submarine **Cashes Ledge** (42° 54' N, 68° 56' W): "Iron-rich *olivine* occurs in several small (0.05.) grains and in one large (0.3 mm.) broken euhedron associated with clusters of riebeckite needles in the section studied. $2V_x$ was determined by universal stage to be $60^\circ \pm 5^\circ$, corresponding approximately to Fa_{85} (ferrohortonolite)".

Espenshade and Boudette (1967) described the fayalite from the Moxie pluton, **Big Squaw, Greenville, Harfords Point, Little Squaw, and Squaretown**: "Olivine mainly forms anhedral to subhedral grains or is clustered in elongated aggregates, some of which are oriented in planes parallel to the plagioclase laminae. Olivine crystals are typically about 1-2 mm long, unzoned, and unaltered; alteration to serpentine occurs only locally. Color ranges from yellow green to dark metallic brown. Olivine commonly has a thin mantle or reaction rim (0.02-0.1 mm thick) of orthopyroxene or pale-brown hornblende. The composition of olivine in this part of the Moxie pluton falls into two groups; one group ranges from 28 to 42 percent forsterite, the other from 55 to 80 percent." In the parlance of mineralogists and petrologists, a small percentage of one end-member's composition means there is a large percentage of the other end-member.

Espenshade (1972) described the Moxie pluton east of Moosehead Lake. At sample location #588, due east of Mountain Brook Pond along Mountain Brook, **West Bowdoin College Grant**, an olivine norite was found containing fayalite (Fe_{28}). Additional locations produced fayalite: Black Sand Island, **Big Squaw** (#569, Fe_{45}); between South Cove of Upper Wilson Pond and Horseshoe Pond (#720, Fe_{36}), **West Bowdoin College Grant**; and northwest of Little Lyford Ponds, east of West Branch of Pleasant River, **East Bowdoin College Grant** (#795, Fe_{26}).

Hussey (1962) reported that fayalite is found in both alkaline syenite and alkaline granite of the Agamenticus Complex, **Berwick, Wells, and York**. It is associated with microcline, magnetite, fluorite, arfvedsonite, etc. The "elliptical" fayalite grains (1-3 mm) are translucent greenish-black and show smooth undulating fracture surfaces. Wandke (1922a) noted fayalite in the syenite of the Agamenticus Complex.

Karner (1974) merely said of the magnetite-aegirine augite granite which forms the outermost margin of the Tunk Lake pluton, **Cherryfield, Franklin, Steuben, T10SD**: "Fayalite is present in some specimens."

Gilman (1978) mapped fayalite occurrences in the Abbott Mountain area, **Shapleigh** and northeast of Symmes Pond, **New-**

field. He reported of the Newfield occurrence: "*The Symmes Pond Stock*, immediately northwest of the town of Newfield, consists of coarse-grained, green-brown syenite containing small amounts of aegirine-augite and fayalite. It appears similar to the interior syenite of Abbott Mountain. The rock contains small amounts of molybdenite and has been the site of minor prospecting in past years."

Hon (1980) noted fayalite as sparse phenocrysts in the Black Cat Member of the Traveler Rhyolite, **T5R9 WELS**.

feldspar - a group name

Feldspar is a group of minerals which has two major sub-groups: plagioclase and alkali feldspars. The name has been used by a number of miners and collectors who have not identified the specific mineral. Feldspar mining was formerly an important industry in Maine and, briefly in the early 1900's, Maine led the nation in feldspar production.

FERBERITE (Wolframite Group)

(Fe,Mn)WO₄

Blue Hill - Blue Hill Falls, Camdage farm A, Route #172 road cut, Route #176 road cut; Bowdoinham?; Brooksville - Callahan M (= Cape Rosier M); Cooper?; Cornish?; Hollis - Hollis Center road cut, Topsham?; T10SD - Catherine Hill Q

Ferberite from the Route #176 road cut, **Blue Hill** is found frozen in cloudy quartz. The terminated crystals (to 7 mm) show the "steep picket fence" bladed profile typical of the species. The black, lengthwise striated blades have a perfect cleavage parallel to the "b" pinacoid. Bright yellow feathery to acicular ferri-molybdenite is associated in quartz vugs. A peculiar tannish brown albite is found frozen in the quartz. Hinckley (1966) reported: "In the wooded area above the road cut on Route 172 going from Blue Hill toward Sedgwick, I have found molybdenite, arsenopyrite, pyrrhotite, wolframite and scheelite in the granite, but they are not abundant and difficult to locate. The road cut itself shows these and minor amounts of at least two other unidentified minerals, which occur filling seams in the rock." Routes #172 and #176 are coincident in Blue Hill for a short distance and might be the source of the two differently designated reports here.

A ferberite analysis with $FeO:MnO \approx 3:1$ of a Blue Hill mineral was reported by Jackson (1837a). Jackson (1838a) further described: "Near the tide-mills on the Camdage farm, we visited the locality from whence the specimen of wolfram was sent to me last year, and after diligent search, discovered the mineral in place. It occurs in the granite rocks, which rise through the gneiss, and forms a hill a quarter of a mile beyond the house. This rock contains numerous veins of quartz, filled with crystals

and plates of sulphuret of molybdena. In the adjacent granite, we found the wolfram in flattened and wedge-shaped crystals."

Morrill et al. (1958) and Morrill and Hinckley (1959) reported additional localities, but no specimens were available for description. Dolloff (1930) noted wolframite from a road cut in Hollis Center, **Hollis**. No specimens known.

FERRIMOLYBDITE



Androscoggin River Falls A - Brunswick, Topsham; Blue Hill - Route #176 road cut; Bradstreet - Catheart Mountain P; Buckfield?; Cooper - Cooper M (= American Molybdenum Mining company); Franklin?; Jackman?; Litchfield - Roth's Pasture A; Poland? - Berry Q; Sanford - Webster P; T10SD - Catherine Hill P, Tunk Mountain road cut

Ferrimolybdate is ordinarily found in close association with molybdenite and is generally derived from the alteration of that mineral. Ferrimolybdate is found in quartz vugs with ferberite crystals from the Route #176 road cut, **Blue Hill**. The mineral forms feathery to curved acicular crystals (to 1 mm) which have a bright yellow color and are clustered as though they were bristles of a brush randomly held together by the surface tension of water.

Yellow films of golden yellow ferrimolybdate surround molybdenite platelets in quartz from the Catheart Mountain prospect, **Bradstreet**. (Some specimens have been simply labeled "Jackman.")

Hess (1908) said of the American Molybdenum Mining company, **Cooper**: "The molybdenite has been altered to molybdic ocher in a few places, but in very small quantity. This ocher has usually been supposed to be molybdic oxide, but Waldemar Schaller has recently shown that it is iron molybdate in all specimens that he has examined."

Seaman (1975b) wrote of **Poland**: "FERRIMOLYBDITE, hydrous iron molybdate, has been noted chiefly as an alteration product of molybdenite *and* as a yellow coating in pegmatite at the Berry Quarry... [italics added]." Seaman (1975c) did not list molybdenite from the Berry quarry and the yellow coating was not further described. No specimens known.

Trefethen et al. (1955) said of the Webster quarry, **Sanford**: "Dump material around the pit contains occasional grains of scheelite up to 3/4 inch in length. Smaller grains of molybdenite coated with molybdate [sic] or powellite are frequently associated with the vesuvianite also." No specimens known.

Molybdenite in granite from the various locations near the falls and bed of the Androscoggin river, **Topsham** and **Brunswick** frequently have yellow fibrous ferrimolybdate coatings and patches. Jackson (1838a) noted: "Sulphuret and the oxide of molybdena occur below the bridge, close to the water's edge, and can be obtained only when the river is low."

Catherine Hill prospect, **T10SD**, ferrimolybdate is found as bright yellow intragranular mats of needles in tannish-brown albite or as thin yellow feathery films on molybdenite flakes (to 1 cm).

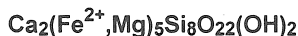
ferrisicklerite - see heterosite

ferristilpnomelane (Stilpnomelane Group) - a variety of stilpnomelane (originally called chalcodite)

TDR2 WELS - Hedgehog Mountain A; **T9R3 WELS** - Saddleback Mountain A

Pavlidis (1962) wrote of **TDR2 WELS** and **T9R3 WELS**: "Stilpnomelane is generally an abundant accessory mineral in the metaperlitic keratophyre of Saddleback and Hedgehog Mountains, and it typically occurs as sheaflike bundles of very fine grained needles. It is markedly pleochroic from bright yellow to deep olive brown and may be ferristilpnomelane... A mineral with similar habit but with pleochroism ranging from pale yellow to deep green and resembling ferrostilpnomelane is a sparse constituent in a few metaperlitic keratophyres examined." The formula of stilpnomelane is complex and the role of many of the common components of the mineral are not fully understood.

ferroactinolite? (Amphibole Group)



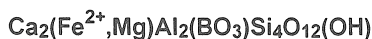
Patch Mountain Member of the Sangerville Formation? - Greenwood, Norway; Sapling? - "Gabbro Point"

Guidotti (1965a) listed "Fe-tremolite" from a calc-silicate granulite from the Patch Mountain Member of the Sangerville Formation and from a calc-silicate granulite in the Billings Hill Formation, **Greenwood** and **Norway**, but no supporting data or description were included.

Boone et al. (1989) analyzed altered rims of amphiboles from "Gabbro Point" - a large point jutting from the south shore of the northwest cove of Indian Pond, **Sapling**, and the "ferroactinolite" was figured as a fibrous mineral (less than 1 mm) with albite. The compositions reported, however, are better classified as edenite varieties.

ferroaugite = augite (q.v.)

FERROAXINITE (Axinite Group)



Bath - Town Q; **Carrabassett Valley?** - Owls Head A; **Casco?** - Chute P; **Cornish?** - Day Hill L; **Minot?** - Pitts-Tenney Q; **Phippsburg?** - The Basin L, Basin Limestone Q (not Basin

pegmatite quarry); **Sanford?** - Webster P; **Wales?** - quartz outcrop

Virtually all of the axinite localities in Maine are probably misidentified. Minerals commonly misidentified as axinite are clinozoisite and titanite.

Yedlin (1941) said of **Bath**: "A new locality for axinite in Maine has been found at the Bath Town Quarry which is located about 1 mile west of the town of Bath on U.S. Route 1, in the southwestern part of the state. The mineral was found in a seam of limestone running through the southern part of the quarry and occurs as small crystallized masses of a brownish-purple color, associated with masses and small crystals of diopside." One specimen (HH 10698) consisted of platy purple-brown masses in massive green diopside and dark green actinolite. The Town quarry on Court Street, near U. S. Route #1, is now occupied by a shopping center.

Boone (1970a) tentatively listed "axinite(?)" from the Sugarloaf gabbroic massif, Owls Head, **Carrabassett Valley**.

Marble (1951b) listed axinite from the Pitts-Tenney quarry, **Minot**: "The best specimens [of grossular] occur in calcite and/or quartz in bands here and there in the metamorphosed rock. Other minerals found at the locality are scapolite, diopside, pyroxene, quartz, calcite, possibly axinite, and of course the garnet." Titanite from the Pitts-Tenney quarry has been called axinite. No verified specimens known.

Ferroaxinite at the intertidal Basin Locality, **Phippsburg** is probably misidentified. It was believed to consist of gray wedge-shaped crystals with grossular crystals (to 3 cm) in vugs. All recent specimens submitted for identification are clinozoisite. The mineral is not uncommon in smaller crystals or crystal fragments which can resemble smoky quartz without the quartz shape or striations, but there are several good to poor cleavages. Hillebrand (1900) pointed out that based on chemical composition, the mineral he analyzed was not an axinite. His analysis calculates out to be a ferroan clinozoisite not far from the species boundary with epidote. No verified axinite specimens are known from this area. Fairbanks (1950) reported: "Visited Prof. Cleaveland's original opening from which he furnished so many museums with gem quality garnet crystals. Found a few, also some of the largest axinite crystals I have ever seen. Plan to blast here later." While Cleaveland may, or may not, have known of The Basin locality, the locality was not written about before Jackson (1837a). Jackson (1837a) did say: "Near Bath, on the peninsula of Phippsburg, Mr. Abraham Hammet discovered, several years since, some rare and beautiful crystals of cinnamon stone-garnet, and idocrase. In 1827, I visited that place in company with Mr. F. Alger, and discovered some rare minerals never before found in America, viz: axinite in crystals, half an inch in diameter, and ferruginous silicate of cerium in deep brownish black crystals, imbedded in garnet. At the same time we found the mineral called laumontite, and many splendid crystals of yellow and manganesian garnet, one and a half inches in diame-

ter, the latter minerals being found at the lime quarry at Phippsburg basin." See also Jackson (1838a).

True (1849) was quoted on his **Wales** find: "Dr. T. N. True says in a letter to one of the Editors, 'I have a good and well defined specimen of axinite in crystallized quartz from the town of Wales, Me.; but although the quartz is in place I could find but a single specimen of this rare mineral['] ." The whereabouts of this specimen and its source outcrop remain unknown.

Though there are numerous old and recently collected specimens from Maine labeled axinite or ferroaxinite, there remains a doubt concerning any Maine specimen's validity. Close scrutiny and testing of specimens have shown that the mineral is either considerably rarer than first thought or that it has been misidentified from the start. **Casco** and **Sanford** "axinite" have consistently proved to be titanite (q.v.).

ferrocarbonate - generic name for unknown carbonates which weather to a rusty surface (see Boudette, 1991)

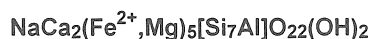
ferrocolumbite - see columbite

Ferrocolumbite was named by Shepard (1844) for material Berzelius (1814, 1816, 1819) analyzed from Kimito, Finland. In the third edition of Shepard's mineralogy (1852), the name was dropped and even the chemical analysis of the Finnish material was not listed with columbite, but was included under tantalite. (The analysis is more likely a ferroan manganotantalite, but a more recent analysis by Rammelsberg (1872b) is so iron-rich it might be an analysis of misidentified tapiolite, a species which also occurs at Kimito. The original material might have also been a mixture.) The first six editions and subeditions of the various *System[s] of Mineralogy* by James Dana, George Brush, and/or Edward Dana do not even mention ferrocolumbite as a synonym for columbite, though the name ferrotantalite (Thomson, 1836a) does appear as a species in one edition (Dana, 1850). Palache et al. (1944) listed ferrocolumbite among the synonyms of columbite. Frondel (1970) inexplicably listed ferrocolumbite as a New England type mineral and a typographical error further suggested it was a variety of ilmenite. It is clear from the original usage of the name that the "ferrocolumbite" of Shepard (1844) is chemically intermediate between tantalite and manganotantalite, has manganese greater than iron, and might actually have been a tapiolite group mineral. Though no paper appeared to formally discredit ferrocolumbite, Shepard (1852) did so *de facto* when he dropped the name himself and reassigned it. Several nineteenth and twentieth century articles have used ferrocolumbite.

The name ferrocolumbite recently re-appeared in Fleischer (1975) along with a resurrection of the name ferrotantalite. The names ferrocolumbite and ferrotantalite were introduced for consideration by the International Mineralogical Association's Committee on New Minerals and New Mineral Names, but no action was taken (Michael Fleischer, personal communication, 1986). Currently, the names ferrocolumbite and ferrotantalite are

in what should be considered "abusive usage." Until the names are formally rejected, or formally accepted, the traditional columbite / tantalite nomenclature will be used here. The name columbite will signify compositions where $\text{Fe} > \text{Mn}$ and $\text{Nb} > \text{Ta}$. Conversely, tantalite will be used where $\text{Fe} > \text{Mn}$ and $\text{Ta} > \text{Nb}$. There do not seem to be cases for Maine specimens where intended historical usage has been different. Some Maine collectors have used the name columbite when manganocolumbite should have been used, etc., but collector misidentifications have no bearing on systematic nomenclature.

FERROEDENITE (Amphibole Group)



Passadumkeag River pluton - Burlington, Carroll, Grand Falls, Kossuth, Lakeville, Lee, Lincoln, Springfield, T3ND, T3R1 NBPP, T4ND, T5ND BPP, T5R1 NBPP, T6R1 NBPP; Sapling - Gabbro Point A

Ayuso (1984) reported ferroedenite and other amphiboles from the Passadumkeag River pluton **Burlington, Carroll, Grand Falls, Kossuth, Lakeville, Lee, Lincoln, Springfield, T3ND, T3R1 NBPP, T4ND, T5ND BPP, T5R1 NBPP, T6R1 NBPP**:

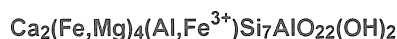
"Amphibole is heterogeneously distributed in this granite. Near the granite - country rock contact, amphibole is absent. In a few areas within the core facies, amphibole and biotite are subequal in abundance, but more commonly, amphibole is subordinate to biotite. Two varieties of amphibole, a phenocryst and a matrix component, are present in the Passadumkeag River pluton. Amphibole phenocrysts (up to 0.7 cm) are black prisms, invariably euhedral to all other silicates except biotite. Although amphibole generally precedes biotite in the crystallization sequence, inclusions of unaligned [sic] biotite plates within amphibole suggest a stage of coprecipitation of these two phases.

... In accordance to the classification of Leake (1978), the amphiboles belong to the calcic group and range from edenite and edenitic hornblende to ferro-edenites and ferro-edenitic hornblende. The $\text{Fe}/(\text{Fe} + \text{Mg})$ ratios range from about 0.51 to 0.75 (table 8) without a distinct trend in the pluton from rim to core facies..."

Boone et al. (1989) reported on three ferroedenite analyses (# 7, 8, 9) of fibrous amphiboles (about 1 mm) from metagabbros located on "Gabbro Point," jutting from the southern shore of the northwest cove of Indian Pond, **Sapling**. (The samples are not hastingsite as there is $\text{Fe}^{3+}\text{Al}=\text{Fe}^{2+}\text{Si}$ coupled substitution between the two series, but the analyses are borderline with the more ferrian, less silicic, ferroferrotschermakite and the less calcic, less ferrian, ferroferribarroisite series.)

ferrohastingsite (Amphibole Group) = hastingsite (q.v.); (hastingsite is an iron-bearing mineral)

FERROHORNBLLENDE (Amphibole Group)



Alder Stream - *camptonite dike*; **Cape Elizabeth** - *camptonite dike*; **Portland?**; **Redington** - *camptonite dike*; **Sapling** - *Gabbro Point A*

Boudette (1991) noted barkevikite (ferrohornblende) in **Alder Stream** and **Redington**: "Porphyritic camptonite ... dike[s] between 0.5 m and 2 m thick (1) cut the Redington Pluton (Dg) ... and (3) conformably intrude the Jim Pond Formation ... near Alder Stream Farm. All dikes have thin chill margins 10 to 15 cm thick that show faint wall-parallel laminations and weak development of columnar structure. Porphyritic camptonite dikes (1 and 3) are composed of pinkish, zoned, and polysynthetically twinned clinopyroxene in aphanitic groundmass composed of zoned plagioclase laths, pyroxene-cored barkevikite, clinopyroxene, and euhedral magnetite. Carbonate amygdules increase in size and abundance toward [the] center of these dikes. Dikes (1) and (2) contain amygdules lined with zeolite or chlorite matte and filled with calcite."

Lord (1898) reported barkevicyte (barkevikite) from a camptonite dike near Portland Head Light, **Cape Elizabeth**: "The *hornblende* crystals are of prismatic development, rarely exceeding 1 mm in length. They have strong pleochroism in brown and yellow tones ($c > b > a$), and the small angle of extinction common to barkevicyte - the angle $c:c = 11$ degrees in maximo." The chemical analysis of an unusual amphibole from New Hampshire was erroneously ascribed to **Portland** when the Lord (1898) article was abstracted in *Zeitschrift fuer Krystallographie* (32: 602).

Boone et al. (1989) reported on fibrous ferrohornblende (about 1 mm) from metagabbros on "Gabbro Point" jutting from the south shore of the northwest cove of Indian Pond, **Sapling**. Analysis #11 indicated a sodic ferrian silicic ferrohornblende.

ferrohortonolite = fayalite

Toulmin (1957) used the name ferrohortonolite when describing fayalite from Cashes Ledge, Gulf of Maine.

ferromanganite = general name for unidentified black stain-forming minerals

Newry - *Dunton Q*; **Rumford?** - *Black Mountain Q*

Bailey (1930) listed ferromanganite from Black Mountain quarry, **Rumford** without description. The intent may have been to give a name for black sooty to smooth lustrous coatings on cleavelandite. Verrow (1941) did not repeat the listing.

The name has been used by collectors for black stains from the Dunton quarry, Newry. A specimen has been studied and contains no crystalline material (George Rossman, personal

communication, 1987). The black stain can have an adamantine to metallic luster and a blue, pavonine, tarnish. Bands of this black stain at the Dunton quarry can be over 30 cm wide. They permeate cleavelandite and even serve as a boundary marker between replacement events in the pegmatite (King, 1980).

FERROPARGASITE (Amphibole Group)

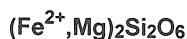


Sapling - *Gabbro Point-Indian Pond A*

Boone et al. (1989) reported on the fibrous amphiboles (about 1 mm) of the metagabbro of "Gabbro Point" jutting from the southern shore of the northwestern cove of Indian Pond, **Sapling**. Analyses # 10, 12, and 13 are for various ferropargasite compositions: some are silicic and some are ferrian.

ferrosalite = variety of hedenbergite

FERROSILITE (Pyroxene Group)



Flagstaff Lake igneous complex garnet gabbro - **Dallas, Davis, Lang, Rangeley**; *Moxie pluton* - **Big Squaw, Cove Point, Harfords Point, Little Squaw**

The pyroxene ferrosilite has been called orthoferrosilite in the recent past, but Morimoto (1989) reported that the only acceptable name in the future shall be ferrosilite. Ferrosilite is an orthopyroxene which is very sparsely represented among the orthopyroxenes of the United States and the world in general. Part of the scarcity is probably one of analysis scarcity, but optical properties are sufficiently documented that ferrosilite can be determined by this method. Maine ferrosilite is gray-brown and occurs as laths enclosed in matrix.

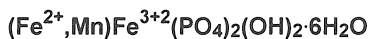
Nielsen et al. (1989) described ferrosilite, En_{21} , from the Flagstaff Lake igneous complex, **Dallas, Davis, Lang, and Rangeley**: "The garnet gabbros are characterized by orthopyroxene, oscillatory zoned plagioclase, and local cordierite. ... This transition zone in the Rangeley area ranges in width from several to hundreds of meters."

Espenshade and Boudette (1967) described ferrosilite from the Moxie pluton exposed in **Big Squaw, Cove Point, Harfords Point, and Little Squaw**: "Orthopyroxene occurs in several forms. In norite, where it is most abundant, it is generally in elongated euhedral to subhedral crystals as much as 3 mm long, or in elongated clusters of grains, and it appears to be about contemporaneous with plagioclase. Where less abundant, as in some troctolite and gabbro, it commonly forms poikilitic crystals as much as several centimeters in diameter, which may enclose olivine, plagioclase, and opaque minerals. Where present in very small amounts, orthopyroxene may simply form thin mantles on

olivine crystals. Thin lamellae parallel to the (100) plane are common and probably represent exsolution of clinopyroxene. Orthopyroxene with this feature is called orthopyroxene of the Bushveld type by Hess (1960). Some of the orthopyroxenes are nonpleochroic, and others have distinct pink to green pleochroism. The orthopyroxene in this part of the Moxie pluton also has two compositional groups, one ranging from 35 to 49 percent enstatite and one from 60 to 80 percent." In the parlance of mineralogists and petrologists, a small percentage of one end-member's composition means there is a large percentage of the other end-member. Espenshade (1972) found one sample of the Moxie pluton (#588, east of Mountain Brook Pond along Mountain Brook, **West Bowdoin College Grant**) that had En_{31} coexisting with fayalite Fo_{28} . Additional ferrosilite localities were found: #732 (En_{46}), due east of Little Lyford Ponds, **East Bowdoin College Grant**, as well as non-mapped sample #789 (En_{39}).

ferrostilpnomelane - variety of stilpnomelane; see ferris-tilpnomelane discussion

FERROSTRUNZITE (Strunzite Group)



Newry - *Dunton Q*

Ferrostrunzite has been identified using semiquantitative energy dispersive chemical analysis (this study). The strunzite group consists of several species of which the manganese-rich member, strunzite, has been assumed to be the most common member. Ferrostrunzite has been found at the Dunton quarry, **Newry** (King, 1993a), as straw yellow splintery acicular crystals (to 1 mm) associated with light butterscotch-yellow jahnsite- (CaMnFe) crystals (to 1 mm) and tan fibrous xanthoxenite (to 2 mm) in cleavelandite.

ferrotantalite - see tantalite and discussion of ferrocolumbite

ferrotapiolite - see tapiolite

ferrowinchite? - a theoretical amphibole component name used by Boone et al. (1989); not intended to indicate a species occurrence.

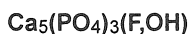
fibrolite - fibrous variety of sillimanite (q.v.)

fillowite? - misidentification of triphylite

Hebron - *Hibbs Q*

Fillowite was identified from the Hibbs quarry, **Hebron** based on an optical study and incomplete chemical analysis by Dorothy Wykoff in 1936 (Juliet Reed, personal communication, 1988). X-ray identification of Bryn Mawr College specimen #8426 originally analyzed by Wykoff showed an exact match for triphylite with no impurity lines. The mineral was visually identical to triphylite and contained no areas of alteration and was visually homogeneous.

FLUORAPATITE (Apatite Group)



Addison - Thornberg Q; **Albany** - Bumpus Q, Johnson Q, Pingree Ledge Q, Scribner Q, Songo Pond Q, Stearns P, Wardwell Q, Wentworth P; **Alfred** - Bennett Q; **Auburn** - Fisher Q, Greenlaw Q, Groves Q, Hatch Q, Keith (Towne) Q, Maine Feldspar Q, Pulsifer Q, Wade Q; **Batchelders Grant** - Peabody Mountain Q; **Biddeford** - Andrews and Perkins Q; **Blue Hill** - Douglass M; **Bowdoin** - Coombs Q; **Bristol** - Round Pond Q; **Brunswick** - LaChance Q; **Buckfield** - Bennett Q, General Electric Q; **Calais** - Beaver Lake Q, Gardners Lake Q; **Chapman** - Edmunds Hill A; **TD** - Bemis Stream P; **Dedham** - 900 Foot Hill A; **Deer Isle** - Deer Isle M; **Flagstaff Lake** pluton gabbro and troctolite - Coplin, Dallas, Davis, Eustis, Lang, Rangeley; **Frankfort** - Mosquito Mountain Q; **Franklin** - W.B. Blaisdell and Company Q; **Freeport** - Freeport Granite Q; **Georgetown** - Consolidated Q; **Gilead** - Wheeler Q; **Greenwood** - Emmons Q, Harvard Q, Nubble Q, Ohtonen Q, Tamminen Q, Tiger Bill Q, Upper Harvard Q, Waisanen Q, West Hayes Ledge Q, West Noyes Mountain A; **Hallowell** - Stinchfield and Longfellow Q; **Hancock?**; **Hartford** - Ragged Jack Mountain L; **Hebron** - Mount Rubellite Q; **Hollis** - Bear Hill Q; **Jay** - Maine and New Hampshire Q; **Jonesport** - Minerva Cove Q; **Lewiston?**; **Lincolnton** - Fernald Q; **Litchfield** - Dennis Hill A; **Livermore?**; **Lovell** - McAllister Q; **Mapleton** - road cut on road 1.6 km east of post office; **Mason?** - Peabody Mountain Q (actually in Batchelders Grant); **Milbridge** - Milbridge Q; **Minot** - LaFlamme Q; **Monmouth?**; **Mount Desert** - Campbell and Macomber Q; **Muscle Ridge Islands** - High Island Q; **Newry** - Bell Pit, Dunton Q, Martin P, Nevel Q, Rose Quartz Crystal L, Scotty Q; **Norridgewock** - Taylor Q; **Northwest Harbor** - Graves Brothers Q; **Norway** - BB#7 Q; **Owen?**; **Oxford** - Roy Q; **Paris** - Ellingwood Q, Hoopers Ledge Q, Lower Hoopers Ledge P, Mount Marie Q, Mount Mica Q, Perham Q, Ryerson Hill Q, Singepole Mountain Q, Slattery Q; **Peru** - Lobikis Q; **Phippsburg** - Thomas Q; **Poland** - Berry-Havey Q; **Pownal** - Pownal Granite Q; **Raymond** - Camp Hinds L; **Rumford** - Black Mountain Q, Elliot Q, Red Hill Q, Rumford Falls?, Whitecap Mountain A; **Saint George** - Clark Q; **Searsport** - Bog Hill Q; **Smithfield?**; **South Thomaston** - Sprucehead Q, Westkeag Q; **Stoneham** - Beryllonite L, Cole Q, Foster Hill Q, Lord Hill Q, McKean Mountain Q?, Virginia Lake P; **Stonington** - Settlement Q; **Stow** - Colton Hill Q; **Sullivan** - Sullivan Village Q; **Sumner** - Biron Q; **Topsham** - Fisher Q, Yedlin

L; **Vinalhaven** - Pequoit Q, Sands Q; **Warren** - Starrett Q, Warren Nickel P; **Waterford?**; **West Bath** - Davis Q; **West Paris** - Perham Q; **Whitefield** - Jewetts Black Granite Q; **Woodstock** - Bryant Pond Q; **Woolwich** - Trott Cove Q; **T10SD** - Catherine Hill Q

Apatite is widespread in Maine, yet its presence is seldom obvious. Granites, for example, have fluorapatite frozen within their matrix and it is hardly ever seen except in microscopic examination of thin sections. Dale (1907) and Smith (1923) reported many apatite occurrences, but certainly not one of their reports involved crystals visible to the naked eye. The crystals were, instead, accessories in the rocks. Jackson (1838a) gave an early description: "Phosphate of lime occurs in scattered crystals in granite-rocks in almost every part of the State, and may be known by its brilliant color, and its phosphorescence or light which it gives out, when thrown on heated iron. Some varieties of it, however, are clear and colorless, and others are straw yellow; hence its appearance being very deceptive, one of its names, *apatite*, is derived from the Greek word signifying to deceive. Another fine bluish green variety is called from its color, asparagus stone. Its colors arise from certain accidental coloring matter which it contains." (Until the late nineteenth century, U. S. geologists called granite pegmatites simply "granites.")

Pegmatites provide the best examples of apatite in Maine and there is hardly one which does not have at least small masses of apatite. The crystallographic descriptions for fluorapatite here do not generally describe the elongation of the particular habit as most of the crystals at a particular quarry vary between tabular, elongated, and equant. Very elongated or very thin tabular crystals may be combined in a single cluster. Most apatite crystal elongation varies between 1:1 and 2:1 in the ratio of vertical:horizontal axes.

Fluorapatite is a species name and it refers to the most abundant member of the apatite group. A series exists ranging to the hydroxyl-rich end-member. It is not possible to unambiguously assign a name based on sight examination only. Statistically, the overwhelming majority of Maine pegmatite apatite crystals are fluorapatite. No systematic chemical analyses of carbonatian apatites have been done for Maine specimens and many examples of this chemical variety could be either fluorine or hydroxyl dominant, but Dunn (1977) analyzed a fluorapatite from the Pulsifer quarry, Auburn. The unmodified word apatite is a generic name and when it is used, common apatite-fluorapatite, might be assumed or the wide variety of apatite species might be discussed. Identification of fluorapatite is usually easy, but the Greek root word for the name means *to deceive*. Fluorapatite can easily be confused with tourmaline, beryl, and triphylite, as well as a number of less likely minerals. Tourmaline and beryl have a higher Mohs' hardness. Triphylite has better cleavage. Beryl almost never forms micromount-sized crystals in vugs. Fluorapatite is soluble in many acids including oxalic acid. Cleaning fluorapatite in acids will ruin the specimens, as would be the case with almost any phosphate. The occurrences

and descriptions for this mineral will be treated in three sections: Purple Fluorapatite, General Fluorapatite, and Francolite or Carbonatian Fluor-hydroxyl-apatite.

Fluorapatite - Variety Purple Fluorapatite

Albany - Pingree Ledge Q; **Auburn** - Dionne Extension Q, Greenlaw Q, Groves Q, Hatch Q, Maine Feldspar Q, Pulsifer Q, Wade Q; **Greenwood** - Emmons Q, Harvard Q, Tamminen Q, Tiger Bill Q, Upper Harvard Q, Waisanen Q, West Hayes Ledge Q; **Hebron** - Mount Rubellite Q; **Newry** - Bell Pit, Dunton Q, Scotty Q; **Paris** - Mount Marie Q, Mount Mica Q; **Poland** - Berry-Havey Q; **Rumford** - Black Mountain Q; **Stoneham** - Lord Hill Q; **Topsham** - Fisher Q; **West Paris** - Perham Q

Maine is world-famous for its purple apatite. Kunz (1892a) reported: "Apatite is found in such remarkably perfect and fine-colored crystals in the tourmaline locality of Auburn, Me., that the hill on which it occurs has been named Mount Apatite. The crystals are transparent green, pink, and violet, and so closely resemble tourmalines as to have been mistaken for it. Some of the local collectors attempted to cut them, but without success, for the hardness is too low for a transparent gem." The fact that the color violet was mentioned last and without fanfare indicates the scarcity of the purple apatite finds to that date. The quarries on the east side of Mount Apatite were interesting mineralogically and gemologically, but it was the western slope which received the attention for its apatite. The coloring agent in purple or lilac apatite is a small amount of manganese, probably in its higher (3+) valence state. At least some lilac or purple apatite has been found at each of the major pegmatite localities in Maine. (Manganapatite probably has its manganese in a lower valence state (2+), in addition to having other substituents.)

Lilac to gray fluorapatite crystals (1 cm) with striated simple prism and "c" pinacoid faces are found in vugs in albite at the Pingree Ledge quarry, **Albany**.

Only a few of Maine's many purple apatite locations receive particular worldwide notice today. These include the Pulsifer quarry, Greenlaw quarry, and Groves quarry (also known as the "hole in the ground"), **Auburn**. The discovery of purple apatite was probably first made in Ehrenfriedersdorf, Bavaria, Germany in the early nineteenth century and the color varied from pale lilac through a few examples of the so-called *Royal* purple color. Some nineteenth century workings at Mount Apatite produced a few sporadic finds also of *Royal* purple apatite and some of these crystals are relatively simple tabular. In 1901, the world-class find was made at the Pulsifer quarry on the western slope of Mount Apatite. Wolff and Palache (1902a,b) described the crystallography of Pulsifer quarry fluorapatite. Many of the crystals were found loose within "sand" and black mud filling the gem pockets that were encountered. The Pulsifer quarry crystals are complex and show first- and second-order bipyramids and first- and second-order prisms. Frequently, the second-order prism is frosted rather than smooth. The basal

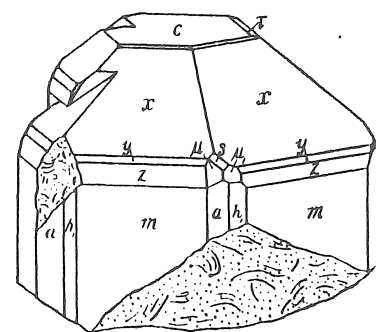
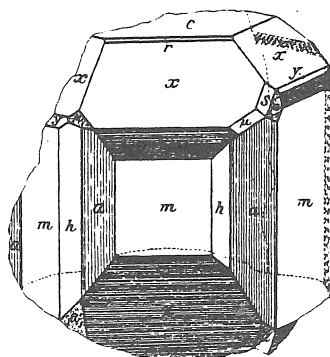
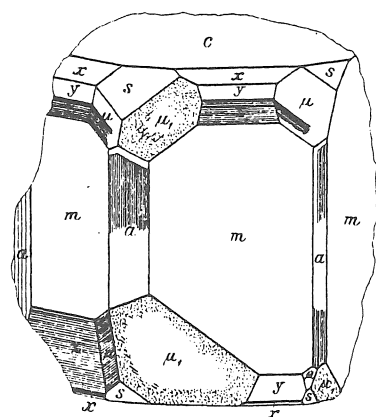
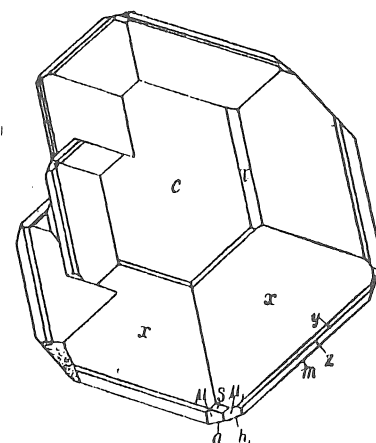
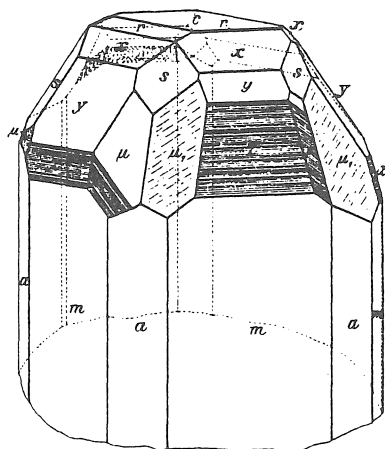
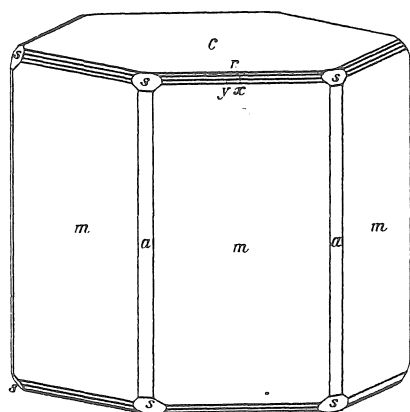
pinacoid is almost always well-developed and a high angle first-order bipyramid is frequently found in combination with the ordinary one. The smaller crystals can also show the dihexagonal bipyramid and additional high- and low-angle first- and/or second-order bipyramids. Occasionally, the Pulsifer quarry fluorapatite shows the third order bipyramid. Strong vicinal development of the prism faces can produce a crystal shape which is corrugated. The associated species include milky quartz crystals; yellow-green cookeite in coarse rosettes; yellow clear and cloudy zoned triangular muscovite crystals (to 3 mm); and occasional green and pink tourmaline. Drusy milky quartz crystals in parallel growth on large (10 cm and larger) smoky quartz crystals can serve as matrix. Fluorapatite crystals, in gray to greenish white shades, to 7 cm were also found. The famous Roebbling purple fluorapatite is 3 x 3.8 x 4.3 cm and was featured on a magazine cover (*Mineralogical Record* 8(#2)). Szenics (1967, 1968) described the character of the purple fluorapatite pockets in detail and illustrated several specimens in color. Several pre-Pulsifer finds of Mount Apatite purple apatite crystals show simple tabular crystal development with little or no etching on minor faces. Szenics (1967) wrote:

"The purple apatites are found as single crystals and crystal groups lining the upper pocket walls and embedded in the thick mud which fills all the pockets. ... The color of the apatites shall be referred to as purple in this article. Actually, a more accurate description would be amethyst, or royal-amethyst, but to avoid confusion with the mineral amethyst, purple or royal-purple will be used. It is interesting to note that crystals of a decided blue or pink color also occur at Mount Apatite. ...

These crystals are generally stubby, being short-prismatic in habit. They are not often large in size. A crystal an inch across is a giant from the Pulsifer Quarry, with the average size around $\frac{1}{2}$ inch across. However, what is lacking in size is made up in amazing perfection and color. ...

The most exciting find made came when a curious seam of milky-white amblygonite was discovered as an offshoot of the pocket zone. It ended in a small pocket the size of a cantaloupe a foot from the pocket that yielded all the single apatites. Carefully I ran my fingers along the pocket walls and felt several smooth crystal faces. At first I imagined them to be quartz crystals. Then with the aid of a flashlight, I peered into the opening and gasped; the whole wall glinted deep purple under a thin mud coating! Working out this pocket yielded the finest matrix specimens, all on white amblygonite. ... The average size of the matrix specimens is 3 inches by 3 inches with purple apatite crystals from $\frac{1}{16}$ to $\frac{5}{8}$ of an inch implanted [sic] on the amblygonite and associated with lepidolite. Strange enough, here there is little or no associated cookeite."

In 1968, Szenics wrote: "The blast broke open, like an egg, a huge purple apatite pocket; laying out its contents in a 3-foot square area. It seemed everywhere ... [there] was that black pocket mud which looks like tar. That beautiful mud! Throughout it, like plums in a pudding, were angular purple crystals, dozens of them, shimmering enticingly under this mud coating in the



Fluorapatite, Pulsifer Q, Auburn (from Wolff and Palache, 1902b)

"Roebling" fluorapatite, Pulsifer Q, Auburn (from Ford, 1918)

noon-day sun." The Szenics' (1967, 1968) articles are among the two most detailed and interesting mineral accounts ever written for Maine and are recommended reading in their entirety. At this writing, the Dionne extension is being developed by Dick Dionne and Duddy Groves immediately east of the Pulsifer quarry and may result in new purple apatite finds.

Pale lilac to deep purple fluorapatite was found with cleavelandite and pink elbaite at the Hatch quarry, Auburn. The Hatch Farm quarry fluorapatite crystals are simple crystallographically with very small modifying faces in combination with the prism and pinacoid.

The fluorapatite crystals (3-4 mm) from the Wade quarry, Mount Apatite, Auburn show the simple pyramid, prism, and "c" pinacoid in approximately equal development and can be transparent pale lilac. Multiple-termination gray crystals (3 mm) there have milky white tips.

The Greenlaw quarry, Auburn produced a few excellent specimens. One in particular consists of a uniform dark lilac crystal (to 2 cm), corrugated prismatic with slightly rounded "c" pinacoid, associated with a pale blue-green gemmy beryl crystal (to 1.5 cm) on albite crystal matrix (Richard Kosnar, personal communication, 1993).

A new discovery of royal purple fluorapatite was made in Auburn by Duddy Groves and Dick Dionne at a small prospect about 100 m west of the Wade quarry in 1992. The prospect was apparently first blasted by William Wade of the Maine Tourmaline Company in the early 1910's and again by the Plumbago Mining Company in the late 1970's. The prospect is currently called "the hole in the ground" by the operators, but is generally called the Groves quarry by the public. The fluorapatite crystals are distinguishable from crystals of other localities when a milky cream-colored zone is present. The cream-colored zone can occupy the basal termination and "bleed" in short lobes into regions bounded by pyramidal faces and even to a small extent by the prism. The transition to full royal purple color is slightly "fuzzy" but abrupt. Only several large crystals were found (to 3 cm) in 1992. Crystallographically, the larger Groves quarry fluorapatites are distinguishable from other Auburn crystals by their having prominent pyramid faces, sometimes nearly intersecting with the pyramid faces of the lower termination. The smaller specimens (less than 1 cm) are generally indistinguishable from Pulsifer quarry, etc. specimens. The matrix can vary from cleavelandite to muscovite, but a characteristic black mud staining is frequently seen in the matrix.

The Harvard quarry, **Greenwood** has been a popular collecting spot where lilac to light purple fluorapatite crystals (generally less than 4 mm each, but up to 1 cm) generally can be found on a given day. A few almost royal purple fluorapatite crystals have been found at the Harvard quarry in cleavelandite, cookeite, and quartz crystal (to 5 mm) matrix. The fluorapatite crystals, though simple crystallographically, showing small bipyramid with prism and "c" pinacoid and occasional second-order bipyramid, have a corrugated appearance as the crystals frequently resemble mosaic aggregates. The termination faces are sometimes etched.

The Tiger Bill quarry, **Greenwood** produced a few purple apatite crystals similar to those that are familiar from the Harvard quarry, but the matrix is albite, stained yellow, brown, and/or black. One cluster of 3-4 mm crystals covered the matrix to 10 cm in maximum dimension (Joseph Perham, personal communication, 1965). A few small purple fluorapatites have been found at the Emmons, Waisanen (pronounced Vi - sa - nen), and Tamminen quarries, all in **Greenwood**. Waisanen quarry purple apatite crystals are generally color-zoned lilac prisms with white cap terminations (to 3 x 2 x 1 cm). Marble (1951c) wrote of the Tiger Bill quarry: "... in 1951 they found some outstanding Purple and Blue Apatite Xtls in vugs of the Spar. The largest Purple Apatite I have seen from there was a tabular hexagonal Xtl with striated sides - a rich deep purple color."

Mount Rubellite, **Hebron** has excellent lilac fluorapatite (to 2 cm) (Jacobson, 1986; Francis and Metropolis, 1986). The crystals show simple morphology, high- and low-angle bipyramids, prism, and large "c" pinacoid. The bipyramids are frequently rounded together in appearance, but still show high luster. The matrix includes clear, lustrous, quartz crystals, tan to gray cookeite botryoids, cleavelandite, albite crystals, and occasional hydroxyl-herderite crystals. The lower quarry yielded the big find of 1985.

A few lilac fluorapatite crystals from Mount Rubellite show the "Hebron" shape. This shape is characterized by the presence of just the bipyramid with perhaps some inconspicuously small faces of other forms. The mistaken phenakite report for Mount Rubellite (Yeates, 1890a,b) was made on what is now called Hebron-style fluorapatite.

Stan Perham (1966) wrote of the Hibbs quarry, **Hebron**: "During the 1927 work, I found a pocket of very beautiful medium-purple apatite crystals about half way up the quarry. The largest was 1 inch by $\frac{3}{8}$ inch. There were about two dozen crystals, and most of them were long and had nicely pointed terminations -- just opposite from the shapes of most apatites." No specimens available for study.

The Bell pit, **Newry** has produced plates (to 10 x 15 cm) of 1 cm thick coatings of lilac fluorapatite cutting across brown and black stained quartz-albite pegmatite. One of the vertical veins which cut through the pegmatite is exposed on the north-facing wall of the pit. The 3-5 mm crystals are tightly intergrown and show high- and low-angle bipyramids, small "c" pinacoids, and first- and second-order prisms. The crystals have a corrugated,

mosaic appearance. Tiny (1 mm and less) transparent and vitreous lilac fluorapatite crystals with lengthwise striations are found in vugs in the siderite assemblage at the Bell pit. The lilac fluorapatite crystals at the Bell pit show "c" pinacoid and pyramid which occur in combination or alone and with one or two prisms. Color-zoned lilac cores and proportionately thick, milky-white outer zones are found on some specimens. Transparent lilac fluorapatite crystals (to 2 mm) are found in siderite vugs at the Bell Pit.

A few poorly-formed but beautifully-colored purple fluorapatite crystals (2-3 mm) have been found at the Dunton quarry, **Newry** between cleavelandite blades. A few 1+ cm simple striated prism with "c" pinacoid crystals have been found in cleavelandite at the Dunton quarry.

Massive and occasionally crystallized (to 3 mm) lilac fluorapatite crystals with platy white fluorapatite crystals (2-3 mm) and tiny (1-2 mm) clear quartz crystals have been found at the Scotty quarry, **Newry**.

A few purple to purple-gray fluorapatite crystals (to 5 mm) have been found in vugs in microcline and cleavelandite matrix at the Mount Marie quarry, **Paris**.

Across the river from Mount Apatite at the Berry-Havey quarry, **Poland** purple-gray fluorapatite is found that is frosted, and the crystals (3-4 mm) show a very small bipyramid in combination with the prism and "c" pinacoid. Sericitic to clayey muscovite frequently coats the Havey quarry crystals. The lilac to nearly colorless crystals can be tightly intergrown on cleavelandite and elbaite.

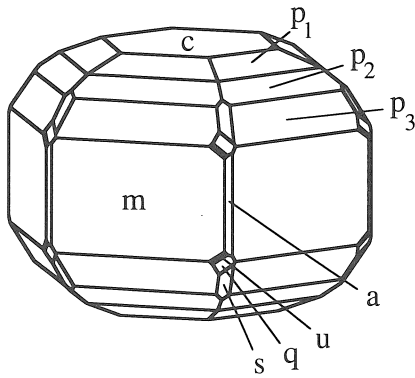
The fluorapatite from the Black Mountain quarries, **Rumford** is so pale and rosy that it is more properly called pink. The crystals are small (1-2 mm) and show the prism with a rounded "c" pinacoid. The matrix is cleavelandite.

The Fisher quarry, **Topsham** produced a few pinkish-gray fluorapatite crystals (6-7 mm). The habit is tabular and the crystals show high- and low-angle bipyramids with prism and "c" pinacoid. The termination is usually etched. The loose crystals were found in the Fisher pocket.

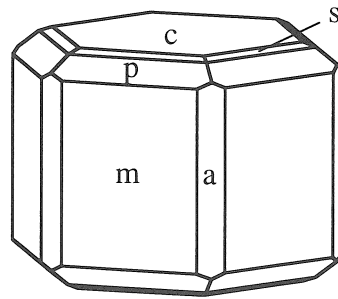
Stan Perham (1966) reported of the A. C. Perham quarry, **West Paris**: "Fairly good purple apatites have come from the left hand side of the work on the head wall and also from a working near the farm wall. Blue, green, and yellow apatite pockets have also been found at the quarry. Almost all the apatite crystals have been less than $\frac{1}{4}$ inch in diameter."

General Fluorapatite

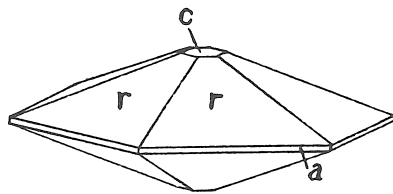
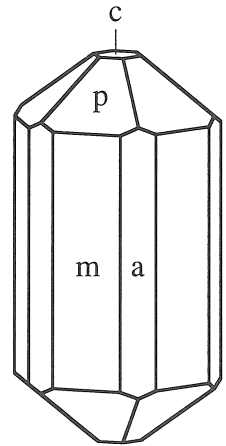
The localities which produce purple fluorapatite, of course, can have other colors including: colorless, green, blue, etc. Specimens are prized both for crystal shape and for their fluorescence in ultraviolet light. The fluorescent fluorapatite is frequently manganoan and has been known by the varietal name manganapatite. Not all fluorapatite fluoresces and not all fluorescent apatite owes this property to manganese impurities as rare



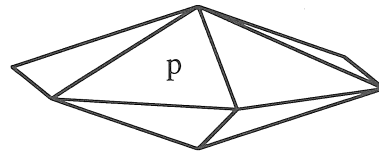
Johnson Q, Albany



Bell Pit, Newry



Berry-Havey Q, Poland
(from Berman and Gonyer, 1930)



Mount Rubellite Q, Hebron

Fluorapatite

earth elements can also cause fluorescence. Manganapatite is often dark green (due to iron substitution) in visible light and yellow to yellow-orange under short-wave ultraviolet light. It does not fluoresce as strongly under long-wave ultraviolet light.

The Guy Johnson quarry, **Albany** has some outstanding vitreous, transparent fluorapatite crystals (to 1 cm). They fluoresce strongly bright yellow in short-wave ultraviolet light. The crystals are equant with high- and low-angle first-order bipyramids, second-order bipyramid, third-order bipyramid, first- and second-order prisms, and "c" pinacoid. The matrix is crystallized albite. Dark green translucent fluorapatite crystals with two bipyramids, prism, and "c" pinacoid also come from the Johnson quarry, but are not fluorescent. The dark green fluorapatite is usually frozen in smoky quartz near the margins of muscovite and albite. The colorless fluorapatite of the Johnson quarry can be "invisible" on the white vuggy albite matrix.

The Stearns prospect, Albany has vitreous, bright blue, as well as clear (fluorescent yellow, short-wave ultraviolet light), fluorapatite crystals (to 3 mm) with high- and low-angle first-order bipyramids, third-order bipyramid, and "c" pinacoid. Light to medium green manganous fluorapatite is abundant at the Bumpus quarry, Albany.

Fluorapatite is well represented in a variety of shapes and colors in **Auburn**. Clear, Hebron-style crystals are found at the Greenlaw quarry, associated with bladed bertrandite crystals (to 1 cm), and pale blue Hebron-style fluorapatite crystals (to 1 cm)

are found on cookeite at the Pulsifer quarry. Simple clear hexagonal prisms with first- and second-order bipyramids, and "c" pinacoid are found with albite crystals and muscovite crystals at both locations. Exceptional transparent and flawless elongated and complexly terminated fluorapatite crystals (to 1 x 0.5 x 0.5 cm) of beautiful bluish green color were found loose in pockets at the Dionne extension of the Pulsifer quarry (Dick and Pat Dionne, personal communication, 1994).

Jackson (1838a) wrote of the Long Island area, **Blue Hill**: "Phosphate of lime, of a light green color, is exceedingly abundant upon this island, there being veins of it 10 inches wide, traversing the granite."

The Bennett quarry, **Buckfield** yielded some fluorapatite crystals from gem pockets. The crystals were usually "c" pinacoid and prism combinations with incompletely developed first-order bipyramids. The crystals (to 1 cm) were color-zoned with dark green cores and clear outer zones. Some of the clear zones have a blue zone near the terminations. Small gas bubble inclusions are numerous in the fluorapatite. Blocky to slightly elongated blue fluorapatite crystals (to 2 cm) were found in albite vugs. Some very steeply terminated blue fluorapatite crystals (to 7 mm) have been found on snow-white cleavelandite. Large rounded dark green manganous fluorapatite (fluorescent yellow in both short and long wave ultraviolet light) occurs both as irregular grains in large patches (to 15 x 15 cm) and crystals (to 3 cm) frozen in cleavelandite at the Bennett quarry. Also from

the Bennet quarry, several dark green manganapatite crystals (to 2 cm) had light purple overgrowths. The nearby Orchard quarry has numerous yellow-green fluorapatite crystals (to 5 mm) which usually have second-order bipyramids as well as second-order prism faces, in addition to the basic forms seen at the Bennett quarry. The matrix is crystallized tan albite.

Boudette (1991) indicated that the Flagstaff Lake pluton gabbros and troctolites, **Coplin, Dallas, Eustis, Lang, and Rangeley** are very unusual in being composed of 3% fluorapatite.

The Harvard quarry, **Greenwood** has a variety of colored apatite: blue, gray, and white are well-known. The crystals are almost always tabular with occasional small additional prisms and pyramids, rarely in rosette groupings. Transparent blue (to 5 mm) and translucent gray (to 1.5 cm) fluorapatite crystals are found lining quartz and cookeite-lined vugs in cleavelandite. The blue fluorapatite sometimes has clear bertrandite crystals associated. Manganapatite, sometimes in crudely-formed crystals, is found frozen in albite pegmatite. Crystals to 2 cm and rich intergrowths of manganapatite with albite (to 7 cm across) also come from the Harvard quarry.

Snow white fluorapatite crystals (to 1.5 cm) from the Waisanen quarry, Greenwood have been found profusely coating goethite-coated matrix. The snow-white crystals are well individualized and separated from each other.

Very unusual elongated, terminated, olive green fluorapatite crystals (to 3 x 0.4 cm) have been found embedded in albite at the Nubble quarry, Greenwood.

The Emmons quarry, Greenwood has vitreous grass green simple hexagonal fluorapatite crystals (to 1 cm) in vugs in albite. Large gray to blue-green fluorapatite crystals (to 1.5 cm) are found in vuggy albite, as well. These larger crystals sometimes have a milky exterior zone which can flake away from the main crystal. The terminal faces can be rounded.

Blue and colorless "Hebron-style" fluorapatite (to 4 mm) is well-known from the Mount Rubellite quarry, **Hebron**. The tabular/wedge-shaped habit of Hebron-style crystals has been confused with phenakite (Yeates, 1890a): "I have received from Mr. Loren B. Merrill, of Paris, Me., for identification, a flat crystal of phenacite from Hebron, Maine. It has a maximum diameter of 14^{mm} and is a combination of the planes, O , i -2, $r^{2/3}$ -2, $l^{2/3}$ -2 and a rhombohedron of the first order, too small to allow of measurement of its angles. The first mentioned plane is new to the species and a fuller description of the crystal will be published later." The misidentification was retracted (Yeates, 1890b): "In the April number of this Journal, I announced that I had identified phenacite from Hebron, Maine; and that, among other planes, I had observed the basal plane, O . This announcement was based upon a preliminary examination, the angle between the adjoining planes of a pyramid, $105^{\circ} 46' \frac{1}{4}$, being practically the same as that between $^{2/3}$ -2 and $^{2/3}$ -2 of phenacite, viz: $156^{\circ} 44'$. The apparent infusibility of the mineral, when first examined, coupled with the striking resemblance of the crystal to phenacite in habit, served further to mislead. A more careful examination recently made by me, disclosed the fact that

the mineral was not phenacite; and a quantitative analysis by Mr. L. G. Eakins of the U.S. Geological Survey, has proved it to be apatite. ... The unusual flat habit of these apatite crystals is well worthy of note."

The Bell pit, **Newry** has clear micromount-sized fluorapatite crystals with "c" pinacoid and prism which are found in the siderite assemblage. Occasionally, a milky white bipyramidal crystal with a clear prism is found. Bundles of straight, acicular colorless crystals sometimes show milky pinacoidal caps. A few pale blue crystals have been seen from here. Etched fluorapatite crystals are not unusual at the Bell pit. Blue or white crystals might have a chalky-white outer coating which frequently is composed of carbonatian hydroxylapatite. Masses of blue-green fluorapatite can be several centimeters in size at the Bell pit.

The Nevel quarry is developed in the same pegmatite as the Bell pit, and their apatites can be similar. Large masses and crystal sections (to 15 x 10 x 8 cm) of very dark blue-green to green fluorapatite can be mistaken for triphylite or tourmaline here. The misidentification "dickinsonite" has been made on green masses of fluorapatite by analogy with the arrojadite from the Smith and Chandlers Mills quarries, Newport, New Hampshire, which also have material called "dickinsonite." A few pale blue-green fluorapatite crystals (to 7 mm) with steep first-order bipyramids with second-order prisms were found in albite crystal vugs. Fluorapatite crystals from the Nevel quarry sometimes are spotted with tiny (very much less than 1 mm) pyrite crystals.

The Dunton quarry, **Newry** has a large variety of fluorapatite. The most common crystals are blue, elongated prismatic. These crystals have lots of faces including first-, second-, and third-order bipyramids, dihexagonal bipyramid, first- and second-order prisms, and very small "c" pinacoids. Frequently the terminations are frosted and/or the prisms are coated with earthy carbonatian (fluor-hydroxyl)-apatite or golden-brown eosphorite botryoids. Tan, salmon to white acicular tufts (1-2 mm) of probable hydroxylapatite sometimes nucleate on the blue fluorapatite. The matrix is cleavelandite. White or blue tapered hexagonal prisms (1 mm) with rounded terminations which have a chalky-white termination are also found in cleavelandite.

Fluorapatite in blocky albite from the Dunton quarry can be up to 1 cm. The gray to white tabular crystals have rounded "c" pinacoid and bipyramid zones in combination with the prism. Frequently the crystals are coated by orange-stained, earthy carbonatian hydroxylapatite. Clear prism and "c" pinacoid crystals (2 mm) are also found. A peculiar radially circular white fluorapatite is found as inclusions (to 2 mm) interlaminated in muscovite cleavages at the Dunton quarry. Another Dunton quarry crystal bridging a 4 mm vug in cleavelandite was zoned tan-mauve-pink-mauve-tan. The thin tabular crystal had a strontium-rich core, but was still calcium-rich enough to be classified as fluorapatite (analysis this study).

The Martin prospect, **Newry** has produced numerous blue fluorapatite crystals (to 8 x 3 cm). The crystals are frequently corrugated on the prism zone and have a basal termination. Small first-order pyramids are present. Some of the largest crystals are

sharply color zoned: 2-3 mm dark blue external rim on a gray-blue core. The matrix is usually heavily stained brown to black granular albite, but the fluorapatite can be stain-free as well as coated.

The Scotty quarry, Newry has white, essentially Hebron-style, crystals (5-7 cm) with clear quartz crystals (to 1 cm).

The Rose Quartz Crystal locality near the top of Plumbago Mountain, Newry has abundant fluorapatite. The crystals (to 6 mm) are simple prisms with rounded terminations. The color varies from clear to gray, blue, and green. Coatings of drusy quartz and carbonatian hydroxylapatite on rose quartz crystals are common. These coatings do not cover the entire vug, but there may be a number of species coating specific minerals in a given vug. Entire crystals may be coated, or just the terminations. The rounded-habit fluorapatite grades into francolite.

Hebron-style fluorapatite frequently occurs at the BB #7 quarry, Norway. The clear to pale green crystals are generally 1-3 mm and occur on recrystallized fracture surfaces in albite as well as in etched quartz-clay-cookeite vugs.

Mount Mica, Paris is not well known for apatite specimens. Tiny (1-2 mm) clear to gray crystals with only prism and "c" pinacoid coat small vugs in albite-muscovite pegmatite. Eosphorite can be associated. E. Dana (1884a) investigated some unusual crystals: "Several years ago the writer, through the kindness of Mr. Samuel R. Carter of Paris, Me., was able to examine a crystal of apatite of so unusual form as to deserve a special notice. The examination was completed at that time but the results are now for the first time published. The tourmaline was from the tourmaline locality at Paris, Me., and when received was partly coated by a film of cookeite which, however, readily scaled off, leaving the planes beneath uninjured. The crystal was small, about one-fourth of an inch in length, and had a deep blue color. The form of the crystal is given in the adjacent figure; it is remarkable both for its complexity and also because the pyramidal termination is essentially formed by a pyramid of the third order. The occurrence of these hemihedral forms on apatite is common, but they are usually subordinate, being only modifications of the predominating simple form." E. Dana (1884a) described two forms new to the species based on the specimen. Toppan (1932) wrote of Mount Mica quarry: "Apatite is found in the solid rock in masses which have a green color and which run up to two pounds in weight."

Hoopers Ledge quarry, Paris has produced some excellent fluorapatite crystals, but usually in micromount size. The 3-4 mm crystals can be transparent, green, and are elongated with high-, low- and very low-angle first-order bipyramids, high- and low-angle second-order bipyramids, first- and second-order prisms, and "c" pinacoid, and are found in vugs in albite. Lower quality and simpler clear to white crystals are also found there. Tan to pink simple hexagonal fluorapatite crystals (to 2 mm) with "blistered" to "orange peel" basal pinacoid terminations are found with albite crystals in blocky albite with gray to purplish gray multiple-growth "mica" crystals (to 1 mm) also at the Hoopers Ledge quarry.

Beautiful blue and blue-zoned to clear vitreous fluorapatite crystals are found in vugs in cleavelandite, muscovite, bertrandite, and cookeite at the Havey quarry, Poland. The elongated prismatic crystals show "c" pinacoid and small bipyramid. Etched second-order prisms are sometimes present.

The Camp Hinds grossular locality, Raymond, has translucent blue-gray fluorapatite prisms (to 1x5 mm) embedded in calcite and associated with vesuvianite and meionite. The fluorapatite sometimes forms an open-weave mat of 1 mm crystals coating part of the vesuvianite crystals.

Lord Hill quarry, Stoneham is one of the earliest apatite - producing localities in Maine. Most of the crystals are clear to cloudy white to yellow (fluoresce yellow, short-wave ultraviolet) or are green (non-fluorescent). The crystals can be tabular or elongated. Most crystals (less than 1 cm) have large "c" pinacoid, small first- and second-order bipyramids, and first-order prism. Occasionally, a high-angle first-order bipyramid is seen in combination with the second-order prism. Crystals found loose in gem pocket sand (to 8 mm) are transparent with high- and low-angle first-order bipyramids, second-order bipyramid, third-order bipyramid, large first-order prism, small second-order prism, and "c" pinacoid. Crystals from Lord Hill quarry can be up to 7 cm across. Large crystals are usually gray to blue gray and blue. Small crystals (under 1 cm) are frequently clear with green phantom cores or are entirely grass green. Unusually etched crystals are known.

Aldrich quarry, Stoneham white fluorapatite has blocky prism, pyramid, and "c" pinacoid faces and fluoresces bright yellow (short-wave ultraviolet).

The Fisher quarry, Topsham produced a few simple blue fluorapatite crystals (to 3 mm) with etched faces and a white outer zone of carbonatian fluor-hydroxyl-apatite that were loose in the Fisher pocket. Additionally, some lustrous bright blue fluorapatite crystals (to several mm) have been found associated with blue-green elbaite.

An unnamed biotite crystal prospect northeast of the Consolidated #1 quarry group, Topsham has produced gray-green fluorapatite crystals (1.5 x 0.3 cm) frozen in graphic granite. Not only is the matrix unusual, but the fluorapatite fluoresces yellow (SW-UV).

Fluorapatite - Variety Francolite (carbonatian fluorian-hydroxyl-apatite)



Newry - Dunton Q, Rose Quartz Crystal L; **Paris** - Mount Mica Q; **Rumford** - Black Mountain Q

The variety francolite is found at several localities in Maine. The original francolite from Wheal Franco, Tavistock, Devon, England is colorless to gray and forms tightly intergrown coatings of small (1 mm) prismatic crystals with rounded termi-

nations. The crystal coatings grade into smooth botryoidal surfaces. In practice, the varietal name francolite has been used to describe not only crystallized, but also "fuzzy," velvety white to brown apatite coatings. Botryoidal francolite has a rough "orange peel" surface where terminations have coalesced, and the variety becomes indistinguishable from dahllite. Frequently, Maine francolite specimens have milky-zoned terminations. The species to which francolite usually belongs is fluorapatite and the modern name should be carbonatian hydroxyl fluorapatite. (The pronunciation of carbonatian should be car-bon-ate-ian. Alternatively, a few people say car-bōn-ā-shun.) Completely smooth carbonatian apatite coatings and botryoids tend to be lower in fluorine and higher in hydroxyl and grade into hydroxylapatite, and the fluorine to hydroxyl ratio may vary widely at a locality. Francolite in Maine pegmatites is frequently found coating muscovite or lepidolite crystals, albite crystals, eosphorite crystals, etc. Both crystals and botryoids of carbonatian apatites can be present in the same vug.

Francolite has a variety of expressions at the Dunton quarry, Newry. Francolite frequently forms a thin coating on ordinary fluorapatite crystals. "Paintbrush" bundles (1 mm) of white to clear francolite crystals are found in etched cavities in beryllonite.

Brown, tan, and cream-colored botryoids (less than 1 mm each to several millimeters) of francolite are found lining vugs of crystallized albite at the Rose Quartz Crystal location on Plumbago Mountain, Newry. Eosphorite, rose quartz crystals, and botryoidal hydroxyl-herderite are frequently associated. Tiny (less than 1 mm) doubly tapering crystals of francolite are also found, sometimes in "pin cushion" clusters of crystals with white tips. White botryoidal francolite/dahllite lining vugs from the Whitehall prospect, Newry has been mistaken for hydroxyl-herderite.

At the Mount Mica quarry, Paris, francolite can line cavities and form thin septa (to several mm thick) dividing cavities in siderite and kaolinite replacements of triphylite in blue tourmaline eyes. The drusy francolite can show tiny highlights of intergrown white to gray hexagonal crystals (to 0.2 mm) which can have a brassy iridescent luster completely obscuring the underlying material.

Francolite in tightly to loosely aggregated white crystals (1 mm) are found in quartz-albite lined vugs at Lord Hill, Stoneham. The crystals show prism and "c" pinacoid only.

fluorapophyllite? - listing of apophyllite (q.v.); Thompson et al. (1988)

FLUORITE (Fluorite Group)

CaF₂

Albany - Pingree Ledge Q; **Andover North Surplus** - East B Hill road cut; **Blue Hill** - Long Island A, Mammoth M; **Calais** - Maine Red Granite Q (= Bodwell Q?) (Red Beach); **Casco** - Chute P;

Cooper - Cooper M (= American Molybdenum Company M); **Deer Isle** - Deer Isle M; **Dixfield?**; **Frankfort** - Mount Waldo Q; **Greenwood?** - Tamminen Q; **Hancock?**; **Lewiston** - Robinson Mountain A; **Livermore** - International Paper Co. mill excavation; **Lovell** - Foster Hill A; **Mount Desert** - Halls Quarry village A; **Newry** - Bell Pit, Nevel Q; **Paris** - western Streaked Mountain A; **Portland** - Stevens Avenue Q; **Sanford** - Webster P, 200 m L, 600 m L; **Stoneham** - Lord Hill Q; **Stonington** - Ryan Q; **Stow** - Colton Hill Q; **Surry** - Sun Burst M; **Thomaston** - Dragon Cement Q; **Tunk Lake pluton** - Cherryfield, Franklin, Steuben, T10SD; **Upton**; **Wayne** - Androscoggin Lake igneous complex; **Wells?**; **Winslow** - Winslow Tin M; **York** - riebeckite granite; **T10SD** - Catherine Hill Q

Frosted white fluorite cubes (2-3 mm) are occasionally found in albite crystal vugs at Pingree Ledge quarry, Albany. One 4 mm clear, colorless cube has dodecahedral faces which are purple. Bertrandite crystals (1-3 mm) and clear bladed albite crystals (to 4 mm) are sometimes associated.

Hodsdon (1965) wrote: "There is a small road cut near the top of East B Hill in Andover North Surplus where narrow colorful streaks in the gray schist are quite noticeable, as one rides along. Thin layers of pinkish orange purple seem to be fluorite in minute crystals, possibly of micromount potential."

Etched purple fluorite fragments (1-2 mm) were found in vugs with scheelite crystals, muscovite crystals, and microcline crystals at a shore outcrop on Long Island, Blue Hill. Jackson (1838a) noted:

"Crossing over to Long Island, in Bluehill bay, we found the rocks to be gneiss and talcose-slate, resting upon granite, the latter rock forming about one half of the island. There are, also, three dykes of greenstone trap, which cut through the strata, and appear on each side of the island. In the granite, near its junction with the gneiss and trap, we found numerous veins of quartz, containing copper-pyrites, and arsenical iron. We also found several veins of fluor-spar, and while we were still remarking on the probability of the occurrence of lead ores with this mineral, with which it is frequently associated, one of the young gentlemen of our party handed me a specimen of galena, or the sulphuret of lead, which he found close by one of these veins.

The fluor-spar occurs in a vein 8 inches wide... It is of a light grass-green color, and is crystallized in octahedral forms. ...

Large druses of crystals are found in these veins of quartz."

Smith (1923) reported of the Bodwell quarry, Cooks Mountain, Red Beach, Calais: "... the red granite is traversed by a banded grayish quartz vein, about 18 inches thick, with a N. 25° W. course and a vertical dip. ... The quartz contains some purple fluorite..."

Hess (1908) recorded fluorite from the Cooper mine (American Molybdenum company mine), Cooper: "In such places the granite is miarolytic, that is, full of small vugs, which show well-crystallized feldspar, quartz, and occasionally purple fluor spar, giving the rock a peculiar spotted appearance."

Wintringham (1955, 1962) felt the fluorite from the Tamminen quarry, Greenwood was "doubtful." The "fluorite" could have been purple damourite. Seaman (1975b) reported cubic crystals from the Tamminen quarry. No specimens known.

Fisher (1948) described a vesuvianite-bearing calc-silicate unit in what was then called the Androscoggin Formation on northwestern Robinson Mountain, **Lewiston**. He described an accessory mineral: "Purple fluorite is also found sparingly and usually occurs in small 1/2 inch. patchlike aggregates."

Bluish purple to clear, rhythmically color-zoned fluorite octahedra (to 3 mm) associated with clear adularia crystals (to 2 mm) were found lining fractures in rock at the International Paper Company mill excavation, **Livermore** (Donald Corson, personal communication, 1991).

Extremely unusual, bright intense greenish-yellow fluorite crystals (less than 0.1 mm) are found associated with white filamentary mats (to 2 mm) of fluorapatite in the siderite assemblage at the Bell pit, **Newry**. Clear goyazites at the Bell pit have been mistakenly called fluorite.

Fluorescent clear to smoky to very pale purple fluorite (short wave and long wave ultraviolet light = dull blue) cleavages (to several cm) are found at the Webster prospect, 200 meter locality, and 600 meter locality, **Sanford**. Associated species can include meionite (fluorescent short wave ultraviolet light = red) and scheelite (fluorescent blue-white, short wave ultraviolet light only). Similar clear to pale purple granular fluorite from the Chute prospect, **Casco** is not particularly fluorescent.

Purple to clear etched masses of fluorite (to 3 cm) are found in vugs and cavities usually associated with fluorian muscovite at Lord Hill quarry, **Stoneham**. Seaman (1975b) noted: "It occurs as small purple cubes at Lord's Hill in Stoneham in small vugs in albite and similarly as small cubic crystals at the Tamminen Quarry in Greenwood." Kunz (1884a₂) wrote: "Fluorite fills cavities in the cleavelandite, dark purple in color; and some small, beautiful octohedral [sic] crystals, of a light blue color, resembled topaz in appearance." Anonymous (1948) noted of the Lord Hill quarry: "The fluorite varied from light rose to deep purple, almost black." A single pale sulfur yellow octahedron (3 mm) of fluorite has been observed as an inclusion in topaz (Duane Leavitt, personal communication, 1990; chemical analysis, Michael Wise, personal communication, 1992). Clear fluorite cubes (to 4 mm) have been observed with purple zoning on etched dodecahedral faces in albite from the Lord Hill quarry.

Fractures in marble from the Dragon Cement quarry, **Thomaston** have rarely produced clear octahedral fluorite crystals (to 3 mm) with purple color zones parallel to the octahedral edges.

Milton (1961) listed fluorite from granitic gneiss in the Old Speck Mountain quadrangle, **Upton**.

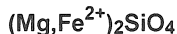
Creasy (1983) noted fluorite as an accessory in hornblende pyroxenite, Androscoggin Lake igneous complex, **Wayne**.

Fluorite was reported (MMJ, May 28, 1880) from the Winslow Tin mine, **Winslow**: "It [cassiterite] is associated with quartz, fluor spar, carb. of lime and margarite, running parallel

with the slates." The fluorite is deep purple and occurs as grains (to several mm) between silvery muscovite cleavages.

fluor spar = fluorite

FORSTERITE (Olivine Group)



Addison - Pleasant River Black Granite Q; Black Narrows A - East Moxie, The Forks; Boothbay Harbor?; Bristol - Joshua House's farm A; Calais - Beaver Lake Black Granite Q; Gouldsboro - Gouldsboro M; Katahdin Iron Works - Katahdin Iron Works M; Lincolnville - Heal Black Granite Q; Linneus - Drew Hill Q; Monhegan Plantation - White Head Q; Moxie pluton - Big Squaw, Harfords Point, Little Squaw, Squaretown, West Bowdoin College Grant; Newry - Plumbago pluton; olivine diabase porphyry - Cape Elizabeth, Cumberland, Freeport, Harpswell; Penobscot - shore east of Pumpkin Island; Rumford - Route #108 outcrop; Saint George - Long Cove Q; Union - Harriman P; unnamed diorite - Bar Harbor, Mount Desert, Tremont; Vinalhaven - Bodwell Q, olivine diabase on southern part; Warren - Warren Nickel P; York - Cape Neddick gabbro

Olivine in Maine rocks is hardly ever visible in hand specimens. Almost all of the accounts are based on microscopic examination of thin sections of rock. Some selected descriptions and listings are presented for this species. Not only are unspecified olivines usually forsterite, the composition Fo₈₉ is the most frequently encountered composition of olivines in igneous rocks.

Chapman (1962) listed olivine from a diorite from northwestern **Bar Harbor**, **Mount Desert**, and **Tremont**.

Jackson (1839) noted in **Bristol**: "In this town there is a dyke of well characterized basalt, containing olivine and basaltic hornblende in grains and crystals. This dyke is found on the estate of Mr. Joshua House, in the north part of the town, near a granite quarry, and two miles from Damariscotta River. It runs N. 60° W., S. 60° E., and shews itself again on the southeast side of Biscay Pond. The basalt is columnar in structure, the columns striking horizontally from the wall rock, which is granite - the width of the dyke varying from twelve to thirty feet. This being the first instance where we have discovered well characterized basalt in Maine, a large number of the columns were recovered for specimens." (See history section in volume 2 concerning Parker Cleaveland and Neptunism. This discovery is important.)

Lord (1900) described olivine from **Monhegan** norite and olivine gabbro, and Lord (1898) described the alteration of olivine in olivine diabase porphyry dikes, **Cape Elizabeth**, **Cumberland**, **Freeport**, and **Harpswell**.

Espenshade and Boudette (1967) described the forsterite from the Moxie pluton, **Big Squaw**, **Greenville**, **Harfords Point**, **Little Squaw**, and **Squaretown**: "Olivine mainly forms anhedral to subhedral grains or is clustered in elongated aggre-

gates, some of which are oriented in planes parallel to the plagioclase laminae. Olivine crystals are typically about 1-2 mm long, unzoned, and unaltered; alteration to serpentine occurs only locally. Color ranges from yellow green to dark metallic brown. Olivine commonly has a thin mantle or reaction rim (0.02-0.1 mm thick) of orthopyroxene or pale-brown hornblende. The composition of olivine in this part of the Moxie pluton falls into two groups; one group ranges from 28 to 42 percent forsterite, the other from 55 to 80 percent." Espenshade (1972) further reported on forsterite: "The olivine content in some troctolitic rocks is as high as 30 percent. Composition of olivine is Fo_{26-74} in the six measured samples (table 1). Olivine commonly forms subhedral elongated crystals that are less than 1 mm long; in some rocks they reach a length of 4 mm. Many olivine crystals have a thin mantle or reaction rim of orthopyroxene or hornblende. They are also enclosed in plagioclase or in poikilitic orthopyroxene, clinopyroxene, or hornblende; these features all indicate that olivine was an early mineral. Olivine is generally fresh, but in a few places it is partly to completely altered to serpentine..." Only one magnesium-rich olivine (#718, Fo_{74}) was reported by Espenshade (1972) from a site about half way between Notch Pond and northern Upper Wilson Pond, **West Bowdoin College Grant**, but other magnesium-rich samples were reported by Espenshade and Boudette (1967).

Houston (1956) reported fayalite? compositions, probably based on optical determinations, from the various pyrrhotite-bearing rocks he studied, but the olivines coexist with bronzite enstatite. Rainville and Park (1976) show their chemical analysis of **Union** forsterite and the implication that can be drawn is that Houston (1956) employed a peculiar notation for his chemical designations. If Fo_{xx} is substituted for his Fe_{xx} , it becomes obvious that consistency is obtained. Of the Black Narrows peridotite, **East Moxie - The Forks** Houston (1956) said: "It is composed dominantly of olivine (Fe_{75}) [emphasis added], with minor amounts of plagioclase (An_{70}) and orthopyroxene (En_{70-75})." Of the olivine from the Katahdin Iron Works mine, **Katahdin Iron Works**, Houston (1956) said: "Olivine ($\text{Fe}_{75\pm}$) [emphasis added] is much more abundant in the mineralized norite than elsewhere. In the norite the highest percentage noted outside the mineralized zones was 10%. Thin sections of samples from the unmineralized areas contained one or two isolated crystals at most. The mineral occurs as subhedral crystals, averaging 1.1 mm. in diameter. Many crystals are partially altered to antigorite and magnetite." Of the **Union** pyrrhotite-bearing peridotite Houston (1956) said:

"Olivine ($\text{Fe}_{80\pm}$) [emphasis added] is the chief mineral constituent of the peridotite. It occurs in proportions from 40 to 60 percent of the rock and makes up approximately 55-60 percent of the mineralized peridotite. Under the microscope, the mineral is colorless but its magnetite alteration mentioned below causes it to be colored black in most outcrops. The freshest grains come from the ore deposit where many of the euhedral crystals are relatively unaltered. Most of the crystals have a border of serpentine alteration and some are criss-crossed by veinlets

containing magnetite and serpentine. However, there is no evidence of crushing or fracturing of the olivine grains by tectonic stress.

In the more highly altered zones all stages of alteration of the olivine are present. Some crystals are almost completely altered to serpentine and magnetite, leaving islands of unreplaced olivine inside the area of unaltered minerals. Olivine is the best crystallized mineral present. The euhedral crystals occur as inclusions in orthorhombic pyroxene and feldspar. They are corroded and partly embayed by the pyroxene. Alteration between the feldspar and olivine makes it difficult to determine the exact relationship of these two minerals but the feldspar probably crystallized at a later stage as judged by the relationships determined in numerous other cases cited in the literature. In fact, the form and mineral relationships indicate that the olivine was the first mineral to crystallize from the peridotite magma."

Devonian ultramafic rocks east of the summit of Plumbago Mountain, **Newry** were described by Moench and Hildreth (1976) as: "... composed of about 35 percent partial pseudo-morphs of serpentine after olivine in a matrix of tremolite and magnesian chlorite; small amounts of tremolite and pyrrhotite are present. The ultramafic bodies exposed near the top of Plumbago Mountain are composed of olivine, tremolite, magnesian chlorite, and small amounts of serpentine, talc, magnetite, pyrite, and pyrrhotite (Moody, 1974)."

Moench and Hildreth (1976) reported of **Rumford**: "The ultramafic rock exposed near Rumford (crops out on Route 108) is massive, tough, and coarsely crystallized; it is composed of tremolite, olivine, magnesian chlorite, sparse anthophyllite and magnetite, and trace amounts of apatite and zircon[.]"

Dickerman and Wadsworth (1884) described olivine as a component of "black granite" from Long Cove quarry, **Saint George**.

Merrill (1884) and Smith et al. (1907) described the olivine diabase from southern **Vinalhaven**.

Rainville and Park (1976) described the rock of the Harri-man prospect, **Union** and the Warren Nickel prospect, **Warren**: "The presence of magnetite-bearing olivine, anhedral plagioclase, and interstitial sulfides gives the rock its unusual appearance. It has been studied petrographically by Bastin (1908a, 1908b) and Houston (1956). ... Olivine (Fo_{76}) is the major mineral in the unaltered Harriman peridotite; Bastin (1908a, p. 12) and Houston (1956, p. 63) estimated that it constitutes 60 vol[ume] percent of the rock. The percentage decreases rapidly toward the margin of the peridotite body. The olivine grains are generally round, with grain size varying from several tens of micrometers to several millimeters in diameter. ... The olivine grains are not highly shattered but are crosscut by numerous fractures that contain serpentine. Serpentine also borders olivine grains. Many of the serpentine veinlets enclose magnetite veinlets; this is partly responsible for the extremely dark color of the peridotite."

Wandke (1922b) wrote of Cape Neddick gabbro, **York**: "In hand specimen the rock has a dark gray color, is fine-grained although the crystals of olivine that are abundantly sprinkled

throughout the specimen may attain a maximum diameter of three millimeters. ... The olivine, never abundant, occurs in grains with an anhedral outline that indicates resorption."

Numerous forsterite olivine occurrences in Maine "black granites" are described by Dale (1907) and Smith (1923).

FOURMARIERITE

$\text{PbU}_4\text{O}_{13} \cdot 4 \text{H}_2\text{O}$

Greenwood? - *Tamminen Q*; **Newry** - *Dunton Q*; **Poland** - *Berry-Havey Q*

Fronde! (1956, 1958c) showed that gummite from New England pegmatites contains abundant fourmarierite, vandendriesscheite, and wölsendorfite. Orange to orange-brown gummite (unanalyzed) (1 cm) rims a small core of black uraninite in albite next to lithiophilite from the Tamminen quarry, **Greenwood**.

Fronde! (1958c) said: "Fourmarierite is one of the main constituents of the inner, orange-red zone of alteration of gummite pseudomorphs after uraninite." Though no studied fourmarierite sample from Newry can be located that was associated with Fronde!'s (1956, 1958c) study, one specimen at Harvard University shows the appropriate alteration. The 3 cm uraninite forms a black mass with muscovite. Several small patches (5 - 7 mm) of bright yellow mineral (beta-uranophane?) coat the uraninite. One resinous seam (1.5 x 0.2 cm), on the contact of a uraninite grain and muscovite, of variegated orange to orange-brown "gummite," undoubtedly contains fourmarierite, vandendriesscheite, and wölsendorfite.

Orange-red gummite (to several mm) (unanalyzed) in cleavelandite from the Berry-Havey quarry, **Poland** probably contains fourmarierite.

francolite = carbonatian fluorian hydroxylapatite; see discussion under fluorapatite

franklinite?

Rumford - *Black Mountain Q*

Franklinite was reported from Black Mountain quarry, **Rumford** by Anonymous (1948): "At a smaller working above the big pit were found purpurite, beryl, franklinite and eosphorites in both rhombs and crystals." Franklinite was also among the species listed for Black Mountain quarry by Anonymous (1949b). Wintringham (1954, 1955, 1962) wrote: "The Black Mountain franklinite appears to be chalcophanite." The source specimen was discovered by Wintringham (personal communication, 1992) and it is labeled: "Not Franklinite! Possibly Chalcophanite (Hydrofranklinite) Check!" The specimen consists of sphalerite and siderite.

fuchsite (Mica Group) - chromian muscovite

Alder Stream - *allochthonous serpentinite*; **Andover West Surplus?** - *East B road A*; **Brunswick** - *southern Brunswick Naval Air Base*; **Cumberland** - *Great Chebeague Island*; **Freeport** - *Wolfs Neck L*; **Gardiner**; **Harpwell?**; **Jim Pond** - *drift boulders, unnamed hill, unnamed serpentinite*; **Paris?**; **Seven Ponds** - *allochthonous serpentinite*

Fuchsite (pronounced "fooksite" and not "fewshite") is an emerald-green variety of muscovite containing chromium. No beryl has been found in association at any of its reported occurrences.

Boudette (1991) mapped an unnamed "allochthonous serpentinite" through **Alder Stream**, **Jim Pond**, and **Seven Ponds**. He noted (Boudette, 1991): "Gray, fine- to medium-grained, waxy soapstone contains scaly to radiating, interleaved aggregates of nearly pure talc, conspicuous crystals of magnetite as much as 15 mm across, and some carbonate. Gray, fine- to medium-grained, cataclastic, silicified virginitite contains about equal amounts of magnesite and dolomite, with subordinate speckled, emerald-green chromian muscovite (sometimes called fuchsite), chlorite, magnetite, serpentine, chlorite, sericite, and sulfide minerals. Nickel and chromium contents as much as 2000 parts per million each. Some virginitite contains as much as 10 percent chromium muscovite and is of gemstone quality." It is not specified whether Ni or Cr dominate and if their occurrence is restricted only to the muscovite or if other phyllosilicates show a green coloration due to Ni and Cr substitution.

Putnam and Perham (1968) noted of **Andover West Surplus** [Andover? or Andover North Surplus?]: "**Fuchsite** has been reportedly found in the vicinity of the Appalachian hut on the East B road [Upton road?]. There are not many of these finds." No specimens known.

Wheeler and Wheeler (1878) noted of **Brunswick**: "Green mica is found at New Meadows. The green mica extensively exchanged by the late Professor Cleaveland was found in a boulder near the river." Jackson (1838a) probably announced the mineral for the first time in Maine: "A beautiful variety of green mica slate, filled with crystals of iron pyrites, was discovered in Brunswick, by Prof Cleaveland many years ago, and elegant specimens of it may be seen in almost every cabinet in the country." A small road metal quarry on the southern portion of the Brunswick Naval Air Station has produced some fuchsite, but no collecting has occurred there in recent times (Ray Woodman, personal communication, 1991). An old Brunswick specimen from the John I. Legrow (deceased ~1880) collection is somewhat friable with lightly rusty veinlets intertwined in the silvery muscovite, light apple green fuchsite, and pyrite schist.

A fuchsite location occurs in a rusty schist zone of the Spring Point Formation on the northern end of Great Chebeague Island, **Cumberland** (Arthur Hussey, personal communication, 1992). This occurrence might be related to the Brunswick occur-

rence. Smith (1882) noted fuchsite from **Harpwell**. No specimens known.

The intertidal zone near Wolfs Neck Woods State Park, Wolfs Neck, **Freeport** has produced abundant specimens of pale emerald green fuchsite (flakes to 3 mm) in a granitic matrix with small (1-3 mm) pyrite grains from an outcrop. Specimens in nineteenth century mineral collections frequently contain specimens identical to the Wolfs Neck material, but are labeled "Paris." A mineral similar to fuchsite was once found in the country rock above the Mount Mica pegmatite (John Raymond, personal communication, 1994).

Fuchsite is found in white to tan dolomite (arnoldite, q.v.) from several places in **Jim Pond**. A blasted outcrop exists on a hilly knob half way between Shallow pond and Little Greenbush pond (Thompson, 1968). Several gravel pits in the town have arnoldite boulders up to several meters across. The fuchsite

patches are generally 3-5 mm, but larger, coalesced flakes (to 3 x 5 cm), of foliated emerald-green to dark grass-green patches are known. Though the mineral is chromium-bearing, it has inexplicably been called garnierite by some collectors. Boudette (1970) noted: "Diapiric serpentinite with associated quartz-carbonate-fuchsite (?) veins (W. B. Thompson, unpublished report [1968]) are found along faults in greenstone (unit 2a) as much as 4 miles away from the serpentinite in the complex."

fulgurite - sand fused by lightning

Waterville?

fuller's earth = montmorillonite or, improperly, any white clay or diatomite

G

GAHNITE (Spinel Group)

ZnAl_2O_4

Auburn - Groves Q, Keith Q, Maine Feldspar Q, Pulsifer Q, Wade Q; **Blue Hill** - Black Hawk M, Douglass M; **Bowdoin** - Coombs Q; **Bowdoinham** - Booker Q, West Booker Q; **Greenwood** - Harvard Q, Ohtonen Q, Witt Hill L; **Norway** - Cobble Hill Q, Witt Hill L; **Stoneham** - Lord Hill Q; **Stow** - Colton Hill Q; **Surry** - woods road outcrop Surry - Blue Hill line; **Topsham** - Fisher Q, unnamed Q, William Wiles #1 Q; **West Paris** - Cobble Hill Q

Gahnite is a member of the spinel group and is related to magnetite and other spinels. Occasionally, gahnite has been called zinc spinel, but this name is imprecise and should not be used. Maine gahnite crystals are sometimes world class.

The Pulsifer quarry, **Auburn** has produced several blackish-green octahedral gahnite crystals (to 2 cm) frozen in quartz-microcline pegmatite. Occasionally, the very brittle gahnite has broken free from its matrix to reveal its crystal shape. The crystal faces are composed of vicinal faces producing triangular striations or triangular "pagoda" steps and the stepped growth is partly responsible for the dodecahedral edge modifications being apparently wider than they are. Similar crystals come from the Keith (formerly Towne) quarry. Bastin (1911) reported of the Towne quarry: "one crystal of zinc spinel of perfect form, five-eighths inch in diameter, was found embedded in the feldspar."

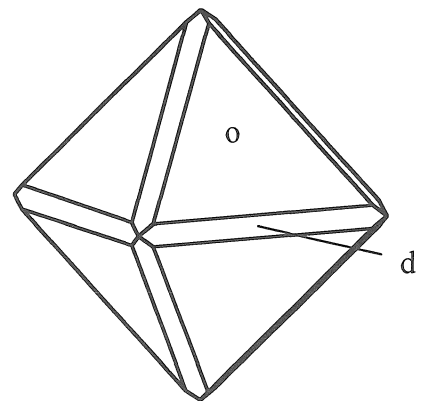
The Wade quarry, Auburn produced gahnite crystals (to 1.5 cm) frozen in albite and almandine. The dark green crystals are dominantly octahedra with dodecahedral modifications. The surface of the gahnite can be covered by sericite.

World class gahnite crystals (excellent crystals to 5 cm! and imperfect crystals to 7 cm) have been found at the Groves quarry (also called Maine Tourmaline prospect, Plumbago pit, and "hole in the ground"), Auburn (King, 1993a). The oily-lustered, deep green gahnite crystals consist of octahedra in combination with dodecahedral faces. The gahnite is characteristically in half crystals with the "bottom" interrupted by rusty coarse muscovite flakes wrapped around the rounded end of the crystal. Muscovite completely surrounds poorly formed crystals. The surfaces of most of the gahnite crystals are not perfectly flat, but consist of planes marked by shallow rivulets or slightly raised scalloped wide swirls. Occasionally, the faint surface markings on the octahedral faces consist of geometrically jagged lines with 60° angles (parallel to the octahedral edges). The gahnite is com-

pletely embedded in garnet-albite pegmatite. Gems cut from this material (to 5+ cts) are brilliant, but nearly black with green internal reflections on thin edges.

Douglass mine, **Blue Hill** ore was described by Forsyth (1953): "A sample of sulfide bearing rock from this mine was examined microscopically and found to be exceptionally rich in quartz. ... Unidentified feldspar grains are somewhat rounded and have been thoroughly altered to sericite. Large grains of bleached biotite are scattered throughout the sample in random orientation, but smaller ones, intergrown with sericite, form crude braided patterns. Zircon is common and is surrounded by pleochroic halos, yellow in the feldspar, but black in the biotite. Chalcopyrite shows marginal alteration to chalcocite and at the same time appears to be corroding and replacing quartz. A few grains of a grayish-green non pleochroic isotropic mineral are present and have been identified as gahnite." Yates and Howd (1988) noted gahnite from the Black Hawk mine, Blue Hill: "Corundum is present in BHE15 (Assemblage B) where it is armored by andalusite, cordierite, and retrograde muscovite and includes grains of gahnite, rutile, and sulfide."

World-class gahnite crystals have been found at the Coombs quarry, **Bowdoin**. The green sharp octahedral crystals (to 5+ cm!) can have smooth surfaces and oily to vitreous luster. The doubly terminated crystals are frequently embedded in albite and almandine and are usually coated with sericite to flaky muscovite. Frequently, vicinal faces develop giving the octahedral "edge" a corrugated appearance. Dodecahedral faces are sometimes present. Some gahnites from the Coombs quarry are comparable with fine crystals from Franklin, New Jersey.



Gahnite, Groves Q, Auburn

Herbert Haven listed in his diary (June 18, 1939 [Morrill, 1966]) concerning **Greenwood**: "Our first stop was Witt Hill which is on the Greenwood-Norway Me. town line. We secured permission from Alvin Brown who owns the land to go to the quarry and to blast. We secured chrysoberyl crystals, black tourmaline crystals and spessartite garnets. The last are aurora red when clear. Sillimanite, gahnite crystals and minute zircons have been found here but not by the [Maine Geological] society." Jacobson (1982) also listed gahnite from the chrysoberyl pegmatite locality on Witt Hill along with zircon, autunite, almandine, and uranophane. The gahnite frequently occurs only as green "dots" (to several mm).

Bjareby (1953) reported gahnite from the Ohtonen quarry, Greenwood: "... I noticed gahnite xls on a pyrite specimen. Several months ago I again examined those specimens and I found colorless xls of bertrandite associated with fluorapatite xls of a pale blue color."

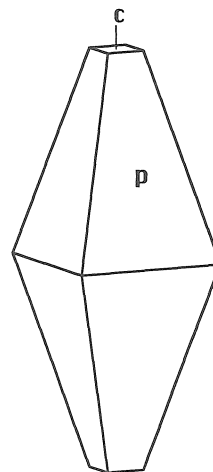
Wintringham (1962) noted: "Spinel has been reported from Noyes Mountain (Greenwood); further study of this material would probably show it to be gahnite." No specimens known.

Lord Hill quarry, **Stoneham** gahnite is octahedral with dodecahedral modifications. The grass-green crystals (to 2 cm, but usually 2-3 mm) resemble green fluorapatite frozen in cleavelandite, but the triangular striations on the octahedral faces are diagnostic.

Smooth-faced medium to dark green gahnite crystals (1-3 mm) are found on a small wooded outcrop (about 1-2 meters high) along the northeastern edge of a woods road on the **Surry - Blue Hill** town line, approximately several hundred meters in from Route # 172. The crystals are frozen in matrix along with terminated pink andalusite crystals (2-6 mm) and occasional molybdenite crystals (to 1 cm).

Fisher quarry, **Topsham** has dark green octahedral gahnite (to 2+ cm) frozen in feldspar. The octahedra are usually distorted and have triangular growth striations composing the crystal faces. Broken masses can have a dull parting surface or show a peculiar jagged fracture. The mineral is very brittle. Palache (1934) reported: "... a single rounded mass of this material weighing upwards of fifteen pounds had been taken from the graphic granite, where it was accompanied by garnets of equally large size." In the same article, green microlite was misidentified as gahnite, but the error was rectified (Stewart, 1938; Palache and Gonyer, 1940). Stewart (1938) noted graphic granite could host gahnite, as well as cleavelandite, at the Fisher quarry. In addition, Stewart (1938) noted: "The crystals are quite black when observed as a unit, but examination of small fragments along the thin edges shows a distinct green color." A further observation by Stewart (1938) includes his reporting a thin rind of yellowish alteration around a gahnite crystal in cleavelandite.

Wheeler and Wheeler (1878) noted of Topsham: "Gohnite [sic] is found in a quarry near the road, beyond the Old Feldspar quarry [Fisher Q?]."



Gaïnesite, Nevel Q, Newry

*GAÏNESITE (Gaïnesite Group)



Newry - Nevel Q

Gaïnesite was first found in Newry in the early workings of the United Feldspar quarry, now called Nevel quarry or Twin Tunnels, **Newry** and was named by Moore et al. (1983). Though actually tetragonal, steep pyramidal, gaïnesite crystals (to 2 mm) are thickly intergrown and superficially resemble lilac-colored fluorapatite, but can also appear granular. Dark coffee-brown fibrous botryoids of "roscherite" are associated in the cleavelandite matrix. The gaïnesite on the main portion of the type specimen is ~1.5 cm in maximum dimension and only several small fragments are known in addition to it. McCrillisite (q.v.) from Mount Mica is the cesium analog of gaïnesite. Gaïnesite was redefined by Foord et al., in press.

Perham (1959) reported: "The mineral was found (4 specimens) the latter part of Sept. 1941 in the lower mine at Newry (The United Feldspar and Mineral Co. Mine [= Nevel Q]) about 1/4 mile before reaching top or upper or Nevel [sic] (tourmaline) mine. The Mineral was first noted as a faint purple spot in a 3 ton mass of cleavelandite which was resting on the floor of the lowest portion of the quarry. The floor at that time was about 20 feet deep. The original finder - Neal Yedlin - said he mistook it for purple apatite." This is the mineral which has been referred to as "yedlinite" by some collectors. True yedlinite (q.v.) has not been found in Maine.

GALENA

PbS

Acton - Boston-Acton M, Dirigo M; Addison - Eagle Island M; Alder Stream; Aurora; Batchelders Grant - Bradley Farm A;

Belfast; **Bingham** - "saw mills A", Wyman Dam excavation; **Blue Hill** - Bisbee M, Black Hawk M, Blue Hill M, Douglass M, East Blue Hill M, Favorite M, Long Island M, Owen Lead M, Revere M, Twin Lead M, Victoria M; **Brooksville** - Callahan M (= Cape Rosier M), Jones-Dodge M; **Bucksport** - Great Eastern M, Snow M; **Camden** - Tolmen M; **Carmel** - Carmel Antimony M, Palmer farm M; **Carthage** - Briggs M; **Castine** - Emerson M; **Cherryfield** - Britton M, Narraguagus M; **Columbia** - Harrington M; **Concord** - Robinson M; **Corinna** - Corinna M; **Crawford**; **Deer Isle** - Crow Island A, Deer Isle M; **Denmark**; **Dennysville** - Birch Hill M; **Dexter?** - Maine Silver Mining company M; **Dixfield**; **Dover-Foxcroft** - well excavation; **Eastport** - Moose Island A; **Ellsworth** - Boston M, Ellsworth M?, Fulton M, McFarland M; **Embden** - Embden M; **Exeter**; **Fort Fairfield**; **Franklin** - Franklin M, Franklin Extension M, Swan M; **Garland** - Preble Hill M; **Gouldsboro** - Globe M, Gouldsboro M, Home M, Kerona M, West Bay M, Victor M; **Guilford** - Bennett M; **Hampden** - Argonaught M, Fowler M, Lawrence M, Silver Drift M; **Hancock** - Copperopolis M, Emmet M, McFarland M, Western Union M; **Herman** - Davis M; **Jackson** - Jackson Gold and Silver M; **Jim Pond**; **Jonesport** - Jonesport Q, Silver Tablet M; **Knox** - Stone M; **Lamoine** - Petit Manan M; **Lebanon** - Lebanon-Acton M; **Levant** - Levant M (= Antimonial Silver M); **Lincolnville** - Lincolnville Gold and Silver M; **Linneus** - Drew Hill sulfide veins; **Lubec** - Hog Island M, Lubec Lead M, South Bay Lead M, West Quoddy Head M, Youngs Point M; **Madison** - Merchant Slate Q; **Marion** - Marion M; **Milbridge** - Cherryfield M; **Milton** - Mount Glines M; **Monson** - Farmer #3 Q, Farmer #4 Q; **Moscow**; **Newfield** - Bergendahl M, Davis Farm M; **New Gloucester** - Richardson M?; **Newry** - Nevel Q, Rose Quartz Crystal L; **Orrington** - Smith Q; **Owls Head** - Owls Head M; **Parlin Pond** - Bean Brook Mountain A; **Parmachenee** - First East Branch Magalloway River A, Thrasher Peaks A; **Parsonsfield** - Swett House A, Elmrow Farm A, Kezar Falls Deposit, Randall Mountain A; **Pembroke** - Barrett P, Big Hill M (= Pembroke M); **Penobscot** - Hercules M, Clyde Limeburner P; **Phillips**; **Phippsburg** - Mount Arat P; **Porter** - Porter M; **Prospect** - Fort Knox Lead M; **Rangeley**; **Ripley**; **Robbinston**; **Rockland**; **Rockport** - Riverside M; **Rumford**; **Saint Albans**; **Scarborough?**; **Sedgwick** - Eagle Brook M, Eggemoggin M; **Sorrento?** - Boss of the Bay M; **Stow** - Colton Hill Q; **Sullivan** - Beacon Hill M, Connors M, Milton M, Sullivan M, Waukeag M; **Surry** - Sun Burst M; **Thomaston** - Williams Q; **Topsham**; **Trescott** - Moose River Bay M, Trescott M (=Sullivan Farm?); **Union** - Harriman P; **Vassalboro** - North Vassalboro A; **Verona** - Empire M; **Vinalhaven** - Island City M; **Warren** - Warren Nickel P; **Wesley** - Rollins M; **West Falmouth** - Beulah Farm P; **Whiting** - Cooper M; **Willimantic** - Sebec Lake M; **Wilton** - East Wilton A; **Winslow** - Winslow Tin M; **Woodstock** - Lone Star M, Union M (= Sigotch M)

Galena is widespread in the metal mines of Maine, though in many locations the galena is barely more abundant than that which would serve academic interests. In particular, massive silvery-gray galena cleavages (sometimes to several centimeters

along a cleavage) are known from the Big Hill mine, **Pembroke**, Lubec Lead mine, **Lubec**, Gouldsboro mine, **Gouldsboro**, Corinna Silver mine, **Corinna**, Porter mine, **Saint Albans**, Robinson mine, **Concord**, Argonaught mine, **Hampden**, and the Boston-Acton mine, **Acton**, in addition to many of the above listed localities. The galena is frequently frozen in milky quartz and the lustrous galena can look black by comparison, especially when the patches of galena become mere filaments in matrix. In some localities, such as the Callahan mine, **Brooksville**, the galena is found as stringers to several centimeters by several millimeters in much larger veins of fine-grained dark brown sphalerite. A number of the above reported galena localities are false reports, as the original reports fraudulently listed galena in order to sell stock in a silver mine. Some so-called silver mines in Maine have no silver and no sulfide mineralization, while at most Maine "silver" mines galena was present only as silvery gray metallic masses (several mm to a centimeter) which may have been intergrown with pyrite, chalcopyrite, and/or sphalerite. The complex mineral associations in some mines, occurring in low concentrations, were virtually inseparable given the technology used when the mines were being opened.

A few cubo-octahedral bright metallic gray galena crystals (2 mm) are known in quartz vugs from the Black Hawk mine, **Blue Hill**.

It was reported of the Ellsworth mine, **Ellsworth** (MMJ, May 21, 1880): "On a recent visit to Boston one of the editors of the Mining Journal saw on exhibition in the office of the Ellsworth - Silver Mining Company some very handsome [galena] ore that did not come from the mine in Ellsworth.[!]"

Smith (1904) visited the Mount Glines mine, **Milton** and reported: "This sample was taken, it is reported, from the No. 1 vein at a depth of about 35 feet. ... the high percentage of lead shows that the sample sent to Mr. Hersey was almost 55 per cent pure galena. This indicates the method employed in collecting the sample, which, indeed, is comparable to a low grade of coarse mill concentrates rather than to ore as mined. This assay is to be regarded as that of a cabinet specimen of galena, rather than of an ore body." The selection process referred to lies at the heart of the problem of assaying. Many of the mine owners felt that the choosing of an assay sample was a matter of pride or, alternatively, a way to perpetuate a scam. Only the purest, hand picked, usually cobbled and purified, samples were sent for assaying with no reflection on the true grade of the ore. It would be possible to have the only sulphide pod in a quartz vein analyzed and make a mine look like the greatest bonanza ever discovered. Of the myriad galena mines in Maine and the numerous reports of assays, hardly a realistic idea has ever been formulated of the true value of a property.

Galena has been found as small (to 1 mm) silvery gray grains intergrown with sphalerite in microcline at the Nevel quarry, **Newry**. Arquette (1968) reported galena from the Rose Quartz Crystal locality, **Newry**.

Cox (1970) reported of an unnamed mine in Kezar Falls, **Parsonsfield**: "Galena and sphalerite occur as coarse crystals in

breccia composed of fragments of dark-gray jasperoid so clouded with fine inclusions as to be opaque in thin section... The breccia is filled by microcrystalline quartz, fine comb-structured quartz, and kaolinite." The minerals are obviously massive. This may have been the locality of Jackson (1838a).

It was reported of the Milton mine, **Sullivan** (MMJ, July 1, 1881): "Fine particles and cubes of galena are found mingled with the clay [of the vein]."

Kempton (1879), Schrader et al. (1917), Schofield (1875), Smith (1907), Morrill et al. (1958), Morrill and Hinckley (1959), Young (1962, 1963), and Fournier (1970) list a number of Maine galena occurrences.

GANOPHYLLITE



TDR2 WELS - Hovey Mountain P; **T9R3 WELS** - Maple Mountain P

The brown to black mica ganophyllite was reported from the Hovey Mountain prospect, **TDR2 WELS** and the Maple Mountain prospect, **T9R3 WELS**, but not described by Pavlides and Milton (1962): "Ganophyllite, a hydrous manganese aluminum silicate (optically resembling bementite), has been identified by X-ray." Pavlides and Milton (1962) do discuss the association of the mineral: "In addition to the localization of rhodonite-bearing veinlets within the manganiferous banded hematite ironstone, many other types of veinlets also are selectively localized within certain rock types. Among these are chloritic veinlets, which are generally restricted to magnetite-bearing rocks that contain much chlorite. Veinlets in these rocks consist principally of chlorite, alkalic feldspar (orthoclase and albite-oligoclase), carbonate of several varieties, quartz, apatite, and in a few veinlets, fibrous and micaceous minerals with optical properties close to the bementite group and ganophyllite. ..." Ganophyllite from "Aroostook County" reported, but not studied, by Smith and Frondel (1968) is from the Pavlides and Milton (1962) study. No specimens known.

garnet = a group name; see almandine, andradite, grossular, spessartine, uvarovite

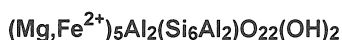
garnierite?

Alder Stream?; **Jim Pond?**; **Warren?** - Knox Q, Warren Nickel P

A peculiar bright green micaceous mineral from **Jim Pond** and **Alder Stream** has been called garnierite (Lander, 1955). Thompson (1968) investigated the Jim Pond material and concluded it to be chromium-bearing rather than nickel-bearing and suggested the material was properly called fuchsite (q.v.).

Morrill and Hinckley (1959) reported garnierite from the Knox lime quarry, **Warren**. Garnierite is a generic term which signifies an unknown, or at least highly variable, nickel silicate composition composed of minerals from the various mica groups, etc. Although no nickel minerals are known from this locality, copper minerals are reported and the green alteration of copper minerals could be confused with another green mineral.

GEDRITE (Amphibole Group)



Grafton - Black Brook A/Cedar Brook A/Hemenway Ridge A; **Harpwell** - Bethel Point A, Cushing Formation on Long Point, Yarmouth Island A; **Upton** - Ammonoosuc Volcanics

The former single species gedrite has been divided into three species: gedrite, ferrogedrite, and magnesiogedrite. Gedrite is volumetrically the most important part of the series.

Gedrite is found in the metamorphosed Ammonoosuc Volcanics in several places in **Grafton** (Milton, 1961): "Gedrite-bearing rocks characterize a belt extending from Cedar Brook to Hemenway Ridge and the area near the head of Black Brook in Grafton..." An analyzed sample (HU 112684) is from "elevation of about 1730 feet in the tributary entering Black Brook at about elevation 1650 near the west edge of the Old Speck Mountain 15' quadrangle. ... The gedrite forms dark green needles or bladed prisms about one centimeter long, with some tendency to sheaf-like aggregation. It is partially altered to a brownish-yellow mineral of low birefringence that may be a serpentine or a chlorite" (Milton and Ito, 1961). The chemical analysis of Milton and Ito (1961) indicate the species is intermediate gedrite.

Gray brown coarse cleavages (to 6 x 2 mm) in bundles (to 5 cm) of laths and knots of gedrite are found in biotite schist of the Cushing Formation, Long Point, **Harpwell** (Arthur Hussey, personal communication, 1990). Hussey (1981) described an occurrence: "The Yarmouth Island Member consists predominantly of light gray, poorly bedded to massive plagioclase-quartz-biotite-gedrite-garnet-cordierite gneiss with beds of very sillimanitic gneiss which have pseudomorphs and relict grains of staurolite." Hussey (1988) further located the formation. The Bethel Point and Yarmouth Island gedrite has not been chemically analyzed and would better be described as gedrite/anthophyllite until data become available (Arthur Hussey, personal communication, 1992).

Gedrite of highly unusual chemical composition was found in the Ammonoosuc Volcanics in **Upton** and **Grafton** by Kimball (1981). The reported compositions are on the aluminum-rich side of the compositional boundary between gedrite and anthophyllite. Kimball (1981) noted: "Gedrite is brown and pleochroic in shades of brown to grey. In most grains the end sections are 1.0 to 2.0 mm across but some are as large as 7.0 mm across. In these specimens, gedrite is the dominant phase. Sample G86a [not indicated on the sample map] is an exception. In it gedrite occurs

as thin foliated layers which alternate with wide quartz layers and thin biotite layers. These gedrite crystals are 0.02 to 1.0 mm long and have faint pleochroism. All gedrite crystals which coexist with anthophyllite contain exsolution lamellae of anthophyllite parallel to (010). These lamellae ... are most readily observed in sections cut perpendicular to the c-direction..." Kimball (1981) found gedrite in a variety of associations including with anthophyllite and/or magnesiohornblende.

gehlenite?

Stoneham? - Lord Hill Q

Bastin (1911) reported of Lord Hill quarry, **Stoneham**: "Other minerals from this locality are autunite, biotite, gehlenite, garnet, muscovite, quartz, triphylite, and zircon." As the presence of gehlenite in either the pegmatite or host rocks of the Lord Hill quarry would be geologically astonishing, a typographical error for galenite (= galena) or gahnite would be more believable.

GERSDORFFITE

NiAsS

Union - Harriman P

Gersdorffite has "rarely been observed" according to Rainville and Park (1976) when referring to the Union pyrrhotite body. Their study was based on polished sections of ore samples and the gersdorffite undoubtedly was better measured in microns than in millimeters. Gersdorffite from worldwide localities is silvery gray with metallic luster. The "species" has been split into three by Bayliss (1986) and it is unknown which ones occur at Union. No specimens known.

GIBBSITE

Al(OH)₃

Greenwood? - Harvard Q; Litchfield - Dennis Hill A

Landes (1925) wrote of montebrasite alteration from the Harvard quarry, **Greenwood**: "The nodules of amblygonite appear to have been converted into kaolin by concentric zones working inward. In the nodules pictured... the outer crusts are kaolin and sericite, but the core has not yet succumbed to this alteration. In other instances the center of the nodule is white and compact, with a conchoidal fracture. Here kaolinization has been more complete. A green crust also surrounds the kaolin core. ... Calculations on the constituents of the core indicate a mixture of mica 52 per cent (muscovite 40 per cent, lepidolite 12 per cent), kaolin 48 per cent and amblygonite 0.1 per cent. Calculated in the same way the green outer crust appears to consist of about 41 per cent kaolin, 31 per cent lepidolite, 0.3 per cent amblygonite

and 28 per cent bauxite." The use of bauxite as a synonym for gibbsite is not the real concern for this listing. The bauxite was calculated by subtracting chemical components reported in a chemical analysis and it would not be necessary for a calculated mineral to actually appear in the specimen for it to be listed in normative calculations.

Thugutt (1910) studied hydronepheline from **Litchfield** as well as several Norwegian localities and concluded that the fine-grained chalky white alteration of sodalite, called hydronephelite, was actually a mixture of natrolite (82%±), hydrargillite (gibbsite)(15%±), and diasporite (2%±).

glaucophane?

Berwick gneiss

Wandke (1922a) wrote of the Berwick gneiss: "Because of metamorphism some of the bands are now characterized by glaucophane. Associated with the amphibole are feldspar, quartz, biotite, chlorite, pyrite, and titanite." The mineral was undoubtedly identified based on optical properties in thin section. No supporting data were presented and in view of the unusual conditions of formation required by glaucophane, the species report should be regarded as a misidentification. Mapping by Hussey (1962, 1985) did not reveal the presence of any such mineral (andalusite is present as the metamorphic indicator mineral).

GLUCINE

CaBe₄(PO₄)₂(OH)₄·0.5H₂O

Paris - Mount Mica Q

Milky white blocky glucine, superficially resembling laueite, has been found in 1-2 mm crystals on earthy avocado-green mitridatite with fibrous white moraesite crystals (to 1 mm) associated with siderite in blue tourmaline eyes in cleavelandite from the Mount Mica quarry, **Paris** (Paul Moore, personal communication, 1990; Ron Januzzi, personal communication, 1991; Robinson and King, 1991a,b). No specimens available for observation. The original, and only other, locality is in the Ural Mountains, Russia.

*glucinite = hydroxyl-herderite

Hidden and Mackintosh (1884) proposed the name glucinite to cover the beryllium-rich mineral they had originally supposed was herderite. The definition of herderite, however, was changed to accept the beryllium composition. Glucinite eventually proved to be hydroxyl-herderite, but has priority as a name.

GOETHITE**FeO(OH)**

Blue Hill - Black Hawk M, Douglass M; **Brooksville** - Callahan M; **Concord** - Robinson M; **Deer Isle** - Little Deer Isle A; **Greenwood** - Beryllium Corporation Q, Harvard Q, Waisanen Q; **Houlton**; **Katahdin Iron Works** - Katahdin Iron Works M; **Linneus** - Drew Hill sulfide veins; **Lubec** - Lubec M; **Monson** - Holman Hill road Q; **Newry** - Bell Pit, Dunton Q, Martin P, Scotty Q; **Oxbow** - Cupsuptic River Q; **Paris** - Mount Mica Q; **Penobscot** - Annear M; **Rumford** - Black Mountain Q, Paint M; **Seal Harbor**; **Skowhegan** - Fifteen Mile Stream A; **Stoneham** - Lord Hill Q; **Swans Island** - Black Island A; **Sweden** - Saltman Q; **Topsham** - Consolidated #1 Q; **Trescott**; **Upper Cupsuptic** - Upper Cupsuptic Q; **Waterville** - Interstate Route #95 road cut; many bog iron locations

Goethite is an extremely common and widespread mineral. It is found in the earthy limonite variety in bog iron, etc. and is a component of the rusty staining on ledges, etc. Goethite is the common replacement mineral in pseudomorphs after pyrite crystals.

Goethite pseudomorphs after cubic pyrite crystals (to 1 cm) are found embedded in milky quartz at the Robinson mine, **Concord**.

Black spheres (2 mm) and botryoids (to 3 mm) are found in vugs in white and red-brown-stained quartz seams in rusty rhyolite on Little Deer Isle, **Deer Isle**. Some of the black spheres are individually perched on clear quartz crystals (4-5 mm) and further have minute quartz crystal druses on the surface of the botryoids. A light tan film of goethite sometimes separates the quartz from the main sphere surface.

Dark mahogany brown goethite pseudomorphs after pyrite cubes (to 1 cm) have been found in aplitic pegmatite at the Beryllium Corporation quarry, **Greenwood**.

The ochre from the Paint mine, **Rumford** undoubtedly contains abundant goethite, but the deposit will be discussed under hematite.

A 2 x 2 cm goethite pseudomorph after pyrite, with deep striations, from **Seal Harbor** is in the George Vaux collection at Bryn Mawr college, Pennsylvania.

Golden brown stellate sprays (2-3 mm) of goethite have been found as inclusions in muscovite at the Consolidated #1 quarry, **Topsham**.

Large (to 10 cm) botryoidal to stalactitic goethite was found in an excavation of the "south bound lane" of Interstate Route #95, near Mayflower Hill and Western Avenue, **Waterville**. The stalactitic growth (to several centimeters) can be dull to submetallic in luster and have a rough surface and friable texture, sometimes with a faint turgite coating. Internally, the stalactites do not show a fibrous texture, but seem more resinous with occasional brown color banding.

GOLD**(Au,Ag)**

Acton - Boston-Acton M, Dirigo M; **Albion**; **Alder Stream** - Alder Stream; **Andover** - Black Brook; **Appleton Township** - Gold Brook, Rock Pond A; **Ashland** - Machias River, Aroostook River; **Augusta**; **Avon** - Sandy River; **Bailey**; **Baileyville** - Hall Q, Saint Croix River; **Baring**; **Bethel** - Farwell Mountain A; **Biddeford** - Roberts Property; **Bingham** - Fall Brook, Johnson Brook; **Blue Hill** - Black Hawk M, Blue Hill M, Victoria M, White Star M; **Bowmantown** - Gold Brook; **Bradley** - Old Town Mining Company M; **Brooksville** - Callahan M; **Bucksport** - G. A. Rich M; **Byron** - Berdeen Stream, Mott Stream, Swift River East Branch, Swift River Main Branch, Swift River Stockbridge Branch, Swift River West Branch; **Calais**; **Caratunk**; **Carmel** - Harrington M; **Carrabassett Valley**; **Carrying Place**; **Chain of Ponds** - Gold Brook; **Chase Stream** - Gold Brook; **China**; **Columbia** - Harrington M; **Concord** - Robinson M; **Corinna**; **Cutler**; **Dallas** - Nile Brook; **Danforth?** - Bub Bailey P; **Dead River**; **Dennistown**; **Dennysville** - Birch Hill M; **Dexter**; **Dover-Foxcroft**; **Ellsworth?** - Eastern Star M; **Etna** - Friend farm; **Eustis**; **Exeter?** - French M; **Farmington**; **Franklin** - Clark M; **Gardiner**; **Gouldsboro** - Gouldsboro M; **Greenfield** - south part; **Hampden** - Lawrence M; **Hancock** - Cline M, Emmet M; **Harmony**; **Harpwell** - The Goslings [islands]; **Harrington** - Flint Island, Harrington M, Ripley Neck; **Haynes**; **Hiram**; **Jackson** - Jackson Gold M; **Kibby** - Gold Brook, Kibby Stream Main Branch, Kibby Stream Middle Branch; **Knox** - Stone M; **Lamoine** - Little Sue M; **Lang Plantation** - Pondsayer rapids; **Lincoln Township?**; **Lincolnvile** - Lincolnvile Gold and Silver M; **Livermore**; **Lowell** - Shorey M; **Madrid** - Oberton Stream, Perham Stream, Sandy River; **Magalloway** - upper Magalloway River, Sturtevant Stream; **Mapleton**; **Marshfield** - Bowker M; **Milbridge** - Cherryfield M; **Milford**; **Milton?** - Mount Glines M; **Moscow**; **Mount Abraham** - Oberton Stream, Quick Stream, Rapid Stream; **Mount Vernon**; **Newfield**; **New Portland** - Drew Stewart House A (1882); **New Sharon** - Sandy River; **Oakland**; **Ogunquit** - Josias River; **Orland** - Brook M; **Orrington**; **Palmyra** - Mineral Springs, stream near golf course; **Paris**; **Parmachenee**; **Parsonsfield** - Kezar Falls A; **Pembroke**; **Penobscot** - Annear M, Hercules M; **Phillips** - Sandy River; **Pittsfield**; **Pittston?** - Pittston M; **Prentiss**; **Prospect** - "gold" M; **Rangeley** - Nile Brook; **Rangeley Plantation** - Bog Brook; **Readfield**; **Riley** - Goose Eye brook; **Rockport?**; **Rumford** - Black Brook, Black Mountain A; **Saco**; **Saint Albans?**; **Saint John River** - head water; **Salem** - Quick Stream; **Sandy River** - Sandy River; **Shirley**; **Skinner** - Moose River; **Skowhegan** - Great Eddy of the Kennebec River; **Sorrento** - Golden Circle M; **South Arm** - Coldwater Stream; **Southwest Harbor** - Clark M, Steamboat Wharf A; **Steuben** - Pillsbury Stevens M; **Stockton Springs** - Cape Jellison A; **Stow**; **Strong** - Blue Ledge of the Sandy River; **Sullivan** - Ashley M, Brooks M, Sullivan M; **Swans Island** - Atlantic Village M, Swans Island M; **Thorndike** - Joseph Stevens P; **Trescott** - Trescott M;

Verona - Empire M; **Waterboro**; **Wesley** - Route #192 A; **West Paris** - Bacon Ledges A; **Willimantic** - "Granite mountain to Poverty mountain"; **Winthrop** - Towle M; **Woodstock**; **T3R5 BKP WKR** - Spencer Stream; **T5R6 BKP WKR** - Gold Brook, Spencer Stream; **T6 North of Weld** - Swift River East Branch, Swift River Stockbridge Branch; **T10SD** - Catherine Hill P; **T31 MD**

The occurrence of gold in Maine is well-known. However, True (1869) wrote: "Much has been said about the discovery of gold in Maine. The writer [N. True] has never been satisfied that he has ever seen a particle of gold found within the boundaries of the State of Maine. There is no reason, however, why it may not be found here as well as in the same geological formations in Canada, New Hampshire and Vermont." * *Specimens of Gold discovered near Portland are in the possession of Mr. L. Dennison of that city." Jackson (1838a), writing of Blue Hill, earlier warned: "If gold mines are really desirable, this rock is the most probable matrix in which the metal may be found - still, however, I should consider its discovery a great evil to Maine, since it invariably produces extravagant expectations, which are rarely realized, as may be seen in examining into the history of the gold mines of the southern states."

Stevens (1989) said that Maine gold was first discovered in Perham stream, Madrid/Mount Abram area in 1854. Hitchcock (1861) briefly discussed the discovery of gold along the Sandy River (into which Perham Stream eventually flows). Maine gold localities have been summarized by Schrader et al. (1917), Schofield (1875), Doyle (undated), S. Perham (1957b, 1963a), Morrill et al. (1958), Morrill and Hinckley (1959), and the Maine State Museum (1973). Pratt and Condon (1947) prospected the Swift River, **Byron** and reported on the distribution of gold along the East Branch. Burbank (1935) published a map entitled *Placer Gold Country* and briefly discussed a few occurrences. Smith (1904) reported that no gold was found in the best specimen that could be selected of the Pittston prospect, **Pittston**, and similarly the Bailey prospect, **Danforth** was declared to be unmineralized (Larrabee and Spencer, 1963; Larrabee et al., 1965).

Many of the reported Maine gold occurrences are based on assay values obtained more than 100 years ago, but there is considerable suspicion that most of the assay reports are fraudulent. Some of the assay values might be valid, but they should not give the impression that much visible gold has been found at any of the mines (see also discussion of galena assays). (Little attempt has been made to verify or discredit, with a question mark, the many relatively unimportant reports of Maine gold. Verified reports stand on their own merit. Unless gold has been specifically reported, mines with the name "gold" in them have not been listed.)

Lode gold, while distributed in small quantities in many Maine sulfide deposits, has yet to be found as good specimens of visible gold. Much has been made of finding the Mother Lode in Maine's gold panning fields. In reality, the known placer gold was probably very sparsely disseminated in the surrounding rocks, and the processes of erosion concentrated the gold in

stream sediments, cracks in ledges, etc. and the less dense material washed away. Anyone who has seen the Swift River after or during a storm or during spring melt will realize the enormous eroding power of the water. Research has begun to demonstrate that gold nuggets increase in size, by self-electroplating while in the stream, and that bacterial action is sometimes important in gold nugget formation.

No other mineral is so fraught with uncertainty and deception as gold. Misidentification is easy and often occurs. Bronzy altered biotite flakes are among the most common confounders. Chalcopyrite is also an excellent gold look-alike - it is somewhat soft, and while not truly sectile, can be scratched in a manner suggestive of gold. Pyrite, or "fool's gold", which is pale in color, hard, and brittle, is not a very good look-alike, by comparison. The color of gold lightens with increasing silver content.

The identification of gold can be easy, but the procedure is not generally recommended, as the specimen value of the gold would be completely lost and, therefore, most of the gold's value to collectors. (Gold nuggets generally sell for three times their bullion value to collectors and tourists, but exceptional specimens sell for a large premium.) Gold is malleable and easily fusible. It is soluble in aqua regia, but in no other common acid.

Gold nuggets, flecks, and fines ("color") are found over a large area in Maine in glacial and stream gravels. Gold nuggets sometime have bits of milky quartz embedded in them, but require magnification to view them. Gold panners will scoop "interesting" stream gravel into their pans, break up the lumps of clay, and wash away large rocks and pebbles so that any gold can settle in the pan. The circular agitation of the pan and its contents, along with the action of the water it is panned in, result in the denser particles settling to the bottom of the pan and the less dense minerals being shaken out of the pan. When the panning takes place in areas of, or downstream from, garnet-bearing rocks, residue in the pan can take on a red appearance due to garnet grains becoming concentrated in the residue. As the sand is carefully agitated out of the pan, the small volume of residual sand becomes black due to its being composed of black minerals such as magnetite, ilmenite, etc. Generally, the last stage of panning - down to black sand, has very much less than 0.01% of the starting weight of the mixture. At this stage, any gold present should be visible as small gold specks or nuggets. (Some panners use the standing water in gravel pits to pan for gold there.)

Occasionally, verbal reports have indicated that very unusual heavy minerals are found in gold pans. Dean McCrillis (personal communication, 1983) indicated that a lump of refined bismuth turned up in a Byron gold pan. Droplets of mercury have rarely been found in gold pans active along the Swift River, despite the cessation of using mercury as a gold scavenger there for nearly half a century (Joe Martin, personal communication, 1990). Gold Brook, **Chain of Ponds** frequently has goethite pseudomorphs after pyrite present in the heavy sand residue. Nile Brook, **Dallas** and **Rangeley** can have tiny flecks of iridescent indigo blue magnetite or ilmenite grains. Swift River, **Byron**, is in staurolite-bearing rocks, so staurolite crystals frequently show

up in the gold pans as does abundant garnet sand. Scheelite can be present in the magnetite heavy sand of the Swift River and very much resembles milky quartz which "shouldn't" remain so late in the panning process.

It was reported of the Appleton mine, **Appleton** (MMJ, October 15, 1880): "He showed us a specimen that he claimed was free gold and I presume he was correct, as he is an old California miner and not likely to be deceived in such matters."

Smith (1923) reported gold in the "black granite" exposed at Hall quarry, **Baileyville**: "... an assay by Carmichael, of Boston, shows it to contain a small percentage of gold. The papers that give formal evidence of these results, having, unfortunately, been misplaced, can not be cited here."

Though the Swift River area in **Byron** has received the most attention, panning can recover gold in many other streams. Stevens (1989) suggested that gold is found in over "Thirty rivers" in Maine. More than that number are listed here and this list cannot be considered comprehensive. Stevens (1989) gave an excellent account of the folklore of Maine gold. No commercial-scale gold mining or dredging occurs in Maine, but a considerable amount of recreational gold panning is done every year. Panners in earlier times were able to earn several times a day's average wages of a factory worker. The largest gold nugget in Maine which has been preserved and which is available for examination weighs 18.5 grams and was found in the gravel bank of the Swift River East Branch in Byron. It is now at the Maine State Museum. A gold nugget almost 1 cm long was panned near The Great Eddy, Kennebec River, **Skowhegan** (Ray Kincaid, personal communication, 1960). Reports of large nuggets by Stevens (1989) include one "larger than a thumbnail" from The Goslings, **Harpeswell**; a 4 ounce nugget from Pond-sayer rapids, **Lang Plantation**; and a $\frac{1}{2}$ ounce nugget from Quick Stream, **Salem**. A $1\frac{1}{4}$ troy ounce gold nugget was recently found on the East Branch of the Swift River, Byron (Cleus Stevens, personal communication, 1994). Except for the Skowhegan nugget, none of the above mentioned large nuggets were observed by the authors.

Perham (1957b), citing the *Maine Mining Journal*, wrote of **Greenfield**: "Some interest has been aroused by the discovery of gold bearing quartz in the south part of Greenfield, the surface rock assaying \$300 to the ton. It is thought by some experts that a vein of gold quartz exists in Milford, and runs thence westerly across the Penobscot at Veazie Falls, terminating near the Stillwater River." One specimen from Milford consists of an irregular gold grain (3 mm) in milky quartz. Although collected in 1991, the exact location is unrevealed. Morrill and Hinckley (1959) gave imprecise directions to the Old Town Mining Company mine, **Bradley**.

Bartlett (May 28, 1880) wrote of the Jackson mine, **Jackson**: "Next this is eighteen inches, possibly two feet, of crystallized quartz, containing nodules of hardened clay, iron pyrites, copper pyrites, zinc blende and galena, also *free gold*."

Foil gold (about 1 x 1 cm) in milky quartz matrix has been found in **Kibby Township** and has been supposed to have been

found as a loose rock along the upper main branch of Kibby Stream (Perham, 1963a). Large milky quartz boulders with rusty streaks which could be gold-bearing are abundant in the main branch of Kibby Stream. The Hardin prospect, Kennebago, **[T3R4 WBKP?]** has produced 1-2 mm grains of gold in milky quartz associated with chalcopyrite and covellite (BC collection).

Seaman (1975b) wrote: "GOLD has been noted as the native metal in pegmatite at the old Glines Mine in Oxford County, Maine, together with quartz, apatite, and pyrite." Given the report on galena (q.v.) by Smith (1904), it is unlikely that gold was actually found at the Mount Glines "Gold" mine, **Milton**.

Small gold/platinum "half-breed" nuggets have been reported as early as 1880 (Bartlett, August 6, 1880) from Nile Brook, **Rangeley** and **Dallas**, which flows into Rangeley Lake:

"During the spring and summer months, Mr. R. B. King of this city, has given considerable attention to the exploration of the Rangeley region and as a result of his work had succeeded in finding gold in many places especially on Nile's brook and the small streams near the foot of the lake. Mr. King has quite a quantity of gold that he and his assistants have washed out of the black sand in that country and he is strongly of the opinion that a profitable business might be commenced with a small outlay of capital. The gold is rather coarse than fine, some nuggets having been found weighing two of three pennyweights. Mr. King noticed amongst the gold many grains of a silver white color and in some instances one-half of a nugget would be gold and the other half apparently silver. This led him to have an analysis of the grains in order to satisfy himself regarding the composition of these peculiar nuggets which seemed not to be an alloy but had every appearance of being welded together though at the same time they were different in color and hardness.

My analysis proved the compound to be gold, platinum and iridium and possibly osmium and some others of the rarer metals, although no tests were made for anything but gold, platinum and iridium, the quantity not being large enough to operate on in testing for other metals which at best occur only in minute quantities, yet usually associated with the platinum ores."

One such "half-breed" nugget about 3 mm has recently been reported (Stella Stevens, personal communication, 1990), but no gold/platinum nuggets have been available for examination by the authors (see platinum). (There are no other reported gold and platinum half-breed nuggets in the world.) Ordinary gold nuggets from Nile Brook are generally up to 3 x 3 mm.

Hannaford (1949) wrote of the road into the Black Mountain quarry, **Rumford**: "Dr. Galpin and others found gold around in the brook, and in my field when I was digging out the bed of a brook." While no gold nuggets high on the slope of Black Mountain are known, small nuggets (to 4 mm) are found in Black Brook flowing northwesterly along Route #120 toward Andover.

Visible gold in milky quartz matrix (1-2 mm) has been found at the Golden Circle mine, **Sorrento** associated with tetradymite cleavages (2-3 mm) (HU collection). A report con-

cerning the Golden Circle mine, Sorrento (MMJ, February 25, 1881) was intriguing: "Received this day box of fine specimens of gold ore from Golden Circle mine, all of which show free gold. One piece showing over fifty small particles of gold; another piece showing a fine gold crystal which is a rare specimen." The whereabouts of these specimens are unknown. Many reports of gold from the Golden Circle mine are found in the MMJ, one in particular (May 27, 1881) indicated: "The gold brick, weighing over 200 pennyweights, produced from Golden Circle ore, has been on exhibition during the past week in the window of Carter Bros' jewelry store, 521 Congress st., Portland, where it has attracted much attention." Problems with the ore were admitted (MMJ, May 27, 1881): "In the real ore I found a large percentage of bismuth and tellurium, which are always very detrimental to the amalgamation of gold by free milling process..." and "But it was shortly discovered that a large proportion of the gold in the rock was alloyed with other metals and could not be saved by the ordinary process of amalgamation" (MMJ, November 4, 1881).

In addition to the above mentioned Gold Brooks, there are streams of the same name flowing into Baker Stream, **Appleton Township**; flowing into McKee Fork of Second East Branch Magalloway River, **Bowmantown**; and flowing into Chase Stream, **Misery**. Recently, a large nugget, "just under one ounce" was found on Gold Brook, **Appleton Township** (Rodney Harn-den, personal communication, 1990).

It should be noted that many of the towns in the Maine goldfields are owned by private wood-products companies. They are closed to the public and permission for access must be obtained, in writing, before entry. Permission cannot be obtained at the gates in the towns of interest. Some privately held towns have granted entry only on an emergency basis or as a courtesy for governmentally sponsored scientific research. Gates, barriers, removed bridges, etc. are generally indicated in the most current edition of *The Maine Atlas and Gazetteer*, but access to a particular town should be researched and local inquiry near the off-the-road embarkation point should always be made. Barriers can quickly be changed during a logging season, etc.

gold telluride?

Sorrento? - *Golden Circle M*; **Sullivan?** - *Ashley M*, *[Mill]Brook M*, *Sullivan-Waukeag M*

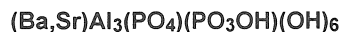
Kempton (1879) reported of **Sullivan**: "In the Brook shaft some telluride ore has occurred, but not enough in quantity to enable the mineral to be identified. It carries both gold and silver. In the Ashley the same occurred, sparingly..." The Waukeag mine, later Sullivan and Waukeag mine, Sullivan also claimed gold telluride (MMJ, December 3, 1880): "The gangue is a fine grained quartzite, carrying black sulphurets of silver, and is beautifully coated with bright native silver flakes with spots of telluride of gold."

It was reported of the Sullivan (Sullivan-Waukeag) mine (MMJ, July 1, 1881): "The vein matter of the Sullivan lode is

mostly quartz, much of which is tinted with chlorite, heavily charged with fine sulphurets of iron, and carrying, near the surface, argentiferous galena, zinc blende, sulphuret of copper and native silver. ... Ruby and native silver are found in greater quantities, minute particles of telluride of gold are occasionally visible, while the sulphurets are of finer grade and chlorides or horn silver and antimonial silver have made their first appearance at the mine." Only one specimen of native silver remains to represent the precious metals of the Sullivan ore. (Given the extent of "puffery" and fraud associated with the silver mining boom, the acceptance of the reported minerals should wait for valid specimens.) No "gold telluride" specimens are known from Sullivan, however.

The Golden Circle mine, **Sorrento** has native gold and "telluride ore" in the form of tetradymite (q.v.), but Morrill and Hinckley (1959) also list gold telluride. Early reports only specify (MMJ, June 25, 1880): "He has also ascertained that the metal which has hitherto been supposed to be molybdenum is *tellurium*, and very rich in gold" and (MMJ, May 27, 1881): "In the real ore I found a large percentage of bismuth and tellurium, which are always very detrimental to the amalgamation of gold by free milling process..."

GORCEIXITE (Crandallite Group)



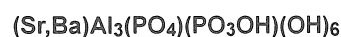
Buckfield - *Bennett Q*; **Newry** - *Bell Pit*

Bennett quarry, **Buckfield** has produced some world class gorceixite/goyazite crystals (7 mm). A grouping (1.5 x 1 cm) of 2-3 mm crystals without matrix is also known. The mineral probably formed within or adjacent to large (to several meters) quartz crystal cavities. The tan to cream-colored pseudocubic gorceixite/goyazite consists of a dominant rhombohedron in combination with small high-angle rhombohedral faces. The large rhombohedron faces show multiple growth features partly due to etching. The mineral is not uniformly intermediate between gorceixite and goyazite, but consists of alternating barium- and strontium-rich zones (Brownfield and Foord, in press).

Gorceixite crystals (to 2 mm) occur as pseudocubic clear crystals, with alternating barium and strontium-rich zones, in quartz and siderite matrix and are visually indistinguishable from goyazite from the Bell pit (Brownfield and Foord, in press).

goshenite - transparent colorless beryl, usually alkali-rich

GOYAZITE (Crandallite Group)



Buckfield - *Bennett Q*; **Greenwood** - *Harvard Q*; **Hebron?** - *Lower Mount Rubellite Q*; **Newry** - *Bell Pit*, *Rose Quartz Crystal*

L?; Paris - Mount Mica Q; Rumford - Black Mountain Q?, Ford Hill Q; Stoneham - Lord Hill Q

Goyazite is a rare phosphate generally restricted to pegmatites. At one time hamlinite was the preferred name. The change of the name hamlinite to goyazite has been somewhat of a mystery to many Maine collectors. Hamlinite was first named in 1890 by Hidden and Penfield using Lord Hill quarry, Stoneham crystals. They said, "Shortly following the announcement of herderite from Stoneham, the mineral, which we are about to describe, was detected by one of us occurring as minute rhombohedral crystals attached to the herderite and margarodite and associated with a mineral which was subsequently identified as the rare beryllium silicate, bertrandite. As the crystals were observed on only a single specimen and would not have weighed much more than 0.01 gram, if they could have been successfully detached from the matrix, it seemed imperative that more material should be obtained before commencing any investigation. During the past five years, therefore, we have kept up a diligent search for the crystals, examining carefully every available herderite specimen; we have informed various mineralogists of the occurrence of a probably new rhombohedral mineral, requesting them to examine the specimens in their own collections, but as up to the present time no success has attended our efforts we feel warranted in giving as complete a description as possible of the material in hand. We hope that in the future sufficient material may be obtained for a complete chemical investigation. We shall, moreover, consider it a great favor if the readers of this article will carefully examine the specimens of herderite which may be in their possession and aid us in securing the necessary material." The crystallography was described and figured and it was revealed that the mineral was a phosphate, probably of beryllium and aluminum containing fluorine, based on their micro-chemical tests and the mineral association. In 1897, Penfield analyzed some material from a new locality described as from "Oxford County, Maine" and submitted by Lazard Cahn. From historical reasoning, the locality Penfield (1897) had specimens from probably was the prospect later known as the Harvard quarry, Greenwood. The crystals showed an unusual variant morphology and the composition was determined to be $(\text{Sr}, \text{Ba})\text{Al}_3(\text{OH}, \text{F})_7\text{P}_2\text{O}_7$. Hussak (1906) had studied material from the goyazite lot described by Damour (1884) and demonstrated a strontium-rich, not calcium-rich, composition of the particular grains he studied. Instead of discrediting the poorly described goyazite material, Hussak (1906) suggested that the name goyazite be resurrected to cover the strontium-rich members of the series which had been correctly analyzed and had been called hamlinite. It was not obvious, in 1897, or even ten years later, that hamlinite was in any way related to goyazite. Solly (1904, 1905) discovered a "new" mineral from the Lengenbach quarry, Binn, Switzerland, which he called bowmanite. In 1907, Bowman, himself, correctly discredited the mineral as being identical with hamlinite.

While the U. S. nomenclature has more or less conformed to the suggested change, European mineralogists have continued the hamlinite usage. The nomenclature of the group is further entangled when one considers that Farrington (1916) studied the Brazilian favas, containing the minerals of interest, and found them to be highly variable in chemical and mineral composition from one grain to the next, with many "goyazite" grains actually being barium-rich (i.e. gorceixite). Additionally Farrington (1916) and Schaller (1912a, 1917a) reviewed the problem of what hamlinite and goyazite really were.

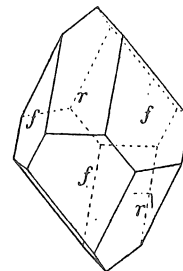
As an extension of a study of the alunite/beudantite group, Loughlin and Schaller (1917) named the mineral crandallite, the composition of which had been formerly occupied by the mistaken(?) original analysis of goyazite. As Hussak (1906) had recommended dropping hamlinite as a species, Loughlin and Schaller (1917) followed the recommendation. They unequivocally demonstrated that the calcium-rich niche occupied by the original goyazite analysis was vacated, by redefining goyazite as a strontium-rich mineral, and then they refilled the calcium-rich nomenclatural niche with their new species, crandallite.

Description of Specimens

Care should be exercised in identifying goyazite. It is generally pseudocubic, but can resemble pseudocubic siderite; both species can have nearly identical, very complex crystal habits on the same specimen.

Bennett quarry, **Buckfield** has produced some world class goyazite/gorceixite crystals (7 mm). Masses (1.5 x 1 cm) of 2-3 mm crystals without matrix are also known. The tan to cream-colored pseudocubic goyazite/gorceixite consists of a dominant rhombohedron in combination with small high-angle rhombohedral faces. The large rhombohedron faces show multiple growth features. The mineral is not uniformly intermediate between goyazite and gorceixite, but consists of alternating barium- and strontium-rich zones (Brownfield and Foord, in press).

Goyazite has been found at the Harvard quarry, **Greenwood**. It was the second locality for what was then called hamlinite and the one which provided the first accurate chemical analysis of the species based on a variety of information including data from the first article on the species hydroxyl-herderite (Penfield, 1894). The locality was first announced simply as



Goyazite, Harvard Q, Greenwood (from Penfield, 1897)

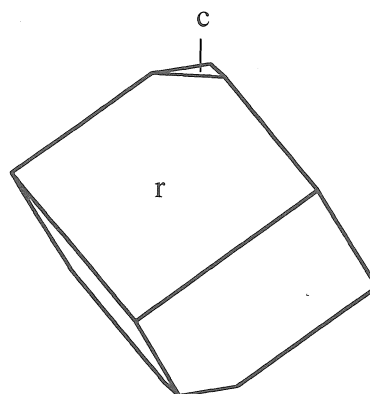
"Oxford County, Maine." The definition of hamlinite was extended by Penfield (1897):

"The crystals are implanted upon feldspar and muscovite and are associated, like the ones from Stoneham, with apatite, herderite and rarely bertrandite. The crystals present two prominent habits: One a combination of the rhombohedrons r , $10\bar{1}1$ and f , $02\bar{2}1$, developed as shown by the accompanying figure. On the crystals there are occasionally small basal planes and slight horizontal striations on the rhombohedral faces near their junction with the base. The other habit is essentially a combination of the hexagonal prism of the first order, $10\bar{1}0$, with the base, but, owing to a vicinal development and rounding, the prismatic faces have a tendency toward a steep rhombohedron, and the basal planes are marked by triangular prominences.

The crystals attain at times a diameter of 3 to 4^{mm}, but are not well adapted for measurement owing to the vicinal character of the faces."

Hamlinite, in the Brush collection at Yale University, is represented by the original specimen from Stoneham, still unanalyzed, and by specimens from the Harvard quarry, Greenwood, which appears to be the only locality for goyazite in that town. The Greenwood specimens currently viewable in the Yale collection were supplied about 1908 by Lazard Cahn who supplied the material more than ten years earlier for the chemical analysis. The initial lack of locality information comes from the discovery time of the quarry, itself, at a point when it still did not have a locality name. (In its earliest years, the locality was usually called the Noyes Mountain locality. As more quarries and prospects began to appear on Noyes Mountain, a more specific name was needed, but one did not appear until Harvard University purchased the locality for the purposes of specimen recovery and scientific investigation, about 1922.) The transparent crystals (usually 1 mm) show positive and negative high-angle rhombohedra implanted on the etched edges of muscovite crystals and on albite crystals in cleavelandite and blocky albite. The habit of specimens includes the shape illustrated by Penfield (1897) as well as the nearly equal development of the forms giving a horizontal "girdle" line straight around the crystal. White to gray fluorapatite crystals (1 mm), sometimes with Hebron-style morphology, and light tan hydroxyl-herderite crystals (5 mm) are associated.

At the lower Mount Rubellite quarry, **Hebron** hydroxyl-herderite has been erroneously called goyazite and occurs as very pale sulfur-yellow pseudocubic crystals (1 mm) in slightly yellow-stained pink lepidolite with tiny elongated quartz crystals (2 mm) in cleavelandite. Bjareby (1955) wrote: "In looking over micro material collected at Mount Rubellite, Hebron (Oxford Co.), Maine, many years ago, I found several specimens having the rare mineral goyazite. It occurs well xld in vugs in the lepidolite together with xld herderite and fluorapatite of the so-called Hebron type xl with basal pinakoids [sic] and pyramidal faces but without the prism faces. The goyazite from this locality shows the finely pitted surfaces lending a velvety sheen to the xls. This characteristic etching has been observed on



Goyazite, Bell Pit, Newry

goyazite from other New England localities. The color is pinkish yellow. This species has been known as hamlinite and bowmanite." Specimens from this find have been identified (chemical analysis and XRD, this study)

Clear to pale green pseudocubic goyazite (to 3 mm) at the Bell pit, **Newry** is found in the siderite assemblage as well as in etched quartz vugs while a few goyazite crystals have been observed on albite crystals. The crystals occasionally have tiny "c" pinacoids and horizontal striations can sometimes be discerned on the rhombohedra. Some very inconspicuous Bell pit goyazite crystals (to 0.3 mm), even using high magnification, consist of tan composite tabular crystals in parallel growth. The composite crystals not only resemble foliated stacks, but also have lobate to crenulated margins. The side of the stacks have a dull luster while the pinacoid is glistening. Eosphorite (to 2 mm) and quartz crystals (to 1 mm) can be associated in the vugs in quartz and albite matrix.

Goyazite has yet to be found at the Rose Quartz Crystal locality, Newry. One specimen (Bjareby #3153) consists of misshapen and broken montebrasite crystals (to 2 mm) in albite vugs.

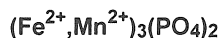
A 6 mm "goyazite" was found at Black Mountain quarry, Rumford (G. Bjareby to Orman McAllister, written communication, January 30, 1955). A large 6 mm specimen from the Bjareby collection which has been identified as hurlbutite (q.v.) (Sidney A. Williams, personal communication, 1986) may have been the specimen of this report. Recent finds of "goyazite" from Black Mountain quarry have been shown to be the new species kosnarite (q.v.). No verified specimens known. Francis et al. (1993) continued the listing of Morrill et al. (1958).

Goyazite specimens from the Ford Hill quarry, **Rumford** are highly frosted cubes (to 2 mm), which are occasionally elongated in the direction of one of the pseudo-cube faces. The color varies from gray to tan and can be associated with gray tabular to prismatic fluorapatite crystals (to 2 mm) and brownish black massive sphalerite in albite vugs (Bjareby #489).

Straw-yellow pseudocubic rhombohedra (to 3 mm) of goyazite with tiny "c" pinacoids have been found at Lord Hill quarry, **Stoneham**. The type specimen of hamlinite (YU 2329)

is rhombohedral (to 1 mm) with a large "c" pinacoid and is found on euhedral muscovite crystals (1-3 mm) which formed in crystal cavities and which have a yellow green rim and associated platy "brushes" of white bertrandite (to 1 mm).

GRAFTONITE



Greenwood - Waisanen Q

Graftonite is known from few specimens from the Waisanen quarry, **Greenwood**. The mineral (USNM #0103008) was originally identified by Glass and Fahey (1937) and further studied by Lindberg (1950). The 3 cm sliver (USNM #0103008) is composed of oily to vitreous, pinkish-brown ("ochre-salmon") massive graftonite without visible banding of triphylite or other minerals, as would be typical of New Hampshire graftonite. The mineral could be mistaken for triplite, garnet, or lithiophilite. Although the specimen is small, the following minerals were observed on the piece: quartz, albite, muscovite, chlorite, "calcite," pyrite, sphalerite, arsenopyrite, and triphylite. (Glass and Fahey (1937) stated the locality was the "Tamminen-Waisanen Ledge," now simply called the Waisanen quarry, and suggested that this was a quarry described by Landes (1925). In fact, the Waisanen quarry had not yet been exposed in the 1920's and the specimens described by Landes (1925) are easily recognizable as Harvard quarry specimens.) Two other specimens contain no carbonate or sulfides, but show some blue-staining by vivianite and one has pale green beryl (Neil Wintringham, personal communication, 1992).

GRAPHITE

C

Augusta; Bangor; Bath; Belfast - disseminated in slate; **Bethel; Blue Hill; Bowdoinham; Brooksville; Brownville; Brunswick; Buckfield** - *Bennett Q*; **Camden; Canton** - *Canton Mountain A, Reynolds M*; **Cape Elizabeth; Carthage** - *Briggs and Saunders M*; **Charlotte; Dixfield; Dover-Foxcroft; Farmington; Freeport; Gardiner** - *Kennebec River banks?, U.S. Route #201 road cut on Iron Hill*; **Georgetown** - *mine*; **Greenwood** - *Deacon Potter estate, Rush Ledges A?*; **Hampden; Lebanon; Lewiston** - *City Q*; **Lincolnton; Litchfield; Lyman** - *Goodwins Mills A*; **Madrid** - *New Madrid (=Phillips?)*; **Marion; Marshfield; Monmouth; Monson; Newry** - *Plumbago Mountain?, Puzzle Mountain M?*; **North Blanchard; Norway; Ox-bow** - *Cupsuptic River Q*; **Paris** - *Crocker Hill A*; **Peru; Phillips** - *Maine Graphite M*; **Phippsburg** - *mine*; **Pittston; Poland** - *Berry-Havey Q*; **Portland** - *Great Diamond A, Munjoy Q*; **Pownal** - *Merco Q*; **Presque Isle; Raymond** - *Dodge Mountain A*; **Readfield; Rockland; Rumford; Sabattus** - *west of Sabattus Pond*

A; Sandy River Plantation; Sangerville - *Center Pond A*; **Scarborough; Searsmont; Sebago; Sumner; Thomaston; Turner; Union** - *Harriman P*; **Vinalhaven** - *mistaken for coal by Jackson?*; **Warren** - *Warren Nickel P*; **West Paris** - *A. C. Perham Q*; **Windham; Woodstock; Yarmouth** - *pegmatite northwest of village*

Graphite is widespread in Maine and is usually disseminated in schists, slates, or phyllites. It is rarely discernible in hand specimens (Dale et al., 1906). Many of the above listed occurrences from Morrill et al. (1958) and Morrill and Hinckley (1959) are low-grade occurrences in rock formations with no specific locality implied. Good graphite does sometimes occur in concentrations or lenses. Burr (1938), Seaman (1975b), Trefethen (1945), and Schrader et al. (1917) list many towns with graphite. Ekren and Frischknecht (1967) report the following for the Grand Pitch Formation, **Merrill, Moro, T6R6 WELS, T7R4 WELS, T7R5 WELS, and T7R6 WELS**: "X-ray analysis... indicates that the carbon in the slate is not graphite." The carbon was amorphous to X-rays and, by definition, is not a mineral. Smith (1906) and Fisher (1934) noted graphite in Maine granite pegmatites.

Graphite from the Bennett quarry, **Buckfield** is very rare. It is known in at least one specimen (Bjareby #434) of 2-3 mm rounded gray plates in microcline with quartz.

Byron has foliated graphite which is unusually hard and approaches the variety shungite. One specimen of indefinite provenance has hard, not particularly unctuous graphite in a 3 x 5 x 2 cm "vein" as well as intergrown "dots" and linings between muscovite, quartz, and albite grains (to 1 cm).

A graphite-"rhombohedral carbonate" schist has been rumored in **Carthage** at the Briggs and Saunders mine area. A graphite specimen from an unspecified area in Carthage consists of foliated graphite intergrown with rhombic, nearly adamantine, muscovite flakes (to 6x6 cm) with occasional tourmaline prisms (to 1x4 mm).

Forsyth (1955c) while describing the pyrrhotite body found in the U.S. Route #201 road cut through Iron Hill, **Gardiner** said: "Graphite is present in the rocks as fine disseminated grains and also as clusters within the pegmatites."

Hamlin (1826) reported on graphite from **Greenwood**: "This occurs in Greenwood about six miles from here, in a north-westerly direction, and is found attached, from one eighth of an inch to one inch in depth, to the surface of a coarse granite, and occasionally very much mixed up with the black tourmaline. Sulphuret of molybdena is also found in the same ledge, in connexion with sulphuret of iron." Jackson (1838a) also noted:

"We visited the town of Greenwood, and near that town upon the estate of Dea[con?]. Porter, I obtained some specimens of bog iron ore....

There is a remarkable vein of plumbago, or graphite, near this place, included in a vein of granite, which intersects the gneiss... The plumbago is of fine quality, and suitable for drawing pencils, but it occurs in a very hard rock, and in comparatively small quantity. We

obtained some specimens 3 inches long, by 2 inches thick, but they are difficult to procure."

Putnam and Perham (1969) noted in Greenwood: "Lead from Rush Ledges at Locke Mills; Southeast areas."

A most unusual occurrence of graphite flakes (to 5 cm, but usually 1-3 mm) in microcline-albite-quartz pegmatite intruded in limestone is found at the City quarry, **Lewiston**. Fisher (1934) said: "Graphite is distributed rather uniformly through all the pegmatite sides. ... There are several occurrences of graphite in feldspar cleavages, the graphite showing a greater affinity for altered feldspar than for fresh plates. Boundaries between anhedral quartz grains are crossed by the graphite... Where associated with zoisite the graphite shows fairly sharp boundaries, although there are a few scattered grains of zoisite that include apophyses of graphite." Associated species include small almandine crystals (to 3 mm) and biotite.

Graphite has long been reported from Plumbago Mountain, **Newry**. Morrill et al. (1958) place a marker for a graphite locality on the summit of Plumbago Mountain, but the authors have met no one who has been there and no one who has found a graphite specimen on the mountain. A lump specimen (3 x 5 cm) has been observed with an old paper label attached indicating it came from Newry. The lump was pure and much rounded by handling. True (1869) while discussing laumontite said: "This rare mineral is found at the Plumbago mine, on Puzzle Mt., in Newry." Additional specimens (3x4 cm, 7 x 8 x 1 cm) from the Edmund Bailey collection (UMO #2624, UMO #2873) consist of foliated graphite with a botryoidal turgite coating with orange iridescence as well as orange to pale yellow limonite. A few prisms of amphibole? are included in the graphite. The graphite probably comes from graphite-rich lenses in the Smalls Falls Formation (Charles Guidotti, personal communication, 1990). No "graphite mine or prospect" was reported by either Milton (1961) or Moench and Hildreth (1976) in the course of their mapping. Though well embedded in Maine mineral folklore, the Plumbago Mountain occurrence should be considered "lost," if not mythical (see Newry laumontite discussion).

The contact action of the quartz crystal veins in the Cup-suptic River quarry, **Oxbow** produced small lenses, films, and impregnations of silvery gray graphite frequently intergrown with silvery muscovite along and in the vein margins.

Crocker Hill area, **Paris** has graphite interleaved with tan to white microcline (to 1 cm) along with fine-grained chlorite. The graphite can occur in foliae 4 x 7 x 2 cm. A "molybdenite" mine was established on Crocker Hill (Hess, 1908), but graphite was the primary look-alike component of the rock removed.

The Maine Graphite Company mine, **Phillips** was first reported (MMJ, June 25, 1880): "What has every appearance of being a valuable deposit of this mineral, commonly called plumbago, has recently been discovered in the town of Phillips, near the Madrid line, and about 100 rods distant from Sandy River... A prospecting shaft has already been sunk to a depth of about 18 feet and 15 to 20 tons of ore have been taken out. The opening

made shows a vein at least six feet in width... The quality of the ore improves rapidly as depth is reached. A crew of men are now at work..." Smith (1906) reported: "The graphite occurs locally in the schist, always close to the contact with the white rock, with the exception of the sporadic occurrence of a few slickensided lenses of graphitic rock, about 18 inches in their longer diameters. At no place seen in this rock cut did the graphitic portion of the schist extend more than a few inches from the contact. At the point in the face of the cut where the two bodies of pegmatite are nearest together the schist is crumpled and crushed into blocks which appear to be largely graphite. However, all of the schist is not strongly graphitic at the pegmatite contact." The mine was located "along the northern slope of a hill immediately south of the village [Madrid]" just into Phillips. The schist away from the mine area towards Route #4 is also graphitic, frequently with speckles of 1-2 mm graphite flakes along with occasional staurolite crystals (to 4 mm). Moench (1971) located the Maine Graphite Company mine.

A small prospect about 100 m south of the Berry-Havey quarry, **Poland** has sparse radially foliated graphite (to 1 cm) in fine-grained pegmatite.

Graphite found in "street construction," **Portland** consists of discontinuous pure bands (to 1.5+ cm) in quartz-plagioclase gneiss.

Fisher (1933) wrote of **Sabattus**: "The area referred to is located in the Lewiston quadrangle, central rectangle, on the western slope of a low hill bordering Sabattus Lake on the west. A road leads northwesterly from the village of Sabattus and at a point one and two-tenths miles from the village an old logging road enters the woods to the east. The old mine prospect is located on the continuation of this road near the top of the hill. ... The schists carry considerable graphite. The mine was worked by trenching. A long trench cut down the hillside slope is now overgrown with brush but it can be traced for more than 100 feet. Several smaller trenches branch off from this main one. Large piles of rocks on the dump indicate past mining activity. None of the rocks on the dumps showed any black minerals except graphite and schorl. ... The materials obtained from the mine during its period of operation were sold to a firm that made shoe and stove polish."

The graphite at the Harriman prospect, **Union** and the Warren Nickel prospect, **Warren** was described by Rainville and Park (1976): "The occurrence of significant amounts of graphite in this deposit distinguishes it from other nickeliferous pyrrhotite deposits, except Kotalahti, Finland ... and Duluth, Minnesota. As much as 6.6 modal percent of graphite is found in a single section of ore-bearing gabbro, although a few sections show no appreciable amounts of graphite. ... Graphite occurs as botryoidal masses, individual laths, and more commonly, as a mass of stringerlike grains. Frequently it is associated with shattered sulfides, and it fills in and surrounds these sulfides. Some of the graphite has contoured itself to the sulfide grains and is locally folded ..." The grains they describe were seen in thin sections of rock and the graphite features described are generally smaller in

overall magnitude than 1 cm. Intergranular graphite films (to 0.5 mm thick by several mm) with dull to glimmering luster are found in lightly iron-stained albite masses (to many cm). The edge of the graphite films shows small cleavages.

Smith (1906) reported on graphite in granite pegmatite "about one-half mile northwest of the village" of **Yarmouth**. "This pegmatite has been prospected at several points within 200 yards and occurs in the form of a dike with an average width of 1 foot. ... Small amounts of mica occur, but only sporadically, while graphite is an important constituent. A few nests of graphite about an inch in diameter occur in the pegmatite, but the most of the graphite is in the form of disseminated flakes evenly distributed throughout the rock."

gray copper - tetrahedrite or tennantite

GRAYITE (Rhabdophane Group)

$\text{ThPO}_4 \cdot \text{H}_2\text{O}$

Topsham - *Havey #1 Q, Havey #2 Q*

Grayite occurs at the Havey #1 and Havey #2 quarries, **Topsham** (Cliff Trebilcock, personal communication, 1991; Robinson and King, 1993a,b; King, 1994; chemical analysis, XRD, this study; chemical analysis, XRD, Carl Francis, personal communication, 1994). The grayite is bright intense resinous to waxy yellow in quasi-pyramidal grains (to 2 mm) embedded in pale pink-tinted oligoclase and dark smoky quartz. Monazite-(Ce), xenotime-(Y), and zircon can be associated. Both grayite and thorogummite fluoresce yellow-green in short-wave ultraviolet light and can be indistinguishable in sunlight.

GREENOCKITE

CdS

Brooksville - *Callahan M; Casco* - *Mount Quito M; Cornish* - *Berry Ledge L; Newry* - *Bell Pit; Sanford* - *600 Meter P*

Greenockite is found as small (to 2 mm) thin yellow patches on quartz and sphalerite matrix from the Callahan mine, **Brooksville** (Gardiner Gregory, personal communication, 1989; also Gregory, 1969).

Bell Pit, **Newry** greenockite is very inconspicuous. It forms tiny (1 mm) yellow patches in fine-grained siderite, sometimes with montebasite in the matrix. Orange-brown massive sphalerite grains (1-2 mm) can be associated.

Greenockite from the 600 Meter prospect area (northwest of the Webster prospect), **Sanford** forms bright yellow powdery to waxy stains investing quartz and almost colorless fluorite grains associated with diopside, vesuvianite, and abundant brownish black sphalerite cleavages. The greenockite does not

particularly confine itself to the margins of the sphalerite, but is found at some millimeters distant without continuous extent. The "patches" stain areas up to 3 x 5 mm.

GROSSULAR (Garnet Group)

$\text{Ca}_3\text{Al}_2(\text{SiO}_4)_3$

Andover; *Aroostook River near Washburn road; Ashland* - *Ashland-Sheridan Road A; Auburn* - *Pulsifer Q; Bath* - *Jones Eddy A, Town Q?*; **Bethel** - *Mount Farwell A; Blue Hill* - *Route #172 road cut; Carthage; Casco* - *Chute P; Cornish* - *Berry Ledge P, Day Hill P, Pease Mountain A; Cushing; Farmington* - *Route #2 road cut Farmington Falls; Gray; Hebron; Hildreths Formation* - *Byron, Carthage, Mexico, Roxbury, Rumford, Weld, 6 North of Weld; Limerick; Linneus* - *Meduxnekeag Lake A; Madrid Formation-lower member* - **Andover**, **Hanover**, **Newry**, **Roxbury**, **Rumford**; **Milton**; **Minot** - *LaFlamme Q, Pitts-Tenney Q; Newfield; Newry; Paris; Parsonsfield; Phippsburg* - *The Basin (not the Basin pegmatite quarry); Quimby Formation* - **Dallas**, **Rangeley**, **Rangeley Plantation**, **Sandy River**; **Raymond** - *Camp Hinds L, Szenics P; Roxbury; Rumford* - *Ski Slope Hill; Sanford* - *Webster P, 200 Meter P, 600 Meter P; Shapleigh; Standish; Warren* - *Middle Road A; Washburn Ferry A* - **Mapleton**, **Presque Isle**, **Washburn**; *Waterville Formation, Woodland Formation* - **Alexander**, **Crawford**; **Woodstock** - *East Woodstock A, Perry Garnet L*

Grossular is generally restricted to calc-silicate rocks in Maine, but is also found in some calc-schists. Hussey (1971c) wrote: "... nearby exposures of the Berwick Formation on the opposite (west[]) side of the Nonesuch River fault where hornblende, diopside, and grossularite garnet are frequently present indicating probable staurolite or higher grade of metamorphism." Ludman (1986) described grossular in thinly bedded calc-silicates of the Woodland Formation, **Alexander** and **Crawford**, while Moench (1969) described calc-silicate beds in the Quimby Formation, **Dallas**, **Rangeley**, **Rangeley Plantation**, and **Sandy River** which contained fine-grained grossular. Moench also wrote of the lower member of the Madrid Formation, **Andover**, **Hanover**, **Newry**, **Roxbury**, and **Rumford**: "The calc-silicate rocks are calcareous metasandstones composed of varied assemblages of quartz, calcic plagioclase, microcline, clinozoisite, pink grossular, idocrase, pale hornblende, actinolite, and diopside." Gregory (1900) wrote of a volcanic tuff near the Ashland - Sheridan road, **Ashland**: "The most unusual feature about the rock is the presence within the trachytic parts of aggregates of grossular garnets in well-developed crystals and irregular grains." Cheney (1967) indicated grossular development in calc-silicates of the Middle Road area, **Warren**. Osberg (1980) indicated that grossular would be expected in calcareous portions of the Waterville Formation which were subjected to high metamorphic grade.

Schlegel (1957) wrote: "Beautiful essonite has been found in Andover, Maine..." No specimens are known from this "lost" locality.

Dodecahedral brown opaque to translucent grossular crystals (to 3 cm) in quartz occur in layers (to 4-5 cm) that are found in rocks "near" the Pulsifer quarry area, **Auburn**. Seaman (1975b) wrote: "It has been noted as the clear, gem variety, essonite in crystals..."

True (1869) said of a presumed **Bethel** grossular: "*Cinnamon Stone - Yellow Garnet - Bethel*. This mineral is found on Mt. Farwell, in an impure limestone. Small crystals are occasionally found of great beauty. The form is that of a dodecahedron with rhombohedral faces, having the angles occasionally replaced by a single plane."

A road cut along Route #172, **Blue Hill**, produced 2-3 mm tannish-green dodecahedra of grossular in quartz vugs.

An unspecified locality in **Carthage** has complex dodecahedra of grossular (1-3 cm) with trapezohedral and hexoctahedral faces. The crystals have high luster and vary from tannish-brown to gemmy red-brown. The crystals form in lenses of the greenish-gray banded diopside matrix and are frequently surrounded by andesine, calcite, or quartz.

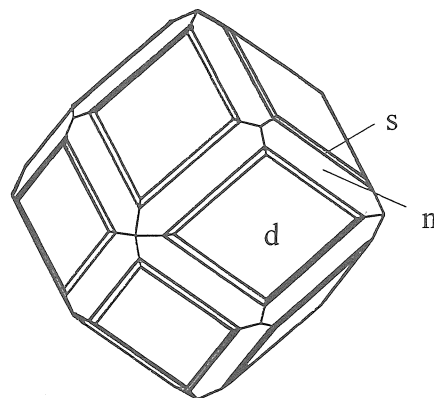
The Chute prospect, **Casco** red-brown grossular dodecahedra (to 2 cm) sometimes have rivulet markings on their faces which are quite rounded. Exceptional, for Maine, diopside crystals (5-6 mm) are sometimes associated along with less significant meionite, calcite, and titanite.

Berry Ledge road cut, **Cornish** produced 2-3 cm grossular dodecahedra with trapezohedral modifications in diopside crystal matrix. Some grossular crystals here are hollow. Associated species include andesine, diopside, scheelite, meionite, calcite, titanite, etc. The Day Hill occurrence has similar grossular, but also has large vesuvianites associated with species similar to Berry Ledge. At Day Hill, diopside frequently occurs on the vesuvianite faces. Some Day Hill grossular (5-7 mm) is transparent.

Kunz (1892a) reported: "Some fair crystals of a rich, green color, from 1 to 5 millimeters in diameter, were found at Hebron and West Minot, Me.," but no specific locality was given. Green grossular has not subsequently been found at these localities and it is possible that the use of green to describe the previous non-Maine entries was inadvertently continued by Kunz (1892a) for these locations rather than calling them orange, red, brown, etc.

True (1869) mentioned a garnet from a lost locality in **Milton** which might be grossular, but which could be andradite: "*Yellow Garnet*. A new locality of very good specimens has been opened in Milton Plantation. They resemble those from other localities in that region."

One of the premier grossular localities in the world is the Pitts-Tenney quarry, **Minot**. While gemmy crystals are rare here, large groups (30x30 cm) of large dodecahedral crystals (7-9 cm) from this location are impressive. The matrix is a fine-grained banded (less than 1 cm) grossular-diopside rock. Associated



Grossular, The Basin L, Phippsburg

minerals include meionite, calcite, clinozoisite, etc. The locality was featured by Shaub (1957) and Gregory (1971).

Jackson (1838a) noted of **Parsonsfield**: "... we found an abundance of a rare variety of egeran, and beautiful crystals of yellow garnet, pargasite, adularia, and scapolite. They occur in a granular variety of limestone, which is scattered in profusion, in the fields near Dr. Swett's house." The locality is now lost.

Red grossular dodecahedra (to 2 cm) with trapezohedral and hexoctahedral modifications are found at the Basin intertidal locality as well as the nearby lime quarry, **Phippsburg**. The lustrous crystals are found in vugs in massive grossular. Gray wedge-shaped clinozoisite crystals are associated with minor quartz and diopside. Fairbanks (1950) wrote: "Visited Prof. Cleaveland's original opening from which he furnished so many museums with gem quality garnet crystals." The Basin locality is most assuredly Charles Jackson's and Francis Alger's discovery (see Jackson, 1837a, 1838a). No Cleaveland references known.

Gemmy red grossular dodecahedra (to 1 cm) are found at a calc-silicate exposure near Camp Hinds, on the north shore of Panther pond, **Raymond**. Melville (1893) wrote of the grossular found with anorthite: "The locality is near the boundary between the towns of Raymond and Gray, and is perhaps in the latter. It adjoins the northern end of Little Sebago lake."

Putnam and Perham (1969) wrote of **Rumford**: "Cinnamon garnets were found on Ski Slope Hill in Rumford about 1960. Said to be real shiny and about 1/2" in diameter."

A few dark red grossular dodecahedra (to 1.5 cm) frequently with skeletal trapezohedral faces have been found on drusy diopside crystals and sometimes with meionite at the 200 Meter and 600 Meter prospects, **Sanford**. (Most of the specimens have been acid-etched out of calcite.)

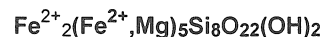
Gregory (1900) wrote of the Washburn Ferry area, **Mapleton, Presque Isle, Washburn**: "The Aroostook River, where it flows through the townships of Washburn, Mapleton, and Presque Isle, gives a good section through the region affected by the Mapleton granite area. The outcrops along the river east of Washburn Ferry show the general country rock to be a black

arenaceous limestone, thin-bedded, and alternating with beds of gritty material which under the microscope proves to be composed largely of broken pieces of quartz, feldspars, and calcite. Following the river downstream, the first marked change in the character of the rock is seen where it occurs between a dike of aplite and one of syenite. Metamorphism has here produced a compact schist of a grayish-green hue, prettily marked by a multitude of fine bands and lines of various shades of gray, representing the bedding planes in the old shale. ... With the aid of the microscope we find the main mass composed of lime garnet (grossularite), some pyroxene, calcite in bunches, and a little quartz and iron in a background of feldspar. ... Farther down the river, between the two large kersantite [should be a biotite-calcic plagioclase lamprophyre] dikes, is a considerable area occupied by an impure, partly crystalline limestone with lead color and conchoidal fracture. ... The microscope shows its composition to be in the main calcite, quartz, and grossularite. A short distance below this outcrop the immediate effects of the dike intrusions disappear."

An old garnet prospect near Perkins School, **Woodstock** produced massive to crystalline yellow to orange-brown grossular (possibly andradite) and was probably the source for Nathan Perry's yellow garnet during the 1870's and 1880's. The locality is now lost.

grossularite - obsolete synonym for grossular

GRUNERITE (Amphibole Group)



Palermo - *Cushing Formation near east Sheepscot Pond*

Pankiwskyj (1978) reported of "stop 3" east shore area Sheepscot Pond, **Palermo**: "Wilson Cove Member of the Cushing Formation - Massive to moderately foliated rusty weathering metavolcanics composed here of garnet, hornblende, grunerite, biotite, quartz, apatite and ore minerals. This unmistakable member of the Cushing formation has been traced from the shore of Casco Bay to the central part of the Brooks quadrangle. Typically it is at or close to the contact with the Cape Elizabeth formation. In the Liberty area this contact is sheared and injected with veins of clear or rusty-stained quartz, commonly with cavities bearing terminated quartz crystals. Gold has reportedly been recovered from some of these veins in the local area."

gummite = a brightly-colored mixture of uranium minerals

Albany - *Wardwell Q*; **Auburn** - *Pulsifer Q*; **Georgetown** - *Consolidated Q*; **Gray** - *Hinkley P*; **Greenwood** - *Tamminen Q*; **Newry** - *Dunton Q*; **Poland** - *Berry-Havey Q*; **Rumford** - *Black Mountain Q*; **Stoneham** - *Lord Hill Q*; **Topsham** - *Biotite Crystal P*

Burr (1942) listed some gummite occurrences from Maine and Frondel (1956, 1958c) discussed the minerals present including: fourmarierite, phosphuranylite, rutherfordine, uranophane, vandendriesscheite, and wölsendorfite (mineral C). Gummite was originally named because of its "gum-like" or pitchy appearance of bright yellow to orange mineral. Most Maine specimens are little more than "dots" (~1-2 mm) in cleavelandite, manganian fluorapatite, or lepidolite replacement-unit matrix, as well as red to brown stained microcline and biotite pegmatite.

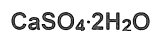
Cameron et al. (1954) indicated of the Consolidated quarry, **Georgetown**: "Gummite, autunite, and many large black tourmaline crystals occur with the beryl." Based on observed specimens, the "gummite" may have been only informally identified and consisted of coatings of bright yellow though brown, secondary uranium-mineral-like species.

Yellow gummite rinds (to 5 mm) composed mostly of uranophane?, surround sooty black cores of pitchblende (to 5 mm) frozen in red to brown microcline, frequently at a junction with biotite at the Hinkley prospect, near the Gray gravel pit and the so-called McKin site, **Gray** and at the so-called Biotite Crystal prospect about 100 m northeast of the Consolidated #1 quarry, **Topsham**.

Orange and yellow variegated gummite masses (to 1 cm) have been found in lepidolite associated with lithiophilite from the Tamminen quarry, **Greenwood**.

Small yellow to red-orange gummite masses (to 2 mm) are found in cleavelandite-manganian fluorapatite matrix, Berry-Havey quarry, **Poland**. Some pure deep yellow masses (1-2 mm) are schoepite (q.v.).

GYPSUM



Brooksville - *Callahan M, Cape Rosier M*; **Buckfield** - *General Electric Q*; **Linneus** - *Meduxnekeag Lake A*; **Oakland**; **Pembroke** - *Barrett P (= Dolsan Pit)*; **Rockland**; **Saco?**; **Skowhegan**; **Sullivan?**

Small (to 2 mm) transparent colorless gypsum crystals have been found in rusty gossan vugs from the Callahan mine, Cape Rosier, **Brooksville** (Gardiner Gregory, personal communication, 1990; also Gregory, 1969).

Clear bladed gypsum crystals (to 1 mm) have been found in vugs in albite at the General Electric quarry, Buckfield, but the gypsum may have formed on the dump.

Gypsum is generally of dubious occurrence in Maine. An unspecified locality near Meduxnekeag Lake, **Linneus** has untwinned gypsum crystals (1-2 mm) directly on limonitic matrix.

Individual untwinned clear gypsum crystals occur as rounded, nearly rhombic platy crystals (1 mm) on tenorite-coated fracture surfaces on matrix at the Barrett prospect, **Pembroke**.

Jackson (1839) noted of **Skowhegan**: "In Bloomfield, we were interested by observing the rapid formation of gypsum in

the soil, by the decomposition of pyritiferous slate containing limestone. The most remarkable locality is the hill on the road side, in Bloomfield, near the Fairfield line. It will there be remarked that the pyrites, or sulphuret of iron, is decomposed by the action of air and water. Sulphate of iron is formed, which is instantly decomposed by the carbonate of lime, and sulphate of

lime and carbonate of iron result. Indeed crystallized gypsum, thus formed, abounds in the crevices of the rock, while large portions of it are washed away and deposited on the soil in the low lands around." The locality is now unknown.

Burr (1930) listed gypsum from **Sullivan**. No specimens known.

H

HALITE

NaCl

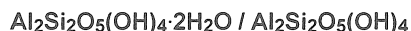
Brooksville - Cape Rosier M; **Kittery** - Cutts Island A; **Perry** - Gin Cove A; **Winter Harbor** - Schoodic Point A; **York** - Cape Neddick A

Halite has been found as a curiosity occurrence at the Cape Rosier mine, **Brooksville** (HU unnumbered). Carpenter and Foster (1960) stated: "A few snow-white platy crystals of anglesite have been observed in fractures in the talc rich wall rocks. The anglesite crystals at the Cape Rosier mine can be recognized by their diamond-shaped outline and close association with small cubes of halite." The individual frosted halite "cubes" (to 2 mm) formed as square platelets on fractures in the talc matrix. The closeness of the Cape Rosier mine to sea level, within a few meters, undoubtedly accounts for the possibility of ground water precipitating the mineral.

Zodac (1950a) observed that evaporated ocean spray on shore rocks on Cutts Island, **Kittery** crystallized temporary halite crystal films on them on hot summer days.

Excellent hopper crystals of halite form in evaporating puddles on high rocky shelves above the high water mark. Summer storms wash sea water onto the shore and summer heat evaporates the "stranded" water with the result that halite and other salts crystallize out. Crystals to 4 mm have been observed. Particularly good examples can be seen, occasionally in the summer, at Schoodic Point, Acadia National Park, **Winter Harbor**.

HALLOYSITE-10Å / HALLOYSITE-7Å (Kaolinite Group)



Hebron - Mount Rubellite Q; **Newry?** - Dunton Q; **Paris** - Mount Mica Q; **Rockland**; **Thomaston**

True halloysite is a clay mineral and is related to kaolinite. Halloysite is microscopically tubular and the numbers after the name imply the same relationship that "meta" does before members of the autunite group. Halloysite-10Å spontaneously dehydrates in dry conditions to halloysite-7Å. Carroll (1970) indicated: "If halloysite is not completely dehydrated, it can be rehydrated to a 10.1Å spacing" and "There appears to be a gradation between kaolinite and halloysite." Carroll and

Hathaway (1963) suggested that halloysite can form from the alteration of montmorillonite and may be, itself, degraded to kaolinite.

The only observed example of "halloysite" from the Dunton quarry, **Newry** is actually cymatolite. No halloysite is visible on the specimen. Given the difficulty in identifying halloysite, especially prior to 1950, for example, it is likely that the name halloysite was not used in a manner consistent with the current mineralogical definition and may have been used to signify what is now consistently called cymatolite.

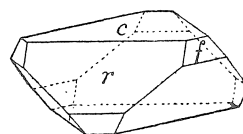
Bastin (1911) listed halloysite from the Mount Mica quarry, **Paris** and the Mount Rubellite quarry, **Hebron** without description. Halloysite-7Å has been found in brecciated pink tourmaline from the Mount Mica quarry, **Paris** (George Robinson, personal communication, 1990). The halloysite forms tiny (less than 1 mm) botryoids which can be individual or closely clustered. The botryoids are tan to cream-colored, dull to waxy, and show no internal structure. The mineral is easily confused with similar appearing botryoidal carbonatite fluor- or hydroxylapatite, but the botryoidal apatite shows a radially fibrous internal structure.

Burr (1930) listed halloysite from **Thomaston**. No specimens known.

***hamlinite** = goyazite

Greenwood - Noyes Mountain A; **Stoneham** - Lord Hill Q

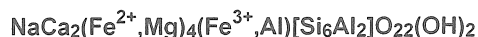
Hamlinite was first described by Hidden and Penfield (1890) on specimens discovered at the Lord Hill quarry, **Stoneham**, and later by Penfield (1897) on specimens from Noyes Mountain, **Greenwood**. No chemical analyses or supporting data were given in the first of these articles which introduced the name. Goyazite was described in 1884 from Minas Gerais, Brazil by Damour, of damourite fame, but the initial description was completely inadequate. The name hamlinite gained popularity and is still used today by collectors, especially on specimens from the Lengenbach quarry, Binn, Switzerland (Bowman, 1907). The "identity" of hamlinite with goyazite was announced



Hamlinite, Stoneham (from Hidden and Penfield, 1890)

by Hussak (1906) and Schaller (1912a,c). See discussion under goyazite.

HASTINGSITE (Amphibole Group)



Androscoggin Lake igneous complex - Wayne; Kittery Formation inclusions - Kittery, York; Meddybemps granite - Alexander, Baring, Charlotte, Cooper, Meddybemps; Tunk Lake pluton - Cherryfield, Franklin, Gouldsboro, Steuben, Sullivan, T7SD, T9SD, T10SD

Creasy (1983) noted of alkali quartz syenite of the Androscoggin Lake igneous complex, **Wayne**: "Massive homogeneous medium-grained rocks composed chiefly of micropertthite; grades from syenite to granite with variation in quartz content; less than 10% mafic minerals (clinopyroxene and ferrohastingsite)."

Included blocks (to 500 m) of the Kittery Formation within the ring-dike rocks of the Agamenticus Complex, alkaline granite and alkaline syenite only, have been partly thermally metamorphosed. Woodard (1957) discussed the progressive zonation in these included blocks which included the formation of hastingsite: "Closely following the development of the outer aegirinaugite zone and the microcline, a gradational zone of greater thickness (up to 2 cm) develops, in which the amphibole, hastingsite, is characteristic."

Ludman and Hill (1990) wrote of the Meddybemps granite, **Alexander, Baring, Charlotte, Cooper, Meddybemps**: "A pale yellow pleochroic mineral with a poikilitic texture surrounding quartz grains occurs in some samples and may be a hastingitic [sic] amphibole."

Karner (1974) when comparing the Tunk Lake pluton and "Maine Coastal ... bodies," **T10SD** and other towns, to the "White Mountain bodies" indicated: "In *both* [emphasis added] belts a mildly alkaline rock series with the following major characteristics is present: ... (3) Succeeding, felsic plutonic phases are predominantly intrusive and follow the sequence; undersaturated to saturated pyroxene-amphibole syenite, aegirine augite-hastingsite-riebeckite quartz syenite and quartz-poor granite ---- hornblende granite ---- hornblende-biotite granite ---- quartz-rich biotite granite and quartz monzonite. ... (5) Mineralogically, syenites and hypersolvus, quartz-poor granitic phases are most alkaline as demonstrated primarily by Na-rich minerals including Na-rich alkali feldspar, aegirine augite, hastingsite, riebeckite and astrophyllite." The amphiboles otherwise specifically reported by Karner (1974) are termed "hornblende."

hatchettolite? - see microlite

Newry - *Dunton Q*

Fronde (1958c) has indicated that hatchettolite, proper, is a uranoan pyrochlore (q.v.). Burr (1930) listed hatchettolite from Newry, but Bailey (1930) did not. Holman (1935) reported that hatchettolite was found at the Dunton quarry, **Newry**. Though no original specimens were available to test the identification, a dark golden brown, almost blackish brown, resinous mass of "hatchettolite" with a brown stain aureole in fine-grained lepidolite was submitted for quantitative chemical analysis and found to be perfectly good, low niobium, microlite with significant substitutions including minor uranium (Bart Cannon, personal communication, 1984). Fraser (1930) had reported of the Dunton quarry microlite group: "Spectroscopic analyses by Mr. Gedney have indicated the light yellow colored mineral is microlite and the dark brown mineral pyrochlore." No recently tested pyrochlore has been recognized from the Dunton quarry and given the uncertainty of spectroscopic analyses of the era, the tentative pyrochlore analysis has to be viewed with caution.

HAUSMANNITE



TDR2 WELS - *Hovey Mountain P; T3R9 WELS* - *Maple Mountain P*

White (1943) suggested of the Hovey Mountain prospect, **TDR2 WELS** and Maple Mountain prospect, **T3R9 WELS**: "Possibly some manganese is present also in an opaque mineral such as braunite or hausmannite, but the metallic minerals were not studied in detail in polished sections or by chemical or X-ray methods." While one might wonder how he was justified in making the statement, Pavlides and Milton (1962) had reason to be confident: "Hausmannite, which appears to be quite rare, is the only other opaque crystalline oxide besides braunite and hematite identified in the Aroostook hematitic manganese deposits. In the deposits of Maple and Hovey Mountains it has been identified only in small amounts within a cream-yellow carbonate-rich pod in one specimen of brick-red hematitic ironstone. ... This rock contains numerous pods, beads, and laminae of various light-colored minerals, which include carbonate, feldspar, barite, spessartite, and possibly bementite. Some of the nodules are partly darkened by black manganese oxides. The hausmannite in this specimen is readily recognizable in polished section by its moderate reflectivity (less than that of hematite, but somewhat greater than that of braunite), its strong anisotropy, with marked reflection-pleochroism, and the diagnostic lamellar twinning." Based on the two reports and the unspecified localities, but the near identical nature of the two deposits, the mineral is listed from both localities (the two Maple Mountain prospects and Hovey Mountain prospect).

***hebronite** (Amblygonite Group)

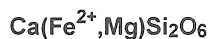
Auburn; Hebron - *Mount Rubellite Q*; **Paris** - *Mount Mica Q*;
Rumford - *Black Mountain Q*

Hebronite is a member of the amblygonite group and was first named from the Mount Rubellite quarry, **Hebron** by Von Kobell (1872b). The status of hebronite has been fought over and confounded. The historical details of amblygonite and montebrasite have been discussed under their appropriate sections and only the usage of hebronite will be alluded to here as the details await fluent German-speaking and French-speaking mineralogical historians. Amblygonite was found at Hebron, the second known locality, by Brush (1862). Amblygonite was also found at Montebras, France (Des Cloizeaux, 1863). In 1871, Des Cloizeaux proposed the name montebrasite, based on "unusual" optical properties of the Montebras "amblygonite" and Pisani (1871) provided support for the name by using it along with a chemical analysis (which unfortunately corresponded with amblygonite). Von Kobell (1872a) criticized the naming of montebrasite and compared the Montebras analysis of Des Cloizeaux (1871) with that of Rammelsberg (1845) and indicated that there was no need of a new name. Von Kobell's response may have been more in protest of a French name superseding an older, well-established German name. (Nineteenth century mineralogy is replete with examples of new mineral names replacing older names which were adequately defined and should have resisted the renaming process, but failed.) Rammelsberg (1872a) re-analyzed material from the type locality for amblygonite, Penig, Saxony, Germany and the material from Montebras, France and concluded: "Das Mineral von Montebras ist Amblygonit..." Rammelsberg (1872a) mentioned similarities of Hebron amblygonite to further establish priority for the name. Des Cloizeaux (1872a) wrote a note to substantiate the name montebrasite and compared the Hebron amblygonite with his montebrasite and concluded that they were both montebrasite. In 1872b, Des Cloizeaux wrote a major article concerning amblygonite and montebrasite and gave the first analysis of montebrasite which had hydroxyl greater than fluorine. By redefining montebrasite as a [new phosphate of aluminum and of lithium hydrate], the new mineral was established. Des Cloizeaux (1872b) gave an analysis of Hebron amblygonite, but called the Maine mineral montebrasite. Von Kobell (1872b[1873]) responded by rejecting the redefinition: "[Authors' translation follows:] Analyses have shown that the questionable older mineral [montebrasite] is not a new species, but is amblygonite." He cited Pisani's (1871) analysis of Hebron material and proposed that it serve as the basis of a new species called Hebronite which would be a phosphate of aluminum and lithium hydrate. Von Kobell obviously believed that a name, originally used incorrectly, shouldn't be redefined to cover a new species. Von Kobell (1872b[1873]) gave a new analysis of Hebron material and gave an analysis for **Auburn** "hebronite" and listed **Paris**, Maine as an additional locality. Des Cloizeaux (1873) discussed the analysis of a specimen from

Auburn and concluded it represented montebrasite, though the data suggested that it had more fluorine than water. Much of the controversy was obviously generated by differing interpretations of chemical analyses, many of which were undoubtedly in error. Dana and Brush (1874) noted the controversy and apparently felt that the matter was settled that montebrasite was amblygonite and made no mention of hebronite.

As late as 1893, Bailey listed hebronite from Black Mountain quarry, **Rumford**.

(Note: The analysis of Auburn "hebronite" by Von Kobell (1872b) is the only reference, other than Hamlin (1895), to suggest that mining, not just surface collecting (Hills, 1869), was active in Auburn before Nathaniel Perry opened the Hatch Farm quarry in 1883. It is doubtful if the hebronite was found in a naturally exposed outcrop.)

HEDENBERGITE (Pyroxene Group)

Belfast quadrangle; Brooks quadrangle; Cornish? - *Healy Farm A; Kittery Formation - Kittery, York; Knox - Mixer Pond A; Raymond?; Rumford?; Island Falls quadrangle - unnamed volcanic rocks; Traveler Rhyolite - Nesourdnahunk, T5R9 WELS*

Hedenbergite is the iron-rich member of the diopside series of pyroxenes. Due to its iron-rich composition, hedenbergite is generally dark green to black and might be more common than currently supposed. No systematic study of Maine pyroxenes has been started.

The ferrosalite variety of hedenbergite was reported by Bickel (1974) from unspecified localities in sillimanite and sillimanite + K feldspar zones of the **Brooks** and **Belfast quadrangles**, but Bickel (1976) specified of the Mixer Pond Member of the Passagassawakeag Formation [north of Mixer Pond, **Knox**]: "Hornblende, green biotite, or, less commonly, ferrosalite is concentrated in laminae about 1 mm thick in about 40 percent of the gneiss."

Large (to 1 x 0.7 cm), greenish black, slightly fibrous-appearing cleavages are found in particular coarse beds in layered calc-silicate rock from the Doctor Healy farm area, South Cornish, **Cornish**. They are associated with orange-red trapezohedral grossular crystals (to 1 cm) and interlocking white meionite crystals and grains (to 1.5 x 1.5 cm). These dark grains have been called hedenbergite by some collectors. However, specimens studied megascopically as well as optically indicate a member of the pargasite/hornblende series and not a pyroxene.

Hynes (1976) presented data indicating that some of the clinopyroxenes from some unnamed volcanic rocks (altered basalts and/or andesites) in the **Island Falls quadrangle** had compositions with Fe > Mg and, therefore, were hedenbergite.

Woodard (1957) noted of the Kittery Formation, **Kittery** and **York**: "The pyroxene-rich strata of the Kittery formation

[sic] are light in color and very fine-grained (0.2 to less than 0.015 mm in diameter). The major minerals present are quartz, calcite, diopside-hedenbergite, tremolite-actinolite, plagioclase, and orthoclase." Whole-rock chemical analysis of the pyroxene-rich beds indicate Fe:Mg ~ 4:1, suggesting hedenbergite in this member of the formation.

Perkins (1922c) reported: "**Hedenbergite. var. Salite.** ... Crystals have been reported to occur with Diopside at Raymond and Rumford." Salite is not a variety of hedenbergite, but diopside instead. Hedenbergite and diopside have complete chemical variability from one to the other and as a result, two different members of the series would not be expected at a particular locality.

heliodor - see description under beryl

HEMATITE (Hematite Group)

Fe₂O₃

Alder Stream - Alder Stream Falls A; **Alexander** - Breakneck Mountain summit; **Aroostook River A** - Currier's house A; **Arrowsic**; **Aurora**; **Baldwin**; **Bar Harbor** - Cadillac mountain A; **Barnard**; **Belfast**; **Blue Hill** - Mammoth M, Stewart M; **Bridgton** - Route #117 road cut; **Brighton** - road cut; **Brooksville** - Callahan M, Tapley #1 M; **Brunswick**; **Buckfield**; **Carrabassett Valley** - Sugarloaf Mountain A; **Castle Hill**; **Cherryfield**; **TDR2 WELS** - Maple Mountain P; **Deer Isle** - Castine Volcanics on Little Deer Isle; **Dixfield** - Paint M; **Edmunds** - Hallowell Island A; **Frankfort** - Mount Waldo Q; **Hampden**; **Hodgdon**; **Howland**; **Jim Pond** - Farm Hill A; **Jim Pond Formation** - Alder Stream, Jim Pond (Farm Hill A); **Katahdin Iron Works** - Katahdin Iron Works Mine; **Knox** - Stone Q; **Linneus** - Stewart M; **Lubec** - Lubec Lead M, Seward Neck A; **Mapleton** - Higgins P; **Monson**; **Mount Desert** - Sowards Island A; **Newry** - Bell Pit, Dunton Q, Nevel Q, Rose Quartz Crystal L, Scotty Q; **New Sweden** - Capital Hill A; **Norridgewock**; **North Yarmouth**; **Oxbow** - Cupsuptic River Q; **Penobscot** - Annear M; **Perham**; **Perry** - Loring Cove A; **Phippsburg**; **Pleasant Ridge**; **Portland**; **Rangeley**; **Rockland**; **Rumford** - North Rumford Paint M, Red Hill Paint M; **Saco**; **Southport**; **Stoneham**; **Stow** - Barbour Q, Upper Colton Hill P; **Topsham** - Standpipe Hill A; **Tremont**; **Turner**; **Vinalhaven** - Sands Granite Q; **Wade**; **Waite**; **Warren**; **Washburn**; **Waterford**; **Wayne**; **Woodland**; **Woodstock**; **T9R3 WELS** - Hovey Mountain P

Hematite is a widespread mineral which occurs in a great variety of rusty stains and coatings. The host of unspecified localities in Morrill et al. (1958) and Morrill and Hinckley (1959) attest to the rarity of good specimens.

Forsyth (1955a) reported of **Alexander**: "Locally as on the summit of Breakneck Mountain, they [the rocks] contain small clots of tabular to acicular sillimanite with many specular hematite inclusions."

Fracture surfaces on granite along Route #117, **Bridgton** contain individual black platy crystals (2-3 mm) of hematite.

Brilliant black hexagonal hematite plates (1-2 mm) occur in cavities in pink crystallized albite vugs in granodiorite at an unspecified road cut in **Brighton**.

The iridescent variety of hematite, turgite, is found in resinous botryoids (1-2 mm) in a few large masses at the former Cape Rosier mine, Harborside, **Brooksville**.

Jackson (1838b) wrote: "Near Mr. Currier's I discovered a valuable mine of rich iron ore. It is of that variety called compact red haematite. ... This multiplied by \$50, the value of a ton of iron, will give \$4,860,000, as the value of the iron in this bed within the limits measured."

Smith et al. (1907) reported of the hematite in the Castine Volcanics on Little Deer Isle, **Deer Isle**: "On the southwest point of Little Deer Island, at the north and south ends of Birch Island, and in the cove on the west side of Hog Island the schistose volcanics are so full of finely divided hematite that on weathering they become dark purplish red in color."

Stephenson (1839) wrote of the hematite ochre of **Dixfield**: "The paint mines at Dixfield have attracted some attention on account of a quantity of the paint having been used with success. The paint or yellow ochre is formed by the chemical decomposition of the pyritiferous slate, and at this place it can be obtained in very great abundance, and answers very well for common purposes, but as an article for the market, it is of little value, being situated in the interior of the state."

Burroughs (1979) wrote of **Jim Pond**: "Well-crystallized specular hematite in places fills joints within the outcrop zone of felsite on the southwestern flank of Farm Hill..." Specular black hematite interlaminated with bright red jasper occurs at Alder Stream Falls, **Alder Stream** and is part of a series of outcrops apparently extending into Jim Pond. The rock is part of the Jim Pond Formation.

Jackson (1837a) reported on Seward Neck, **Lubec**: "On the western side of this neck of land, two miles from Gove's Point, numerous veins of micaceous specular iron are found, included in the porphyry. They are seldom more than eight inches wide, and consequently are not of commercial value." Bartlett (July 2, 1880) wrote of Lubec: "The 'iron mine' was worked years ago; there is a shaft down 149 feet with several drifts; 300 tons of good specular iron was extracted and sold. ... The veins are in jaspery flint and lime porphyry, while the gangue is pure calc spar or carbonate of lime." Bastin and Williams (1914) added: "An iron furnace and foundry which was operated at Pembroke in the 'thirties' derived its ore supply from Nova Scotia. A few small iron-bearing veins were observed within the quadrangle. On the southwest shore of Seward Neck several nearly vertical veins traverse the rhyolitic flows, occupying sharp fracture planes and breccias in the rhyolite. They consist of quartz and specular hematite."

The iridescent variety of hematite called turgite has been found as colorful films on a rock with slaty cleavage at the Cupsuptic River road metal quarry, **Oxbow**. The turgite usually

is a metallic golden yellow to red, while blue and green shades are less abundant. The turgite occurs in the parts of the quarry with abundant pyrite, much of which has dissolved away leaving curious casts over 1 cm across.

At Loring Cove, **Perry**, bright red earthy patches of hematite (to several cm) can be found on and in greenish black basalt. The combination has been incorrectly identified as iddingsite, bloodstone, etc.

Akers (1952) wrote of the limonitic and hematitic ochre of the North Rumford Paint and Red Hill Paint mines of **Rumford**:

"My father recalls that William McCrillis dug and sifted 200 barrels of yellow-brown ochre or limonite, some of which he sold, some he gave away, and some, being an impatient man, he dumped in a Rumford street. Charles Penley was caretaker at the mine for some time, and it was from him that my father purchased two barrels for about one dollar apiece, he says.

My father's blacksmith shop and wagon house were painted with the yellow ochre as purchased from the mine. It was a brownish-yellow, not very attractive and not quite so durable as when properly baked. The baking drives off the water in the limonite, leaving it red ochre or hematite. Nature did a fine job of it both at North Rumford and Red Hill, where both red and yellow ochre are found. ...

My great-grandfather, Russ Andrews... painted the end of his barn with the red ochre from the North Rumford Paint Mine, using skim milk as the liquid ingredient."

An earlier description is available in Jackson (1839).

Small patches (to 5 x 5 mm) of black specular hematite are found in etched cavities in tan to orange-brown microcline at the Upper Colton Hill prospect and the Barbour quarry, **Stow**.

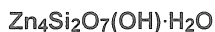
Seaman (1975b) wrote of an unspecified quarry in **Topsham** that hematite: "...has been noted as good, small crystals at Standpipe Hill in Topsham. It is a common mineral at many pegmatite localities, usually occurring as a stain on fracture surfaces within the pegmatite."

Exceptional hematite crystals were found at an unspecified locality in **Waterford** (HU 85499). The individual crystals without matrix are 1.5 x 1.5 x 0.3 cm with small rough rhombohedral faces in combination with large striated "c" pinacoids. Striated red rutile crystals (to 2 mm) are occasionally epitaxially grown on the "c" pinacoids. A small fragment of reddish microcline is attached to one of the crystals suggesting a granitic matrix. The crystals were originally identified as ilmenite, but were later identified as hematite (XRD, Carl Francis, personal communication, 1991).

Miller (1947), Eilertsen (1952) and Pavlides and Milton (1962) described the manganese ores that are interbedded with hematite at Hovey Mountain, **T9R3 WELS** and Maple Mountain, **TDR2 WELS**. The hematite forms fine-grained to earthy red to red-brown layers (generally less than 1 cm) interbedded with black manganese mineral-bearing layers. Pavlides (1962) wrote: "Banded hematite ironstone typically is a light-red to dark-red rock with a high specific gravity and a blocky fracture.

The thickness of individual layers is variable, but most of the layers average between $\frac{1}{8}$ and 1 inch. Individual layers are commonly very finely laminated... The rock consists of alternating very dark red to black layers rich in hematite or braunite, lighter colored red layers with less iron and manganese oxides, and pink and gray layers virtually free of opaque iron and manganese minerals. The lighter colored bands normally contain carbonate and are more readily leached than the ferruginous layers during weathering."

HEMIMORPHITE



Brooksville - Callahan M (= Cape Rosier M); **Lubec** - Lubec Lead M; **Pembroke** - Big Hill M

Hemimorphite is found at the Callahan open pit mine (site of the former Cape Rosier mine), **Brooksville**. The hemimorphite occurs in the stellate rosettes (1-2 mm) of lustrous, transparent striated crystals. The rosettes are found on brown-stained cavities in talc phyllite. Gregory (1969) noted hemimorphite at the Callahan Mine.

The Lubec Lead mine, **Lubec** has tan hemimorphite in indistinct sprays (1 mm) with cerussite and galena in quartz vugs.

Big Hill mine, **Pembroke** has clear crystallized botryoids (1-2 mm) of hemimorphite on snow-white earthy hydrozincite and cloudy gray-white compound smithsonite crystals (1 mm) on limonite in quartz.

HERCYNITE (Spinel Group)



Blue Hill? - Ellsworth Schist; **Carrabassett Valley** - Owls Head A; **Stoneham?** - Sugar Hill Q; **Union** - Harriman P; **Warren** - Warren Nickel P

Li (1942) noted from the Ellsworth Schist, **Blue Hill**, without substantiating data: "The andalusite includes dusty carbonaceous matter, magnetite, hercynite, and green spinel (pleonaste)." Forsyth (1953) reported gahnite (q.v.). Yates and Howd (1988) noted spinel chemical analyses from the Black Hawk mine area, Blue Hill with low iron compositions.

Boone (1970a) reported on "hercynite-rich?" green spinel from the northern summit of Owls Head, **Carrabassett Valley**. Later, Boone (1973) reported hercynite once, without question, as well as corundum (q.v.): "This zone is represented by pelitic roof remnants and xenoliths in the gabbroic rocks of the massif. ... Common mineral assemblages, each accompanied by plagioclase, are: ... cordierite + biotite + hypersthene + green (hercynite-rich?) spinel ... Compared to the regional, quartz-rich metapelites, the rocks bearing these assemblages have been desilicated." The hercynite is a dark bottle-green isotropic min-

eral in thin section, but has not been verified by chemical analysis (Gary Boone, personal communication, 1990). Lander (1953) reported: "The minerals that we found on Sugarloaf were as follows: magnetite, picotite, gray lepidolite [sic], black tourmaline, hercynite, ilmenite, and a fine piece of crystallized hematite in float."

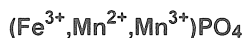
Morrill et al. (1958) reported hercynite and other iron-rich minerals (magnetite, ilmenite, and hematite) from Sugar Hill (quarry?), **Stoneham**. No specimens are known.

Rainville and Park (1976) gave analyses of various spinel-group minerals from the Harriman prospect, **Union** and the Warren Nickel prospect, **Warren**. One mineral, the "Dark spinel phase" calculates to be a chromian hercynite. The associated "Light spinel phase" yields a formula of a titanian chromite, while the "ulvöspinel" is intermediate in composition.

herderite - specimens from Maine have been shown to be hydroxyl-herderite (q.v.): early nomenclature errors, analytical errors, etc. have perpetuated the name in the literature

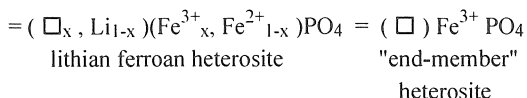
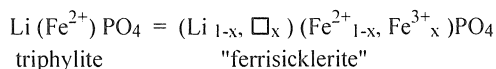
hessonite = brown to red grossular

HETEROSITE (Triphylite Group)



Cushing - State Prison Farm P (=Peg Claims); **Greenwood** - Emmons Q; **Newry** - Bell Pit, Dunton Q, Nevel Q, Rose Quartz Crystal L, Scotty Q, Whitehall P; **Norway** - BB #7 Q; **Paris** - Mount Marie Q; **Mount Mica** Q; **Peru** - Perry Q, Lobikis Q; **Rumford** - Black Mountain Q, Thurston Brown Q, Red Hill Q, South Twin Mountain A, South Whitecap Mountain A; **Standish** - Breakheart Hill A, Oak Hill P, Oak Hill road cut; **Stoneham** - Cole Q, Lord Hill Q; **Warren** - Starrett Q, State Prison Farm P (=Peg Claims)

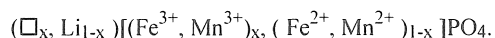
Heterosite is a commonly encountered mineral in Maine's pegmatites. Virtually every triphylite location has heterosite. This species is derived from triphylite through oxidation and leaching by the following sequence:



\square = a vacant site or "hole".

The alteration of lithiophilite to sicklerite to lithian manganian purpurite to "end-member" purpurite is the same sequence, but for the manganese-rich character of that part of the series. When other metals are present, which is the usual case,

the iron oxidizes first and the resistant manganese is oxidized only as the process is carried to its extreme. Magnesium and zinc are naturally found in one oxidation state and do not oxidize further. The formal definition for heterosite only requires that $\text{Fe}^{3+} > \Sigma \text{Fe}^{2+}, \text{Mn}^{2+}, \text{Mn}^{3+}, \text{Mg}, \text{Zn}, \text{etc.}$ A general formula for heterosite, which does not acknowledge, for illustrative purposes, that Fe^{2+} and Mn^{3+} should be mutually exclusive, would be:



Heterosite is the advanced result of the oxidation of triphylite that occurred in pegmatites during their evolution. Minimal alteration of triphylite results in a brown dull mineral which has been called "ferrisicklerite." (Note: ferrisicklerite and sicklerite are not true species, but are the intermediate stages in continuous oxidation sequences of triphylite and lithiophilite, respectively [Palache et al., 1951; Moore, 1973].) Triphylite exposed to weathering on a quarry dump can develop a brown external coating of "ferrisicklerite." Ferrisicklerite may also be produced during the original formation of the pegmatite. Extensive alteration appears to be the realm of late-stage oxidation connected with the pegmatite's history. Heterosite has a dark reddish-purple color, but the same cleavage as the parent triphylite. The streak is lighter purple than the massive mineral. The above indicated sequence has ignored the oxidation of manganese for the sake of clarity, but some change does occur for that element as well. The removal of lithium and corresponding oxidation of iron is probably never complete. The formation of heterosite/purpurite requires the presence of parent triphylite/lithiophilite (Paul Moore, personal communication, 1974). The implication is that heterosite/purpurite cannot be formed directly from a fluid.

The most important way to distinguish heterosite from its look-alike, purpurite, is knowledge of the parent material. During the oxidation of triphylite and lithiophilite, the abundance of iron and manganese does not appreciably change. Triphylite localities do not have purpurite and lithiophilite localities do not have heterosite. When heterosite or purpurite are soaked in some acids, both can become unnaturally bright purple in color. The streak of the two species is identically purple.

Heterosite usually appears in 5-20 cm patches frozen in heavily iron-stained quartz matrix, sometimes with cleavelandite. There are seldom any other secondary phosphates associated. The foregoing descriptions are applicable to all of the above listed localities.

Small prospect pits (to 1 m) near the Rose Quartz Crystal locality, Plumbago Mountain, **Newry** have produced brownish purple heterosite pseudomorphs (to 5 cm) after triphylite crystals associated with muscovite, quartz, etc.

Dolloff (1936) wrote that "purpurite" was found as the alteration of "triploidite" (q.v.) from three small **Standish** localities. If the minerals were correctly identified, it is likely that triphylite was intergrown with triploidite/wolfeite and the

triphyllite, being less resistant to alteration, was replaced by heterosite. No specimens known.

Sundelius (1963) reported of the State Prison Farm prospects (Peg Claims) **Warren** and **Cushing**: "Nests of varicolored alteration products of iron-manganese-lithium phosphate minerals were found in one place. The principle alteration product is sooty purple in color and has three good cleavages. Index of refraction measurements indicate that it is probably heterosite."

heulandite?

Greenwood - Harvard Q

Harvard quarry, **Greenwood** produced a number of quartz (q.v.) epimorphs after unknown minerals. It has been suggested (Palache and Landes, 1925) that one of the precursor species was heulandite based on the pseudomorph's shape. As no original heulandite has been found, the suggestion seems unverified. The wedge-shaped valencianite or zygadite variety of albite crystals could more reasonably account for the pseudomorph's shape. Seaman (1975b) erroneously(?) reported: "HEULANDITE, a hydrous calcium, sodium, and aluminum silicate, is very rare in pegmatite, but it has been noted in unaltered remnants as one of the minerals after some of the quartz pseudomorphs at the Harvard Quarry, Greenwood, Maine, have formed." No specimens of Harvard quarry heulandite known.

hiddenite? - a varietal name for transparent, green chromian spodumene (q.v.) not found in Maine; false reports have been made by collectors on non-gem, non - chromian light green to greenish-gray spodumene

Andover?; Newry? - Dunton Q

The locality of the **Andover** deposit is unknown. See discussion for spodumene. Sterrett (1907) stated: "The discovery of kunzite, or lilac-colored spodumene, at Andover, Oxford County, Me., will add a new interest to the gem industry of that state if pieces large enough for cutting are found. ... Mr. F. G. Hillman, of New Bedford, Mass., has reported the discovery of lilac-colored spodumene, or kunzite, as well as of some with a greenish color, called hiddenite by the informant, at Andover, Oxford County, Me. A cleavage specimen sent to the Survey measured about 12 by 10 by 3¹/₂ millimeters and had a very pretty clear lilac color. It was not entirely without cleavage cracks, however. The greenish material had a pale aquamarine [color], nearly clear, though rather badly fractured. This spodumene was obtained near the surface, and it is hoped flawless material will be found with depth." Sterrett (1908) noted: "Further work on the lilac and pale-green spodumene deposit at Andover, Oxford County, Me., has yielded mineral of good color, though clear only in small patches. Mr. F. G. Hillman reported surprisingly beautiful gems cut from material that had been pronounced

valueless by two dealers in precious stones." (See further locality discussion under spodumene.)

Morrill et al. (1958) was the first to ascribe the hiddenite report to the Dunton quarry, **Newry**. No specimens known. (Note. Hiddenite must be permanently colored. Transparent green spodumene from Georgetown will bleach to colorless in light.)

hisingerite?

Newry? - Dunton Q; Paris? - Mount Mica Q

Hisingerite is a conspicuous mineral, but one which is hard to identify by sight alone and as such may be more prevalent than has been supposed. A red-brown iron silicate (chemical analysis, this study) which is probably hisingerite, forms a rim around uraninite grains (to 1 mm) frequently replaced by an unknown uranium silicate (unknown mineral #5) in cleavelandite at the Dunton quarry, **Newry**.

Hisingerite has been reported at the Mount Mica quarry, **Paris** as a thin black stain on siderite-cleavelandite matrix which incidentally contained "brazilianite" and "palermoite" (Sidney A. Williams, personal communication, 1987). The thinness of the black coating makes it difficult to test. Many supposed black manganese stains could be black iron stains. The communication read: "Isolated from the siderite are patches of very coarse, finely twinned oligoclase riddled with irregular stringers of quartz. The oligoclase is studded with wedge-shaped euhedra of brazilianite that show some marginal decay to palermoite, further to an irregular network of evansite seams. The final alteration assemblage includes kaolin and hisingerite" (S. A. Williams written communication to R. Thomsson, 1985).

***holmanite?** - an apparently undescribed tin-bismuth mineral

T10SD - Catherine Hill Q

Burr (1917) provided the only mention of "holmanite" from Catherine Hill prospects, **T10SD**: "Mr. Holman states that the rock assays a small amount of gold, (probably not enough to be of practical importance); and that one excavation has yielded a few grains of a new mineral, a natural alloy of tin and bismuth, to which the name holmanite has been given." The mineral was never formally named or described and is not counted among the minerals recognized today. Anonymous [1915?] noted:

"This metal [mineral] is, in reality, natural tin in alloy with bismuth. It is found in sheet and ingot formation, but how great the deposit, is not known ...

So far as Mr. Hills and Prof. Ora W. Knight of Bangor, a noted chemist and mineralogist, have been able to ascertain, no such a combination ever has been known and both these gentlemen do not hesitate

to say that outside the collection of Mr. [C. Vey] Holman, there is not a specimen of the metal in any collector's cabinet. ...

... Mr. Hills came upon the peculiar new metal. It had all the appearance of being molybdenite, which had become tarnished. It looked to be a good-sized piece and Mr. Hills thought he would knock it off and take it along as a specimen. When his prospector's hammer had been removed, the piece he saw was an entirely different metal. Taking it to Mr. Holman, who has had much experience of it. Having no chemicals or apparatus with which to make a proper test, they were unable definitely to decide what the stuff was, but felt sure that it contained some tin.

Mr. Holman at once took the sample to Bangor, where Prof. Knight made a thoro test, which established the fact that Mr. Hills had discovered a metal hitherto unknown."

No specimens are known.

HOLMQUISTITE (Amphibole Group)



Rockport - *Cripp Farm A*

Zodac (1941) reported on holmquistite: "The mineral occurred as a bluish-black mass in a loose boulder, about 2 x 1 feet in size, that was found in a field on the Cripp's farm; the farm is 3 miles west of Camden on the Camden-Augusta highway [Simonton Corner road]. Unfortunately, only one boulder containing the rare mineral could be found and most of it went into the construction of an outdoor fireplace... [of a] Mr. Fred Swan." One specimen was given to Zodac by the original finder and several were given to Harvard University (HU 95338) where it was identified and placed on display. At the time, holmquistite was known from only two other localities in the world, and though several additional localities have been discovered, it is still a scarce mineral. A large slab (about 15 x 15 cm) is preserved in the Herbert Haven collection (HH 11283). The dark bluish purple, fine-grained patches (to 5 x 1 cm) are in white to gray matrix.

hornblende (Amphibole Group) - split into two species: magnesio-hornblende (q.v.) and ferrohornblende (q.v.)

Alder Stream; Berwick - *Berwick Formation*; **Bristol; Brooksville** - *Westcott Q*; **Brunswick** - *Hutchins Corner Formation*; **Bryant Pond quadrangle**; **Byron**; **Cashes Ledge**; **Cherryfield**; **Concord**; **Deer Isle**; **Denmark**; **Elliottsville** - *slate quarry*; **Franklin** - *Bianchi Q*; **Frankfort** - *Mosquito Mountain Q*; **Freeport**; **Gouldsboro** - *Gouldsboro M*; **Greene**; **Greenwood** - *Berry Ledge Formation, Patch Mountain Formation*; **Hancock**; **Harpwell**; **Hermon** - *Hermon Hill Q*; **Jim Pond**; **Kingfield**; **Leeds**; **Lewiston**; **Lincoln Sill**; **Lincolntonville** - *Heal Q*; **Ludlow** - *railroad cut*; **Machias**; **Monhegan** - *White Head Q*; **Monmouth**;

North Berwick - *Miniutti Q*; **Northeast Harbor** - *Graves Brothers Q*; **Norway** - *Berry Ledge Formation, Patch Mountain Formation*; **Phippsburg**; **Princeton** - *Dog Brook A*; **Raymond**; **Rumford**; **South Berwick** - *Spence and Coombs Q*; **Stonington**; **Sullivan** - *Whaleback Q*; **Swans Island** - *Baird Q*; **Thomaston** - *Williams Q*; **Umbagog** - *Granodiorite*; **Union** - *Harriman P*; **Upton** - *camptonite dike*; **Vassalboro**; **Vinalhaven** - *Pequoit Q*; **Warren** - *Warren Nickel P*; **Wayne**; **Winthrop**; **Woodstock** - *Berry Ledge Formation*; **York** - *Bald head Cliff A*; **T5R1 NBPP** - *Whitney pegmatites*; **T10SD** - *Catherine Hill Q*; **T18 ED BPP**; **T19 ED BPP**

The new amphibole nomenclature (Leake, 1978) discarded the mineral names hornblende and barkevikite and replaced them with the names magnesio-hornblende and ferrohornblende, respectively. Most of the previously reported "hornblende" localities are magnesio-hornblende localities. A significant proportion of the identifications are probably misidentifications and the specimens are other amphiboles, with some properties not far from hornblende. Due to the lack of specimen descriptions and the lack of chemical identification of Maine hornblende, no survey of the species was attempted as "hornblende" could be found in almost every town in the state. The increase in amphibole species recognized in the State clearly indicates that a great many identifications for hornblende need further examination.

Bastin (1908a), Ferry (1976), Smith (1905b, 1923), Smith et al. (1907), Trefethen (1937), and Zodac (1951) reported hornblende, usually without description, as a common accessory mineral in Maine schists, peridotites, basalts, minettes, granites, "black granites," etc. "Hornblende" is a principal or significant constituent of medium- to high-grade metamorphic rocks. Hussey (1962, 1985) noted hornblendes in igneous rocks, particularly gabbros, from Alfred; Cape Neddick, York; Tatnuck Hills, South Berwick and Wells; and in the granodiorite of the Webbanet pluton, Wells. The endless modern reports, without substantiation of the identification and for which no chemical analyses or descriptions exist, would only clutter these pages. No important specimens known.

Lord (1900) wrote of **Monhegan**:

"Apart from the fibrous aggregation of uralitic hornblende and actinolite already mentioned, the microscope reveals in nearly every instance small grains of a brown, primary hornblende. This mineral can best be described in the hornblende-gabbro which forms mineralogically a connecting link between the olivine-noryte and gabbro-dioryte. The rock is dark gray, almost black, and porphyritic in structure. Phenocrysts of bytownite and hornblende are embedded in a dense, coarse-grained ground mass [sic] composed of hornblende, diallage, hypersthene, bytownite, and magnetite in about equal proportions, and all, excepting the hornblende, pan-idiomorphically developed. This latter mineral (of both generations) is poikilitically intergrown with pyroxene, magnetite and feldspar crystals, which in thin sections gives it a very characteristic mottled appearance. The hornblende is of dark brown color and strongly pleochroitic: parallel **b** and **c**=chestnut brown, parallel **a**=yellow. Absorption is **c>b>a** [.]

The poorly developed crystals vary in size from 1 mm - 2 cm and have well defined prismatic cleavage, against which a maximum extinction (c:c) of 14° was determined."

Larrabee (1964) noted of the Pocomoonshine gabbro-diorite, **Princeton**: "A feldspathic-hornblende pegmatite facies is exposed along Dog Brook; here hornblende masses are as large as 6 by 4 by 3 inches, and crystals commonly are 1/2 by 1 inch."

Milton (1961) noted: "Feldspar veins with hornblende crystals up to an inch long occur in the Umbagog Granodiorite, but no real pegmatites are associated." Milton (1961) also observed of camptonite dikes in **Upton**: "One dike contains well rounded phenocrysts of hornblende to 3 cm in diameter."

horn silver = chlorargyrite

hornstone = fine-grained quartz resembling chert

Belfast; Topsham

Cleaveland (1816, 1822) reported hornstone from **Belfast** and **Topsham**.

horse-flesh ore = bornite

huebnerite?

Blue Hill?

The manganese-rich member of the wolframite series is called huebnerite. Morrill and Hinckley (1959) question the validity of the designation apparently because no valid specimens remain to represent the identification and because no manganese-rich deposits also have wolframite group minerals in the **Blue Hill** area. Jackson (1837a) reported ferberite (q.v.).

HUMITE (Humite Group)



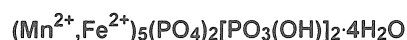
Belfast and/or Brooks quadrangles?; Norway - Patch Mountain Member of the Sangerville Formation in Crockett Ridge Q

A member of the "humite group" was reported without description by Bickel (1974) in the calcareous portion of the Sillimanite Zone and calcareous portion of the Sillimanite - K-Feldspar Zone of the Brooks and Belfast quadrangles without revealing whether it was in specific areas later called either Passagassawakeag Formation or Penobscot Block (Bickel, 1976). No humite group mineral was mentioned in Bickel (1976) though forsterite, optically similar to the humite group, was found in the Rockport sequence of the Penobscot Block.

Humite has been found as pink rounded grains (to several millimeters) frozen in the calc-silicate Patch Mountain Member

of the Sangerville Formation, exposed in the Crockett Ridge road metal quarry, **Norway** (Charles Guidotti, personal communication, 1989).

HUREAULITE



Buckfield - Bennett Q; Greenwood - Emmons Q, Tamminen Q; Newry - Dunton Q; Paris - Mount Mica Q; Poland - Berry-Havey Q; Rumford - Red Hill Q; Standish - Oak Hill road cut; Stoneham - Cole Q, Lord Hill Q

Hureaulite from the Bennett quarry, **Buckfield** has been found as orange blocky crystals (3 x 5 mm) in vugs in coarse pink rhodochrosite cleavages in quartz. A large mass (12 x 15 cm) of brownish-orange hureaulite embedded in albite has also been found at the Bennett quarry (HU collection).

Emmons quarry, **Greenwood** has produced at least one extraordinary hureaulite crystal which is free-standing and 1.3 cm long in a vug in black-stained quartz with muscovite. The crystal is relatively sharply developed and fully as good a crystal as some of those which have been found at Hagendorf, Bavaria, Germany. (Emmons quarry specimen formerly in Joseph Pollack collection.)

The Tamminen quarry, **Greenwood** has chalky pink to pinkish brown hureaulite masses (to several mm) found on the outer margins of lithiophilite. A single mass (2 mm) of phosphosiderite was associated (Gene Bearss, personal communication, 1993).

The Dunton quarry **Newry** has the bright salmon-pink bastinite variety of hureaulite which is not only distinguished by its "peachy" tint, but also has nearly rectangular platy-shaped crystals (to 1 mm) along with "chisel point" edge modifications. Some platelets are so thin that they look micaceous and both thick and thin sub-transparent crystals can be grouped in rosettes. Numerous patches (5 x 5 mm) can coat surfaces in manganoan siderite in blue tourmaline eyes in cleavelandite with manganoan triphylite. Cellular masses (to 1 cm) of dull platy vivianite crystals (to 1 mm) in blue tourmaline eyes can have nearly colorless to tan tiny (to 1 mm, but generally very much less than 1 mm) hureaulite crystals. Also from the Dunton quarry, brick-red to salmon-red hureaulite crystals (to 1 mm), with large vicinal faces giving the crystals an aspect resembling a bundle of slightly smaller crystals superimposed on each other, have been found in black-stained apatite and siderite patches in cleavelandite. The associated minerals include manganoan jahnsite-(CaMnFe), fairfieldite, mitridatite, rockbridgeite, stewartite, and strunzite. Hydroxylapatite in the vugs can form fine-grained septa across the vugs. Seaman (1975b) noted additional associated species, but as those species occur in different parageneses, their association must be considered more accidental than systematic: lancesite?, lazulite?, moraesite, wardite, and whitlockite.

Brick-red to orange hureaulite crystals (to 2 mm) have been found as crystal bundles (to 2 mm) in siderite from the Mount Mica quarry, **Paris**.

Light salmon-pink hureaulite occurs at the Berry-Havey quarry, **Poland** as a dense latticework (to 3 mm) of indistinct bladed crystals associated with stewartite and phosphosiderite at the intersection of muscovite with quartz.

Hureaulite is found as tiny (to 0.5 mm) blocky pink to tan transparent crystals with siderite in triphylite matrix associated with beraunite and strunzite from the Red Hill quarry, **Rumford**.

Dolloff (1936) reported triploidite (q.v.) from the Oak Hill road cut, **Standish**, but a supposed triploidite from that locality has been identified as hureaulite (William Metropolis, personal communication, 1988). No specimens known.

Lord Hill quarry, **Stoneham** has produced clear to very pale straw-yellow through light pink hureaulite crystals along fracture surfaces in massive triplite or along fractures in quartz. The lengthwise striated hureaulite crystals (1-2 mm) generally lie along their length on a coating of earthy green mitridatite or grass-green beraunite with jahnsite-(MnMnMn), strunzite, and/or rockbridgeite. Phosphosiderite is not usually directly associated.

HURLBUTITE

$\text{CaBe}_2(\text{PO}_4)_2$

Paris? - Mount Mica Q; **Rumford** - Black Mountain Q

A hurlbutite specimen labeled Mount Mica quarry, **Paris** has been observed by us and is believed to be from the G. E. Smith quarry, Newport, New Hampshire.

Hurlbutite is known from a single specimen from Black Mountain quarries, **Rumford** (Sidney A. Williams, personal communication, 1988). The colorless, sub-vitreous mineral can be pseudocubic (6 mm) transparent or coated by tan botryoidal hydroxyl-herderite in vugs in cleavelandite with carbonatite fluor-hydroxyl-apatite, eosphorite, and "roscherite." The mineral was originally identified as goyazite (q.v.). Tiny unidentified golden yellow grains which resemble the remarkable fluorite from the Bell pit, might actually be "roscherite."

hyalite = a variety of transparent common opal (q.v.)

hydrargillite = gibbsite (q.v.)

hydrate of silica = diatomite?

Limerick; Newfield

Hydrate of silica is normally ascribed to common opal, but Jackson (1838a) clearly signified material that would now be

classed as diatomite: "Hydrate of silica, a white mineral, frequently mistaken for, and sold as magnesia, is found abundantly in the low grounds of Newfield... Beneath the peat of Limerick occur valuable beds of hydrate of silica..."

***hydro-herderite** = hydroxyl-herderite

hydromica = generic name for muscovite or cookeite; see discussion under damourite

Auburn - Pulsifer Q, Wade Q; **Vinalhaven** - Ames Knob A

Bastin (1911) wrote of the Pulsifer and Wade quarries, **Auburn**: "The hydromica cookeite occurs principally in the pockets with quartz as a coating on lepidolite, quartz, feldspar, and tourmaline."

Smith (1901) noted an unusual occurrence of hydromica on Ames Knob, **Vinalhaven**: "Prof. Beecher states that nearly all the corals are confined to the lower beds, being found in a conglomerate of coral fragments together with quartz and hydromica schist pebbles, and in a limestone."

hydromuscovite - generic term indicating incipient alteration of muscovite; synonym of illite; see discussion under damourite

Bradstreet - Catheart Mountain P

Ayuso (1987) indicated that the white muscovite from the Catheart Mountain Porphyry Copper Deposit, **Bradstreet** in many instances, had begun to alter to "hydromuscovite" and had acidic water replacing some of the potassium.

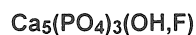
***hydronephelite** = altered nepheline

Litchfield - Dennis Hill A; **West Gardiner** - drift boulders

Hydronephelite was first named by Clarke (1886c) on fine-grained, chalky white specimens from **Litchfield**. Further research on the origin of hydronephelite was made by Clarke (1900b). Clarke (1886c) stated that: "So close is the association in fact and so similar in occurrence are the two minerals [hydronephelite and sodalite] that the latter [hydronephelite] has been called white sodalite by the local collectors. Like the sodalite it is found in seams, and yields specimens as much as two centimeters in thickness; it is white, lusterless, and has the fracture of sodalite, and probably it originated from the alteration of the latter. ... Hydronephelite, indeed, is directly derived from sodalite, but the latter itself probably originated from elaeolite; so that the new species may quite properly be considered along with the other zeolites which were previously mentioned." Kunz (1885) noted a Litchfield material that was later called hy-

dronephelite: "...some of the white seams found are evidently altered sodalite ..." Hydronephelite was discredited by Thugutt (1910) as a mixture of natrolite (82%±), hydrargillite (gibbsite [15%±]), and diasporite (2%±). Hydronephelite from other world-wide localities can be pink, as well as snow-white.

HYDROXYLAPATITE (Apatite Group)



Auburn; **Buckfield** - *Bennett Q*; **Greenwood** - *Emmons Q*; **Hebron** - *Mount Rubellite Q*; **Newry** - *Bell Pit, Dunton Q, Rose Quartz Crystal L, Scotty Q*; **Norway?** - *BB #7 Q*; **Paris** - *Mount Mica Q*; **Rumford** - *Black Mountain Q*; **Stoneham** - *Lord Hill Q*

Hydroxylapatite is related to fluorapatite, but is considerably scarcer than that species. In Maine, hydroxylapatite is usually found in replacement carbonate bodies, near phosphate minerals, and is formed by late-stage aqueous fluids in pegmatites. These fluids are generally very depleted in fluorine. It is not possible to unambiguously identify hydroxylapatite based on sight examination or its association with other species. Many "francolite" specimens are actually the hydroxyl-dominant member of the series. Carbonatian hydroxylapatite is given the varietal name dahllite. The descriptions and suggested identifications in this section are partly arbitrary. The optical properties of this part of the apatite group decrease in magnitude with lowering fluorine contents. However, increasing carbonate substitution, as (CO₃OH), reverses the trend and raises the indices of refraction. The effect does not equally compensate for the lowering of refractive indices by hydroxyl substitution for fluorine. Without a chemical analysis, then, optical properties cannot provide final species identifications. In general, hydroxylapatite is white, tan, or cream-colored. Carbonatian apatite is a generic term which can cover specimens which are either fluorine- or hydroxyl-dominant. Carbonatian apatite will effervesce slowly in cold dilute hydrochloric acid.

Bright transparent and colorless simple hexagonal hydroxylapatite crystals (generally 0.1-0.2 mm) sometimes form granular clusters and septa in vugs of rhodochrosite, reddingite, jahnsite-(MnMnMn), etc. at the Emmons quarry, **Greenwood**.

The Bell Pit, **Newry** has abundant apatite specimens. Tan (1-2 mm) spherical clusters of hydroxylapatite can be found on the clear to lilac fluorapatite crystals in veins cutting across the pegmatite. The white caps on the clear fluorapatite crystals (1 mm) in siderite vugs might be hydroxylapatite. White fibrous to splintery hydroxylapatite can be found in thick "paintbrush" sprays or in individual "whiskers" (to less than 1 mm) and groups of whiskers in siderite. (Care should be exercised in identifying fibrous apatites, moraesite, strunzite, etc. as they have subtle differences which require comparison with identified samples in order to be appreciated. Flat "c" pinacoid terminations can sometimes be observed on the hydroxylapatite crystals.)

The Dunton quarry, **Newry** has hydroxylapatite which, when highly magnified, resembles the splintery texture of wooden matches. The individual "crystals" are less than 1 mm, but form patches of crystal clusters sometimes several centimeters across. The color varies from snow-white though tan to pale salmon-colored. The hydroxylapatite can be found in siderite/rhodochrosite fillings in blue tourmaline eyes frozen in cleavelandite or in the interstitial vugs formed by intersecting cleavelandite blades and occasionally in lepidolite cavities. Sprays of salmon-colored hydroxylapatite sometimes are found grown on blue fluorapatite in the cleavelandite vugs. Waxy white to tan coatings of what appear to be francolite might actually be dahllite at this locality. Splintery clear whiskers to bladed hydroxylapatite (1 mm) crystals have been found with eosphorite "suns" (1 mm) in albite quartz pegmatite. Colorless to white; radial and intergrown circular hydroxylapatite is found as interlamellar inclusions (to several mm) in muscovite from the Dunton quarry.

The Scotty quarry, **Newry** has produced some highly etched wafers of white hydroxylapatite (to 1 cm) that are barely recognizable as crystals.

At the Rose Quartz Crystal locality, **Newry** abundant tan, hydroxylapatite crystals (1 mm) of the splintery matchstick variety are found in albite vugs with or without associated phosphates or rose quartz crystals.

Minute colorless to cloudy hydroxylapatite crystals (to 1 mm) are found in parallel bundles (to several mm) in siderite in blue tourmaline eyes from the Mount Mica quarry, **Paris**.

The Black Mountain quarries, **Rumford** have abundant examples of the fluorapatite/hydroxylapatite series. The distinction has been based on a few determinations. Small (1 mm) white and frosted elongated carbonatian hydroxylapatite crystals with prism-"c" pinacoid combinations are found, sometimes stained by limonite or dark brown to black minerals, and occur in vugs in albite-muscovite pegmatite. "Paintbrush" bundles of carbonatian hydroxylapatite crystals (to 2 mm) have been found in cleavelandite. The smaller clusters tend toward fibrousness and are white their entire length, and sometimes epitaxial on gray cores which are probably fluorapatite. The larger bundles are more compact and are better termed parallel-growth with the multiple terminations white and the main body of the prism gray. The luster is dull to waxy. Small needles have a higher apparent luster. Much of the botryoidal francolite at this locality is probably dahllite, as it is hydroxyl-dominant over fluorine, but there is no reliable way to sight-identify the material.

*HYDROXYL-HERDERITE



Albany - *Bumpus Q, Songo Pond Q*; **Auburn** - *Greenlaw Q, Keith Q (= Towne Q), Maine Feldspar Q, Pulsifer Q*; **Buckfield** - *Bennett Q, General Electric Q*; **Georgetown?** - *Consolidated Q*;

Greenwood - Beryllium Corporation Q, Emmons Q, Harvard Q, Heikkinen Q, Tamminen Q, Tiger Bill Q, Waisanen Q; **Hebron** - Hibbs Q, Mount Rubellite Q; **Newry** - Bell Pit, Dunton Q, Kinglet Q, Nevel Q, Rose Quartz Crystal L; **Norway** - BB #7 Q; **Paris** - "not Mount Mica Q" (=Hammond Farm Q?), Mount Mica Q, Ryerson Hill Q; **Poland** - Berry-Havey Q; **Rumford** - Black Mountain Q; **Stoneham** - Lord Hill Q; **Topsham** - Fisher Q, Purington Q?; **Waterford?** - Black Guard A; **West Paris** - Cobble Hill Q (=Ski Pike Q)

Hydroxyl-herderite was found at Lord Hill, erroneously called Harndon Hill in some references, **Stoneham**, early in the mining by Nathan Perry in the 1880's. The species, "hydro-herderite," was not recognized until 1894 by Penfield from an undisclosed locality in **Paris** ("not Mount Mica") along with "two localities" in Greenwood; [Mount Rubellite quarry], Hebron; [Lord Hill quarry], Stoneham; and an unspecified Auburn locality, perhaps the Maine Feldspar quarry. Earlier, Wells and Penfield (1892) noted that this calcium analysis of Hebron material was a "failure," but "The analysis shows the mineral to be a new and interesting variety of herderite almost free from fluorine. The result confirms the idea advanced by Penfield and Harper that fluorine and hydroxyl are mutually replaceable ..."

The visual identification of hydroxyl-herderite is frequently difficult, especially if a person has not seen a large number of specimens. The luster of hydroxyl-herderite is usually waxy and the color is usually tan, cream-colored, pale straw-yellow, colorless, etc. which results in the mineral being inconspicuous. The main problem with identification is the typical "rounded" appearance of hydroxyl-herderite crystals. A feature which can be helpful is response to ultraviolet light. Most Maine hydroxyl-herderite is slightly to very distinctly fluorescent yellow in short wave ultraviolet light. Sometimes the response is so slight that the eyes have to be dark-adjusted for several minutes before the fluorescence can be seen apart from the general purple-red reflection of the ultraviolet light on the specimen's surface.

The Herderite Controversy

What seems to be an inordinate number of articles concerning this mineral appeared in the scientific literature in the latter nineteenth century, and the interest was not entirely due to mineralogists merely trying to discover what minutiae the mineral had to offer. Chemical analysis had begun to mature and the older minerals had much that needed to be rectified in their formulas. The phosphates amblygonite-montebbrasite and herderite/hydroxyl-herderite were crucial species in understanding the role of hydroxyl, fluorine, and water in minerals. The concept of such a substitution began to unlock the understanding of the laws of mineral chemistry.

Hidden and Mackintosh (1884) said that the mineral from Stoneham was at first thought to be topaz due to its orthorhombic

character, but their preliminary research established it as "herderite" based on a qualitative analysis for phosphorus and a crystallographic study. Hidden and Mackintosh (1884) reported that as no quantitative analysis had ever been published to establish the species, they made their own quantitative analysis where they determined fluorine by analogy, rather than directly. E. Dana (1884b) made a crystallographic study of Maine and German crystals to ascertain their relationship, but the monoclinic symmetry was discovered by Penfield, 1894. Des Cloizeaux (1884) studied Stoneham "herderite" and found it had similar optical properties to the Ehrenfriedersdorf, Germany material. Later, a comparison of Weisbach's (1884) and Hidden and Mackintosh's (1884) analyses of herderite by "R" (1884) revealed the presence of water in the Maine material and contrasted the result with the supposed fluorine-bearing character of the original German herderite, but the analyses were inadequate to draw proper conclusions for a formula. They did, however, discover that "herderite" was a beryllium-bearing mineral rather than an aluminum-bearing one. Hidden and Mackintosh (1884) had pondered: "In case the original determination of Herderite, by Turner and Plattner, was correct, namely, an *alumina* lime phosphate fluoride, then this mineral from Maine is not herderite but a new species. However, the probability is, from the imperfect nature of the work previously done, that this mineral from Maine is identical with the herderite of Haidinger (Phil. Mag., iv, 1, 1828, Dana's Syst. Min., p. 546). Should it prove to be otherwise, we suggest the name of *Glucinite* as appropriate." Packard and Cope (1884) summarized research on herderite. Subsequent researchers believed that there was no doubt that the mineral was related to herderite; no one addressed the suggestion of the mineral being called glucinite; and everyone accepted the essential nature of beryllium in herderite. Penfield (1894) finally established that Maine crystals were, in fact, a new species and named hydro-herderite. Glucinite was an inappropriate name as it was the same as redefined herderite. When Penfield (1894) introduced the name hydro-herderite, he, too, did not discuss the place of glucinite in the series. Palache et al. (1951) changed the name to hydroxyl-herderite.

The scientific competition was intense concerning this species. (The real concept at stake was the role of water in a mineral. The earlier inklings of water's role in minerals is discussed under montebbrasite, amblygonite, and hebronite. Students of the history of mineralogy should understand that the focus was not the "tempest in a teapot" of rare mineral nomenclature. These species merely provided the ammunition on a much wider battleground. Moore (1989) stated that the identification of hydroxyl substituting for fluorine in a mineral was first made by Penfield, but the first announcement of the concept, in English, appears to have been made by Penfield's colleagues George Brush and James Dana (1878). Note the earlier montebbrasite problem.)

George Kunz provided specimens of "herderite" collected by Nathan Perry to Genth. Genth wrote (September 27, 1884; AMNHL) to Kunz: "I expected that I had already about \$46- but

his Draft was not honored; otherwise I would have invested the amount in Herderites. ... The herderite analysis is far more troublesome than I had anticipated, although I know that it was not easy. The preliminary analysis gave on ignition a loss of about 4%, so I thought there might be some water, but the best xls gave from $\frac{1}{3}$ gram only 2 milligrams loss which is probably owing to the slight volatility of lead fluoride, and therefore the mineral contains no water. - The topaz analysis - of colorless cleavage pieces - is commenced. I have just determined the Sp. Gr. which is 3.553. - Also a difficult analysis. -" Genth wrote to George Kunz (October 6, 1884; AMNHL): "The analysis of herderite is progressing and I hope to finish it in the course of next week and intend to read my paper on 3d Friday of this month, and have it printed immediately; therefore let me have the remarks which you wanted to make in time to insert in my paper. You have undoubtedly seen Winkler's analysis in the last number of the Journal of Science. His analysis I may say already is erroneous. But I have just commenced the analysis of the best xls and when finished we will see the differences."

Genth (1884) said: "The analysis of herderite presents great difficulties ..." After a discussion of the methods of analysis that he used, he compared the analyses of Hidden and Mackintosh (1884) and Winkler (in Weisbach, 1884) which varied considerably from each other. (The totals varied from Genth's lowest at 90.76 % to Winkler's amazing 114.89%. One of the totals (for Ehrenfriedersdorf herderite) came out to 100.00%!) Genth's (1884) best analysis (# IV) gave $\text{Ca}_{.98}\text{Be}_{.99}(\text{PO}_4)_2[\text{F}_{.96}(\text{OH})_{.08}]$, which would be regarded as nearly end-member herderite. Genth was obviously a scientist of remarkable openness and scientific integrity. He discussed his errors and places where low analyses were obtained, which is quite a different style than the seemingly effortless analyses reported by the Yale mineralogists and chemists. (Penfield undoubtedly was one of the finest mineral analysts since Berzelius when compared with the knowledge of the times.) Genth (1884) commented, however, on Winkler's results (in Weisbach, 1884): "It is to be regretted that the results of Dr. Winkler's two analyses are so very unsatisfactory, and that he has sacrificed the very precious Ehrenfriedersdorf herderite by employing incorrect methods for his analyses." The controversy is fascinating to follow and in Genth (1886) a glimpse of personality is seen:

"Dr. Winkler published (Jahrb. Min., 1875, i, 172), a justification of his work on herderite in which he says that *my reproach that he had sacrificed valuable material by the use of incorrect methods, is unwarranted and that he must firmly repel it*.

I had intended to reply to Dr. Winkler, but really do not see any necessity for it, because, he fails to show any error in my work, but only tries to find excuses for his own shortcomings, and mentions experiments made with apatite, a mineral with which herderite has no resemblance, either physically or chemically.

That the minerals from Ehrenfriedersdorf and Stoneham are identical, as *I have suggested*, he now admits, and as this *settles the main question* it would be a waste of words to say more about the matter."

By 1886, Penfield and Harper had reanalyzed the Stoneham material and proposed the isomorphous substitution of hydroxyl and fluorine and showed the Stoneham species to have OH:F contents ~4:3, but they did not propose a new species at that time. In 1894, Penfield published on some material from a new locality, "not Mount Mica," in Paris and previously five other localities. He said: "The analysis revealed the interesting fact that the mineral is herderite and that it contains practically no fluorine, agreeing in this latter respect with a variety described by Professor Wells and the author [1892] from Hebron, Me. ... The analyses indicate a well defined type of herderite which may well be called hydro-herderite in distinction from the variety containing fluorine." From this and other statements, the type localities for hydroxyl-herderite consists of five different places. Penfield (1894) discovered the monoclinic symmetry and cryptically twinned nature of hydro-herderite. Ford (1911) reported on the morphology of obviously twinned "herderite" (Pulsifer quarry?, Auburn) and determined F:OH nearly 2:1. (The Pulsifer quarry had been recently activated during the time period and many fluorapatite specimens from the gem pocket assemblage were found.) Leavens et al. (1978) were able to study the original crystal of Penfield (1894) and determined that it contained about 1 weight % fluorine, corresponding to 91% end-member hydroxyl-herderite.

Leavens et al. (1978) made 41 analyses of worldwide members of the series: three from Poland, six from Stoneham, two from the Bennett quarry, Buckfield, one from Greenwood, four from Auburn (including Ford's (1911) original crystal), one from Paris, and one from Topsham. The compositions from these Maine samples ranged from 91% hydroxyl-herderite to a low of 61% hydroxyl-herderite. The analyses of Auburn material varied by 34% relative to the four analyses. It is unclear how many localities were represented by the Auburn analyses. The Stoneham analyses, presumably representing only one locality, varied by 18% over the six analyses. The hydroxyl-herderite from the Fletcher quarry, North Groton, New Hampshire varied by 28% in two analyses from one locality. A specimen from Poland, Maine yielded 19% relative fluorine variation in a single crystal, though it was not stated which portions of the crystal gave the results. Leavens et al. (1978) discussed the uncertainty of the accuracy of the nineteenth century methods for fluorine analyses, while their electron microprobe results varied from totals of 98.00% to 100.38% total determined components. The results of the Leavens et al. (1978) study suggest that, in all probability, no herderite was found in Maine and only one true herderite, a gemstone from Brazil, was found in all of the samples they investigated. Leavens et al. (1978) provided equations for determining the fluorine composition of the series from refractive indices.

Hidden (1886) reported that for Stoneham material: "This American herderite can be readily distinguished by its phosphorescence in the dark when gently heated. It exhibits under this treatment a bright orange-yellow color; amblygonite from the same locality showed a bright lavender-blue phosphorescence."

Description of Specimens

The major hydroxyl-herderite localities on Mount Apatite, **Auburn** (Maine Feldspar quarry, Greenlaw quarry, Pulsifer quarry, and Keith quarry) have so few adequately labeled specimens to represent them that it is not possible to be definitive concerning systematic descriptions of the modes of occurrence.

Several types of matrix are noted from Mount Apatite. Hydroxyl-herderite crystals placed on quartz crystal faces are generally transparent with internal flaws. The crystal faces have oily luster and are relatively sharp, as are hydroxyl-herderite crystals perched on cleavelandite crystals. The rounded, big tan to murky amber hydroxyl-herderite crystals, which are as large as three centimeters and more, are usually found on yellow- to brown-stained albite. Peculiar clusters of subparallel crystals of yellow muscovite with rounded-terminations are sometimes associated, along with occasional cookeite. Corrugations and furrows parallel to the otherwise rounded crystal edges are seen on a few etched hydroxyl-herderite crystals. Hydroxyl-herderite crystals are found on parallel-growth smoky quartz crystals or corrugated etched albite crystals from unspecified Mount Apatite quarries.

In general, the Pulsifer quarry was not a major producer of hydroxyl-herderite. Clear to tan Pulsifer quarry hydroxyl-herderite is found in generally less than one centimeter crystals on tan to yellow fine-grained cookeite on quartz. Sub-parallel hydroxyl-herderite crystals are frequently splayed in "bow tie" fashion. White fluorapatite with lilac phantom cores can be associated. Milky white hydroxyl-herderite crystals (to 8 mm) from the Pulsifer quarry can have light to dark coffee-brown cores and be found on the concave surface of cookeite casts (to 2 x 4 cm) after "rectangular" minerals (principally elbaite).

Bastin (1911) wrote of the Maine Feldspar quarry, Auburn: "Crystals of light bluish-green beryl also occur rather abundantly, embedded in the solid pegmatite. One hexagonal beryl found about 1898 is reported by J. S. Towne to have been 4 feet in diameter and 20 feet in length, but the majority do not exceed 1 foot in length and a few inches in diameter. Near the gigantic beryl mentioned occurred several pockets bearing the finest crystals of herderite ever found on Mount Apatite; the form and composition of these have been described by Penfield.^b" The footnote "b" refers to Penfield (1894). An insight is given by Penfield (1894): [Hydro-herderite] "...as far as known to the author is represented by a single specimen in the Bement collection and two crystals belonging to Mr. T. F. Lamb of Portland, Maine." No Mount Apatite "herderite" specimens are mentioned in reports or correspondence prior to Penfield (1894) and it may be surmised that the pit worked by Nathaniel Perry [Hatch Farm] did not earlier produce hydroxyl-herderite. (Nathaniel Perry died May 19, 1890.) However, mining at the pit area by Thomas Lamb along with Loren Merrill in 1890, followed by the workings of the Mount Apatite Mining Company, organized in 1891 and later reorganized, through merger, to form the Maine Feldspar Company, was the principle source of hydroxyl-herderite. Many

smaller prospect pits were opened by Perry and others, but none approached meaningful size. Lamb appears to have also worked the Greenlaw quarry [originally Joshua Littlefield Farm abutting to the north of the Hatch Farm](Kunz, 1898) and no mention of rare minerals or hydroxyl-herderite is made until H. U. Greenlaw worked that property (about 1912 [Sterrett, 1914]).

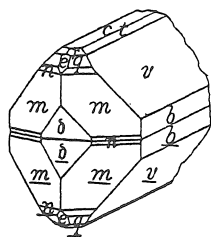
Colorless and transparent, typically rounded, hydroxyl-herderite crystals (to 3 mm) have been found at the Greenlaw quarry, Auburn on etched, recrystallized albite matrix. Conical muscovite crystals (to 3 x 3 x 5 mm) with a triangular cross-section are found throughout the albite in roughly parallel growth. The hydroxyl-herderite can be found along fractures in this matrix or on surfaces of the etched feldspar. Occasionally, the hydroxyl-herderite matrix is composed of botryoidal or "ball" muscovite.

The Keith quarry (originally the Towne quarry), Auburn had a large early twentieth century production of hydroxyl-herderite, but few specimens have been labeled precisely. Bastin (1911) noted that: "In April, 1907, a quarry was opened by J. S. Towne, of Brunswick, Me., on the Pulsifer farm about one-half mile northwest of the Maine Feldspar Company's quarries on Mount Apatite. ... Some fine specimens of herderite have also been found at this locality. This mineral occurs in short prisms, few of them over one-fourth inch long, commonly as an incrustation on the quartz crystals of the pockets. One short stout crystal attached to muscovite was as large as the end of one's thumb."

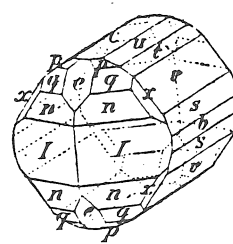
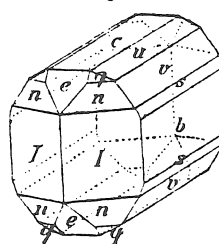
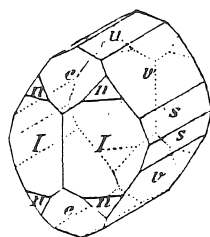
Bennett quarry, **Buckfield** is a prolific producer of hydroxyl-herderite. It became so common, in the 1970's, that numerous specimens were tipped onto the dumps as supply far exceeded collector demand. The crystals (up to 3-4 cm) have typical development: prismatic with tiny multiple-growth terminal faces, rounded forms, occasional fish-tail twins, and tan to cream-colors. The associated minerals are generally cookeite, quartz crystals (3-5 mm to large sizes of many centimeters), cleavelandite, and accidentally associated species. Landes (1925) wrote of the Bennett quarry: "Several pale green crystals were found embedded in cleavelandite. Others either clung to the sides of lepidolite books, or partially enclosed them... The largest crystal is 4 centimeters long, 1.2 centimeters wide, and a centimeter thick, but most are about a centimeter long. Many of these smaller ones are twinned."

Lewis (1933) noted of the Bennett quarry hydroxyl-herderite: "A most peculiar and inexplicable development in this suite wherein herderite invariably seems confined to one particular side of the mineral it replaces; large, free-growing milky quartz crystals are coated and etched by this herderite, always on one side of the specimen only." Tan to nearly white hydroxyl-herderite crystals (to 5 mm) are found closely sprinkled on cookeite epimorphs. Loose pocket crystals (to 4 cm) have been found.

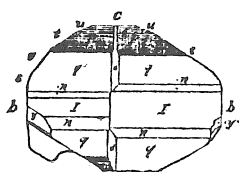
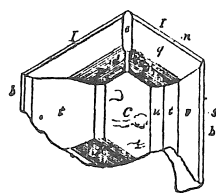
General Electric Pollucite quarry, Buckfield hydroxyl-herderite crystals (2-4 mm) are frosted very slightly, tan to light cloudy gray, and are even more inconspicuous than normal for the species. The associated minerals at this locality include tiny



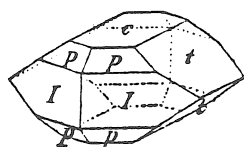
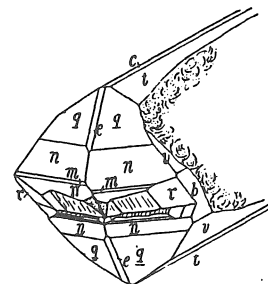
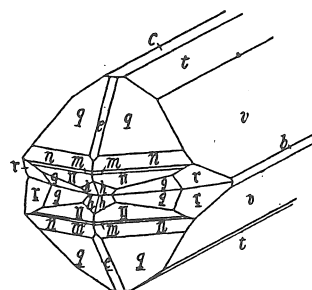
Maine Feldspar Q, Auburn
(from Penfield, 1894)



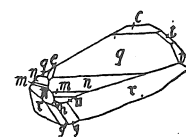
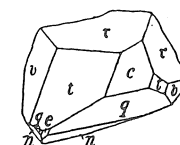
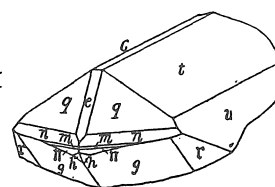
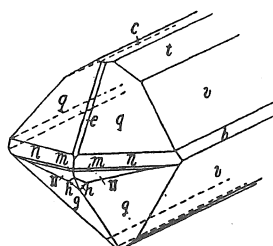
Auburn (from Dana, 1884b)



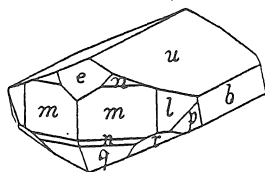
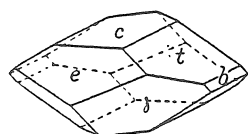
Lord Hill Q, Stoneham (from Hidden, 1886)



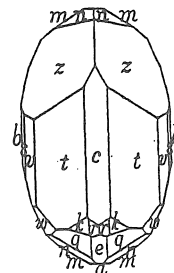
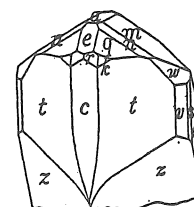
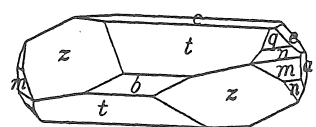
Auburn
(from Dana, 1884b)



Auburn (from Ford, 1911)



Greenwood (from Penfield, 1894)



Mount Rubellite, Hebron
(from Penfield, 1894)

"Not Mount Mica," Paris
(from Penfield, 1894)

Hydroxyl-herderite

(less than 1 mm) white carbonatian fluorapatite in granular "crystals" and cleavelandite.

Morong (1990) listed from the Consolidated quarry, **Georgetown**: "Herderite tentative identification based on material in a vug of cleavelandite, waxy, botryoidal, with a slight fibrous internal radiating structure, very much like hydroxyl-herderite. Had childrenite [sic; = eosphorite] crystals growing out of it." No data were given. Specimens available appear actually to be carbonatian fluorapatite.

Emmons quarry, **Greenwood** hydroxyl-herderite is found on cleavelandite and muscovite. The color of the crystals varies from cream white to pinkish tan. While Mount Apatite hydroxyl-herderite is usually untwinned, Emmons crystals are generally fish-tail twinned (to 1.5 cm) and show a rounded, wedge-cross-sectioned, "Roman Sword" termination. Tan to brown translucent waxy botryoids (to 2 mm) of hydroxyl-herderite are found in albite vugs at the Emmons quarry, also.

Harvard quarry, **Greenwood** hydroxyl-herderite is relatively scarce. It is found in tan to cream-colored twinned crystals (to 5 mm) on cleavelandite as well as 7-8 mm twins on cookeite with red-brown to chocolate-colored external color zones on tan hydroxyl-herderite cores. A single specimen of orange-brown botryoidal (1-2 mm) hydroxyl-herderite on green tourmaline was found at the Harvard quarry.

Tamminen quarry, **Greenwood** hydroxyl-herderite is found as tan, wedge-shaped crystals (to 7 mm) which are not unlike titanite in appearance, except that the crystals are somewhat rounded and occur in vugs in cleavelandite and quartz matrix.

The best publicized single find of hydroxyl-herderite in Maine was made in 1963 at the Waisanen quarry, **Greenwood** (Perham, 1964). Several habits were encountered. When cookeite was abundantly associated, the creamy white hydroxyl-herderite had a polygonal wafer shape. Hydroxyl-herderite with an oblique rhombic shape was found on limonite- and clay-coated normal quartz crystals (5 mm) and highly corroded microcline. A few specimens crystallized directly on quartz crystals (to 20 cm) with bertrandite crystals (to 1 cm) and lilac fluorapatite crystals (to 2 cm) associated in a few specimens. (Hydroxyl-herderite was known from two unspecified localities in **Greenwood** in 1894 (Penfield).)

Faulkner (1953b) wrote of the Tiger Bill quarry: "In October, 1951, some pocket material was found on the dump at Tiger Bill mine in **Greenwood**. ... There was purple and blue apatite, beryl with beveled terminations and with etched surfaces, clusters of mica crystals, and many odd quartz crystals. Some of the beryl and many of the quartz crystals were encrusted with small crystals varying in size up to about one-eighth of an inch long. These smaller crystals were later identified by C. S. Hurlbut as herderite." Marble (1951c) mentioned the same find.

Mount Rubellite, **Hebron** crystals get to be large (over 2 cm), but such large crystals are frequently etched and show an "alligator-hide" surface of multiple-growth terminations. The smaller crystals have a smoother surface though they can be coated with brown stains. The matrix can have cookeite, quartz

crystals, lilac fluorapatite, lepidolite, and cleavelandite. Somewhat rounded, small colorless and transparent pseudocubic (to 2 mm) hydroxyl-herderite crystals are found on transparent quartz crystals (to 1 x 0.2 cm) with cookeite and zygadite albite. Milky tan pseudocubic hydroxyl-herderite crystals have been erroneously called goyazite (q.v.).

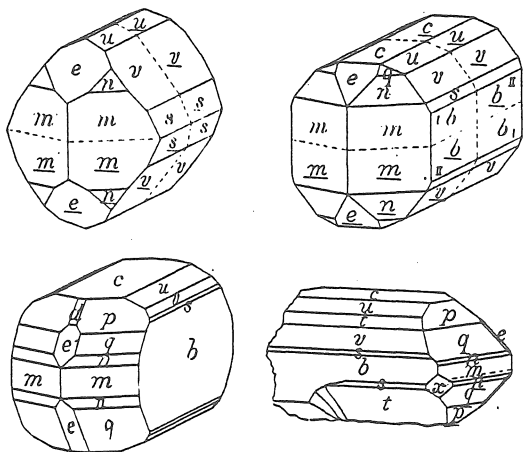
Hydroxyl-herderite is abundant at the Dunton quarry, **Newry**, but the mineral is generally botryoidal (despite the comments of Yedlin (1972) and illustration in Roberts et al., 1974). Palache and Shannon (1928) described the alteration of beryllonite to hydroxyl-herderite: "It was first noted as tiny colorless spheres attached to the tips of albite crystals of acicular habit. These [hydroxyl-herderite] have exactly the translucency and gray color of chalcedony. Later it was found in considerable abundance lining small cavities with a botryoidal coating. Similar fibrous masses coat the beryllonite crystals and form walls dividing the interior of hollow pseudomorphs of that mineral." King (1975b) noted: "Hydroxyl-herderite occurs as botryoidal groups of an amber color. The luster is waxy and the color ranges from white to brown in its extremes. Botryoids to 5 mm have been observed. ... It coats the beryllonite masses as well as the solution vugs inside. ... The surface of the botryoids is generally smooth. Internally they show a radial fibrous structure."

Crystals of this mineral are rare at **Newry**. Yedlin (1972) described the crystals as 'somewhat equant'." Botryoidal hydroxyl-herderite is found in cleavelandite interstitial cavities and can be found on a variety of phosphates including fluorapatite, eosphorite, wardite, etc. It is paragenetically earlier than iron-rich roscherite, uralolite, and moraesite. An indistinct illustration of a **Newry** hydroxyl-herderite crystal is seen in Roberts et al. (1974). No quarry specified.

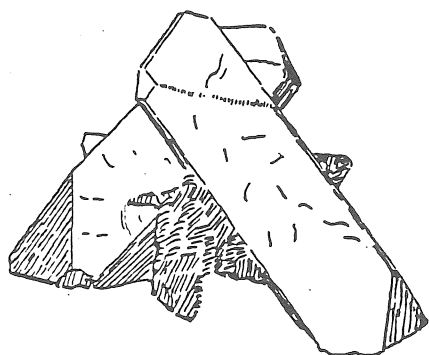
Tan botryoidal hydroxyl-herderite (2 mm) has been found with albite and acicular green elbaite at the Kinglet quarry, **Newry**.

Berry-Havey quarry, **Poland** hydroxyl-herderite crystals (generally 2-5 mm) exhibit a wide variety of appearances. Typical blocky, cream to tannish yellow crystals with barely perceptible twinning have been found, as well as a 6 cm fish-tail twin (Terry Szenics, personal communication, 1988). Less obvious habits include prismatic crystals with essentially square cross-sections and dome-like terminations which give the combination a topaz-like habit. Some transparent hydroxyl-herderite on pale smoky quartz crystals (1-3 mm) are wedge-shaped and a few look like albite crystals without striations. One twin is canary yellow (about 2 cm) and forms part of an intergrown group of crystals (to 3.5 x 4 x 0.5 cm) which are partly colored green due to small elbaite inclusions (Ray Woodman, personal communication, 1991).

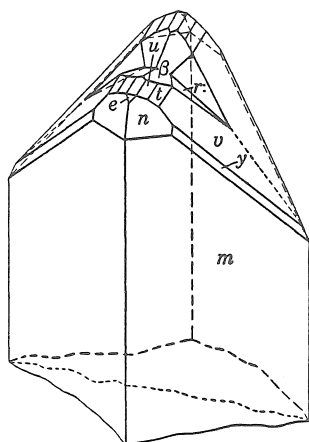
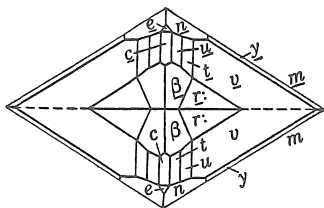
Black Mountain quarry, **Rumford** has produced botryoidal hydroxyl-herderite (to 2 mm) associated with the valencianite or zygadite variety of albite crystals (to 2 mm), muscovite crystals (to 4 mm), botryoidal masses of carbonatian hydroxylapatite (to 2 mm), "roscherite" crystals (to less than 1 mm) in cleavelandite, and equant-grained (to 3 mm) albite.



Lord Hill Q, Stoneham (from Penfield, 1897)



Fisher Q, Topsham (from Palache, 1934)



Fisher Q, Topsham (from Palache et al., 1951)

Hydroxyl-herderite

The Lord Hill quarry, **Stoneham** produced the first hydroxyl-herderite in Maine and, therefore, in the world, but the true chemical character of the mineral was not recognized. It was found in quartz pockets, some large enough for a child to stand erect in, as well as in the vuggy albite that frequently occurs above pockets. The mineral was first thought to be tiny topaz crystals, because of the similar habit. The hydroxyl-herderite crystals (to 2.3 x 2.5 x 1.8 cm) have an elongated rhombic cross-section. The mineral usually sits on fine- or coarse-grained muscovite, cleavelandite, quartz crystals (to several mm), and on one specimen, beryllonite. An early report by Hidden (1886) stated: "The crystal here noticed was found in the early part of 1884 at the locality near Stoneham, Me., by Mr. N. H. Perry, but it did not come before me for examination until after the notices of this material had appeared. ... Excepting ... [three forms] all the planes observed on the American crystals occur on this crystal, and one new plane, the unit macrodome, is seen to be present ... The pyramid [in Figure] 1 (111, *p*) is invariably dull and waxy looking on the crystals from Stoneham and for this reason it is distinguished from the other planes. This crystal has a diameter through the macro-axis of 25 mm and in point of size and general perfection is unequalled." Many crystals, however, are etched and rounded in form and do not have an immediately recognizable shape.

Fisher quarry, **Topsham** hydroxyl-herderite has a distinctive appearance for Maine. The crystals (to 5 cm) were, until the 1970's, the largest crystals known, but specimens from Virgem da Lapa, Minas Gerais, Brazil greatly eclipsed them. By 1989, even the United States record passed to a specimen from the MGM pegmatite, San Diego county, California. The Fisher quarry crystals have a nearly equant development and look like very short to wafer-like simple topaz crystals composed of triangular crystal faces. With additional faces, the hydroxyl-herderite begins to resemble its appearance from the various other Maine locations. The associated species include: muscovite, elbaite, microlite, and cleavelandite.

Cobble Hill quarry (Ski Pike Q), **West Paris** had tannish brown to pale greenish brown hydroxyl-herderite crystals (to 2 cm) which were relatively sharp, with an almost square cross-section and asymmetric "pyramidal" termination and were found with cleavelandite and quartz in a gem pocket.

HYDROZINCITE



Blue Hill?; **Brooksville?** - *Cape Rosier M (=Callahan M)*; **Deer Isle** - *Deer Isle M*; **Pembroke** - *Barrett P (=Dolsan Pit)*

Carpenter and Foster (1960) report having tested the specimen described by Hinckley (1951) from Cape Rosier mine, Harborside, **Brooksville** and found it to be fluorescent calcite. Gregory (1969) listed blue-white fluorescent hydrozincite from the Callahan mine.

A specimen of hydrozincite from the Deer Isle mine, **Deer Isle** is in the Canadian Museum of Science and Nature, Ottawa, Ontario, Canada. Specimen not seen.

Hydrozincite is an alteration product of zinc ores which forms during the oxidation of the material. The Barrett prospect, **Pembroke** has fluorescent (blue-white, short-wave ultraviolet)

snow-white earthy botryoidal coatings in limonite. Smithsonite and hemimorphite are associated.

hypersthene - see enstatite

I

ICE

H₂O

usually seasonal - virtually no Maine town without it; Greenwood - ice caves; Kennebec River - Gardiner; Penobscot River; Monhegan - Ice Pond; Riley - Mahoosuc Notch ice caves

Ice crystals are usually dendritic and a series of drawings will serve to show the variety of habits, though it has been rumored that some identical snowflakes have been found in Maine. (Note: Water is not a mineral as it is a liquid and would be better thought of as molten ice.) One of the earliest reports of Maine ice (variety snow) was Levett (1628): "Another evil or inconvenience I see there [Maine], the snow in winter did lie very long upon the ground."

Ice is rarely thought of as an industrial mineral, today. The definition of an industrial mineral is one which is mined to be used unrefined for an industrial application. The Kennebec and Penobscot rivers, in particular, have served as sources of ice for icebox-style refrigeration. The now defunct ice industry is described in *Tidewater Ice of the Kennebec River* by Jennie Everson. The mining of river ice in Maine and its effective storage by burial in sawdust, etc. allowed Mark Twain to comment that: "Ice is a wonderful thing. The rich get it in the summer time and the poor get it in the winter." The *Maine Mining Journal* reported (December 30, 1881): "The ice men are happy along the Penobscot and Kennebec. The open winter promises a short crop outside of Maine and it is consequently expected that high prices will prevail for this necessary article during the coming summer."

Gardiner (1865) measured the differential flow of river ice in the center of the Kennebec River ice at **Gardiner**. In March 31, 1882 (MMJ) it was reported: "The Kennebec Reporter estimates the ice out on the Kennebec this season as about 900,000 tons." Ashley (1974) wrote on a modern ice harvest on **Monhegan**.

The "ice caves" in **Greenwood** are claimed to contain ice throughout the year. The depths of "The Cathedral" and the deepest recesses of the other formations generally contain ice continuously, but the deepest cracks and crevices are shrouded in virtual total darkness and are nearly inaccessible. Similarly, the Mahoosuc Notch "ice caves," near the Appalachian Trail, **Riley** contain perennial ice (Charles Guidotti, personal communication, 1990).

iddingsite = altered olivine

Mapleton - *teschenite dikes*; **Paris**; **Perry** - *Loring Cove A*; **Robbinston**

Iddingsite is usually a red to brown fine-grained alteration of olivine. Iddingsite has variable mineralogical composition and is frequently composed of diopside, antigorite, etc.

Toppan (1932) noted of the teschenite dikes in southwestern **Mapleton**: "The minerals under the microscope given in order of their formation include: black iron ore containing some pyrite, apatite, biotite, feldspar, augite, and analcite. ... Alteration products consist of a green chloritic mineral, calcite, serpentine, and a mineral resembling iddingsite."

In describing the igneous rocks of the Perry Formation, **Perry**, Smith and White (1905) said: "Dark reddish brown iddingsite is present, and probably represents grains of olivine, which must have been an important constituent in the fresh lavas." Iddingsite is an indefinite alteration of olivine and sometimes other rock-forming silicates and is variously composed of relict olivine, hematite, goethite, chlorite, etc. At Loring Cove, bright red patches of hematite (to several cm) can be found on and in greenish-black basalt. The combination has been incorrectly identified as iddingsite, bloodstone, etc.

idocrase - synonym for vesuvianite

illite (Mica Group)- a varietal name for muscovite which has been partly potassium-leached due to weathering, hydrothermal alteration, etc.

Auburn; **Augusta** - *Bond Brook A*; **Bradstreet** - *Catheart Mountain P*; **Bristol** - *Muscongus Bay A*; **Brunswick** - *Bunganuc Bluff A*; *Casco Bay area - Presumpscot River, Royal River, Waquoit Bay*; **Gouldsboro** - *Gouldsboro Bay A*; **Jonesboro** - *Chandler Bay A*; **Jonesport** - *Presumpscot Formation*; **Kennebunk** - *Great Hill A*; **Machiasport** - *Machias Bay A*; **Medway**; **Orono** - *esker*; *Penobscot Bay area - Lazy Gut, Turner Farm*; **South Bristol** - *Damariscotta River A*; **Strong** - *Sandy River bridge A*; **Wayne** - *Presumpscot Formation*

Illite is a varietal name for muscovite which has had some inter-layer potassium leached out and H₃O⁺ and/or other components substituted. The mica structure is only partly destroyed by the process. Additionally, some illite represents poorly defined

mixed-layer minerals whose only common characteristic is a 10Å interlayer spacing (Grim, 1968; Carroll, 1970). Illite is frequently found in the clay-sized fraction of muds. Illite is abundant in glacially deposited clays and the clay fraction of tills. Kelley (1989) reported on 19 glaciomarine clays on the western "margin" of the Gulf of Maine and three samples from Maritime Canada. Kelley (1989) indicated: "Although muscovite is certainly a major component of the silt size, no chemical analyses were performed to distinguish it [from illite], and for consistency [sic] with previous work (Carroll, 1970), the 10 angstrom mineral is herein reported as 'illite'." Kelley (1989) further indicated that species composition varied significantly in the various grain size fractions. The "illite" of the studied clay-sized fractions averaged over 60%. The remaining species were usually chlorite and minor feldspar, and usually little or no quartz.

Ayuso (1987) noted that muscovite from the Catheart Mountain Porphyry Copper Deposit, **Bradstreet** had altered to illite. An illite from an unspecified locality in **Auburn** exists (USNM 120757; not seen).

ILMENITE (Ilmenite Group)

FeTiO₃

Blue Hill - *Ellsworth Schist*; **Byron**; **Cutler** - *Cutler diabase*; **TD**; **Dallas** - *Nile Brook*; **TE**; **East Moxie** - *Black Narrows A*; **Eustis** - *was originally identified as molybdenite*; **Farmington** - *Bragdon Brook road A*; **The Forks** - *Black Narrows A*; **Greenwood**; **Harpswell** - *Long Point A*; **Katahdin Iron Works** - *Katahdin Iron Works M*; *kyanite zone* - **Gorham**, **Windham**; **Leeds**; **Monhegan** - *pyroxenite*; **Newfield**; **Newry** - *Dunton Q?*, *heavy mineral sand*, *Plumbago Mountain A*; **Oakfield**; **Rangeley** - *Nile Brook*; **Rangeley Plantation** - *Bog Brook A*; **Rockland**; **Stoneham**; **Stonington** - *Crotch Island Q*; **Topsham** - *Standpipe Hill Q*; **Union** - *Harriman P*; **Vassalboro**; **Warren** - *Warren Nickel P*; **Waterford?**; **Wayne**; **Windham** - *Dundee Falls*

Li (1942) wrote of the Ellsworth Schist, **Blue Hill**: "The dark bands are composed essentially of biotite with minor andalusite, sericite, cordierite muscovite, bleached biotite, magnetite, and ilmenite or leucoxene, but some of the so-called skeleton crystals are still seen."

Gates (1961) noted ilmenite in the Cutler diabase, **Cutler**. Burr (1930) listed ilmenite without comment from **Greenwood**.

Houston (1956) described ilmenite associations from **East Moxie**, **The Forks**, **Katahdin Iron Works**, **Union**, and **Warren**, in general: "Ilmenite occurs in every one of the ores examined. It forms characteristic intergrowths with magnetite and is almost invariably associated with that mineral. It is later than the magnetite since the ilmenite intergrowths conform to the already formed magnetite parting. Aside from intergrowths with magnetite, ilmenite also occurs as interstitial masses between silicate crystals. In this type of occurrence it is usually in contact with magnetite which it clearly postdates. In the Union peridotite,

ilmenite occurs in separate masses later than the silicates. At **Katahdin**, where ilmenite is more abundant than magnetite, some of the large ilmenite crystals contain irregular veinlets and blebs of magnetite. The magnetite is probably later in this case. In the Union ores, in particular, ilmenite shows the same relationship to the sulphides as magnetite. It must have originated in a similar manner except that it was slightly later in origin than magnetite." The ilmenite crystals referred to from **Katahdin Iron Works** are undoubtedly optically continuous grains seen in polished section rather than suggesting morphological crystals.

Black platy masses of ilmenite (to 1 x 2 x 0.5 cm) have been found in the fine-grained rocks of Long Point, **Harpswell**.

Lord (1900) reported that ilmenite "needles" were included in a pyroxene in a pyroxenite dike on **Monhegan**: "The pyroxene of the one dark vein critically examined is a brownish green augite resembling diopside. ... Microlitic inclusions of opaque ilmenite needles, arranged crystallographically very much like those in the bytownite, are very plentiful in this pyroxene."

Ilmenite is an abundant mineral which is usually inconspicuous. It is commonly reported as an accessory mineral of 1 mm or less in schists, volcanic rocks of many kinds, etc. Vitro Minerals Company analyzed soil/sediment samples from an unspecified location in **Newry** and found abundant ilmenite grains among the fraction containing the "heaviest" minerals. The grains were 2-3 mm, black, and sub-angular. Seaman (1975b) noted ilmenite in pegmatite at the Dunton quarry, but no specimens are known. Toppan (1932) noted ilmenite on Plumbago Mountain, **Newry** in "scattered grains in rock."

Bartlett (August 6, 1880) reported the menaccanite variety of ilmenite from the heavy minerals panned from Nile Brook, **Dallas** and **Rangeley**. The lustrous black hexagonal crystals, as well as irregular and imperfect crystal grains, are much less than 1 mm, being part of the final pan concentrates in gold and platinum panning. Sometimes the ilmenite has a deep blue tarnish and presents a conspicuous presence in a gold pan.

Cameron et al. (1954) wrote of the Parker Head area, **Phippsburg**: "Magnetite and ilmenite occur with fine-grained quartz and plagioclase as small irregular, kidney-shaped pods in the outer parts of the wall zones of many pegmatites, particularly those in the southern half of the area. Similar pods occur in the fine-grained biotite granite."

Guidotti (1974) reported: "Ilmenite is present in virtually all specimens and occurs in amounts up to 1 percent. In some cases, alteration to an opaque white material (leucoxene?) has occurred." The area covered included the staurolite and sillimanite-bearing rocks of western **Rangeley Plantation**, **TD**, **TE**, and **Byron**. Analyses of ilmenite from these rocks are given.

Standpipe Hill quarry, **Topsham** magnetite contains numerous platy ilmenite lamellae as parallel oriented inclusions (Carl Francis, personal communication, 1991).

Rainville and Park (1976) reported of **Union** and **Warren**:

"Ilmenite is the dominant primary oxide in the Harriman and Warren deposits. The combined average of the primary oxides (il-

menite, rutile, magnetite, and spinel) from the deposits is 0.6 vol[ume] percent, of which ilmenite constitutes over 90 percent. Several different size and textural categories into which ilmenite may be classified are as follows, in decreasing order of abundance: (1) several hundred micrometre- to several millimetre-sized irregular grains; (2) a few micrometre- to several hundred micrometre-sized grains of varying shape, although generally round to elliptical; (3) oriented needles within biotite; (4) minor irregular grains associated with spinels, either within or bordering grains; and (5) ilmenite-magnetite exsolution intergrowths.

The near absence of *primary* magnetite from the Warren and Harriman bodies is an unusual feature of these deposits. We have found no similar type of deposit described in the literature where magnetite was not at least a well-distributed minor constituent."

Houston (1954, 1956) also discussed ilmenite from Union and Katahdin Iron Works.

Ferry (1976) listed ilmenite in the rocks of the **Vassalboro** area.

The ilmenite from Dundee Falls, **Windham** has been found as wrought-iron-black crystal plates (to 3 x 4 x 0.3 cm) in quartz and kyanite matrix. Thomson and Guidotti (1989) noted: "Occasionally, inclusion trails of ilmenite, continuous with the external schistosity, pass straight through a kyanite porphyroblast."

ILMENORUTILE

(Ti, Nb, Fe)O₂

Albany - *Songo Pond Q*

Ilmenorutile forms black indistinguishable inclusions in niobian rutile from the Songo Pond Q, **Albany** (chemical analysis, XRD, Al Falster, personal communication, 1994).

indicolite = indigolite = blue tourmaline

iolite = cordierite

iridium

(Ir, Os, Pt)

Hermon - *Hermon Hill Q; Nile Brook A* - **Dallas, Rangeley**

Iridium can occur as extremely tiny inclusions in grains of platinum and is visually indistinguishable from it except on microscopic examination of polished sections of the material

(Ramdohr, 1969). Dale (1907) and Smith (1923) reported platinum assays of magnetite lumps from the Hermon Hill Black Granite quarry, **Hermon**. Virtually all platinum assays are due to native platinum grains in the rock and virtually all native platinum contains iridium inclusions. The only problem is that no specimens of the platinum are known to represent the locality.

The existence of iridium with platinum (q.v.) and gold (q.v.) from Nile and other brooks, **Dallas** and **Rangeley** was reported by Bartlett (August 6, 1880). The analysis was based on samples panned from the Nile brook area of Rangeley by a prospector. No samples are known to represent the occurrence. The iridium could actually have been present as iridosmine (q.v.), the hexagonal polymorph of iridium. Iridium, isomorphous with platinum, would have been an impurity; while iridosmine could have existed as a separate silvery, flaky mineral. See discussion of platinum.

The existence of platinum in Maine is not acknowledged by Howe and Holtz (1919), but their report was a bibliographic survey, while little has been written on Maine samples.

iridosmine?

(Ir, Os, Pt)

Dallas? - *Nile Brook*; **Rangeley?** - *Nile Brook*

Iridosmine has long been known from the Megantic area of Quebec, Canada, not far over the Boundary Mountains (Longfellow Mountains) from **Rangeley** and **Dallas** (Hunt, 1854). The chemical analysis of iridium (q.v.) would have been insufficient for Bartlett (August 6, 1880) to distinguish it from iridosmine.

iron sulfate - a general term for unidentified alteration products of sulfides

Princeton - *Pocomoonshine Mountain fault*

Ludman (1986) reported of **Princeton**: "Gossan associated with the D5 Pocomoonshine Mountain Fault, however, was prospected by the El Paso Natural Gas Company in 1971. Secondary mineralization in this fault occurred where it cuts the pluton on the northwest slope of Pocomoonshine Mountain, and resulted in enrichment of chalcopyrite, pyrrhotite, and pentlandite to several times their normal abundances in the pluton. The rock in the fault zone is a deeply weathered, highly friable, limonite and iron sulfate stained gabbroic gouge."

J

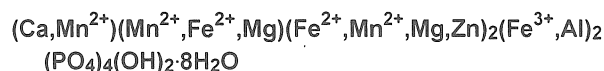
jade - non-technical name given to fine-grained monomineralic rocks (usually composed of the nephrite variety of tremolite or jadeite) for lapidary use

Alder Stream; Eustis; Jim Pond; York (Ogunquit) - Spouting Rock

Jade is a name which has had a large variety of meanings and is not a mineralogical term. To the Chinese, jade signifies an ornamental rock, of many varieties, suitable for carving. Nearly all of the world's "jade" is the nephrite variety of tremolite or jadeite. However, serpentine has frequently been called jade and so the distinction "true" jade has come into usage to distinguish it from the less desirable, and softer, serpentine "jade." The bowenite variety of serpentine jade was reported by S. Perham (1963b) from the Eustis region and was said to be sometimes associated with nephrite jade. Some of the compact amphibole rock from the **Eustis / Alder Stream / Jim Pond** area has been called jade by some enthusiastic collectors, but the quality of the "jade" is poor, being splintery rather than hard and compact. A few slabs of Wyoming or British Columbia nephrite jade have been occasionally "passed off" as coming from Maine. To date the specimens found are either serpentine or of too low a quality to qualify as a good jade.

Keeley (1924) noted of Spouting Rock, Ogunquit, **York**: "Directly back of the cave is a four-foot dike of dark gray diabase, with fresh plagioclase showing usual albite twinning; but the augite, save in a few isolated residual patches, is completely altered to an interlacing, fibrous, green amphibole, resembling jade in texture." This "jade" is probably not of lapidary grade.

jahnsite group



Greenwood - Emmons Q; Newry - Bell Q, Dunton Q; Norway - BB #7 Q; Paris - Mount Marie Q, Mount Mica Q; Rumford - Red Hill Q; Stoneham - Lord Hill Q

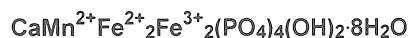
The jahnsite group is potentially a large one due to the possible chemical variations. Each member of the group needs

to be chemically analyzed for a proper naming. Semi-quantitative chemical analysis (this study) has revealed the presence of at least three members of the group. The most commonly occurring member of the group is jahnsite-(CaMnFe), but jahnsite-(MnMnMn) and jahnsite-(CaMnMn) are also known in Maine. (Although not yet recognized in Maine, when aluminum is greater than ferric iron, the jahnsite group grades into the whiteite group.) The associations of the variously studied specimens are indicated, but so few specimens have been studied that, still, it may be impossible to specifically sight-identify which jahnsite is present.

Jahnsite group species usually occur as rounded clusters (generally 0.1 to 0.5 mm) or V-shaped sprays of red-brown curved crystals, but color can vary to tan. The surfaces of the clusters can appear at least partially botryoidal with a rough to "orange peel" texture. Individual crystals are scarce. Jahnsite is virtually always found in vugs in siderite/rhodochrosite and is frequently associated with strunzite/ferrostrunzite, mitridatite, laueite, fairfieldite/xanthoxenite, and rockbridgeite as well as similar late-stage phosphates. Jahnsite can superficially resemble tiny eosphorite crystals.

Unanalyzed milky pinkish brown to butterscotch-colored, striated jahnsite crystals (to 0.5 mm) occur on fairfieldite botryoids in tan siderite at the BB #7 quarry, **Norway**. A thin coating of mitridatite or green beraunite can occur between the jahnsite and fairfieldite. The jahnsite and fairfieldite are in turn the matrix for open sprays of strunzite crystals, usually sparsely sprinkled over the surface and only occasionally tightly grouped. This unanalyzed material is probably manganese-rich, jahnsite-(CaMnMn) or jahnsite-(MnMnMn), by implied analogy with the chemistry of the associated species.

Jahnsite-(CaMnFe) (Jahnsite Group)



Newry - Bell Pit, Dunton Q Rumford - Red Hill Q

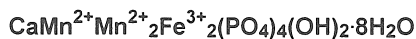
Jahnsite-(CaMnFe) has been found as tan to light yellow-brown, rounded, striated, subparallel groups of crystals (to 2 mm) at the Dunton quarry, **Newry**. The mineral is found with laueite, strunzite/ferrostrunzite, xanthoxenite, and/or diadochite in

brown to black-stained blue tourmaline eyes lined with drusy quartz in cleavelandite. The surface of the jahnsite-(CaMnFe) has a resinous luster and the interior can have a crackled appearance. Due to the rounded nature of the crystals, the mineral can be inconspicuous.

The Bell pit, **Newry** has jahnsite-(CaMnFe) in vugs in triphylite with white veinlets of etched fairfieldite and fine-grained montebrasite in the matrix. The bladed, striated golden brown crystals (generally 1 mm or less) are usually clustered together and can have an indistinct appearance. Clusters of particularly good jahnsite-(CaMnFe) can be grouped in a three-dimensional spray. The crystals are usually transparent and the color varies through many different shades of light and dark red-brown. Some jahnsite-(CaMnFe) has been found associated with very tiny black rockbridgeite botryoids (to 0.2 mm). The chemistry of Bell Pit material seems to be intermediate between jahnsite-(CaMnFe) and jahnsite-(CaMnMn). Jahnsite directly associated with relatively fresh triphylite seems to be iron-richer, i.e. jahnsite-(CaMnFe).

Jahnsite-(CaMnFe) occurs at the iron-rich pegmatite complex on Red Hill, **Rumford** and forms minute (less than 1 mm) red-brown ingrown "foliated" botryoids in vugs in microcline associated with triphylite, rockbridgeite, beraunite, strunzite, and other secondary phosphates.

Jahnsite-(CaMnMn) (Jahnsite Group)



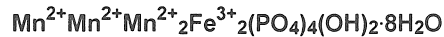
Newry - Bell Pit; **Paris** - Mount Mica Q

The Bell pit, **Newry** has jahnsite-(CaMnMn) in the siderite assemblage, usually with masses of ferroan fairfieldite. A thin layer of olive green earthy mitridatite can be a substrate. The bladed, striated crystals (generally 1 mm or less) are usually clustered together and have an indistinct appearance. Clusters of particularly good jahnsite-(CaMnMn) can be grouped in a three-dimensional spray. The crystals are usually transparent and the color varies through many different shades of light and dark red-brown, sometimes with orange brown tints. The Bell Pit jahnsites are intermediate in composition between jahnsite-(CaMnMn) and jahnsite-(CaMnFe) with slightly manganese-richer jahnsites having a lighter, more orange-brown color. Color, however, should not be used as an identifying tool, and unknown composition jahnsites should be labeled simply jahnsite without chemical suffixes.

Jahnsite-(CaMnMn) from the Mount Mica quarry, **Paris** is found as tiny (1 mm and less) golden brown though greenish brown multiple, subparallel growth aggregates of blocky crystals in vugs in black-stained patches of fairfieldite and siderite in blue tourmaline eyes in cleavelandite. Hureaulite, stewartite, fair-

fieldite, mitridatite, arsenopyrite, an alluaudite-group mineral, etc. can be associated.

Jahnsite-(MnMnMn) (Jahnsite Group)



Greenwood - Emmons Q; **Stoneham** - Lord Hill Q

Emmons quarry, **Greenwood** jahnsite-(MnMnMn) can be associated with a bewildering array of phosphate species. The tiny jahnsite-(MnMnMn) crystals (to 1 mm) are found in hydroxylapatite-lined vugs in a variety of habits and associations. Particularly fine-bladed golden brown jahnsite-(MnMnMn) crystals (to 2 mm) with Roman sword-shaped terminations have been found in etched masses and crystal-lined vugs in pink, bipyramidal reddingite along with rare earlshannonite. The jahnsite-(MnMnMn) can be clustered in open radial sprays. The reddingite can form masses with tiny, closely spaced etched "slits" which can have granular botryoidal mitridatite lining the openings. Gray translucent fairfieldite crystals (to 4 mm) can be present which may have rockbridgeite twins (to 1 mm) implanted on them. Fine-grained, etched triplite/triplite can be found replacing some of the reddingite and minor strunzite has been observed in reddingite vugs. Another association of jahnsite includes cellular etched siderite/rhodochrosite lined with jahnsite-(MnMnMn) crystals (to 1 mm) along with fine-grained hureaulite and hydroxylapatite. The cellular assemblage includes ludlamite cleavages, vivianite as an intergranular filling, minor rockbridgeite and stewartite. A third association consists of pink, fine-grained rhodochrosite interlaced with thin rhodochrosite veinlets with a single visible set of cleavages. The matrix is impregnated with fine-grained crystalline, pseudo-granular hydroxylapatite associated with nearly colorless, steeply rhombohedral rhodochrosite which almost appears acicular. The tiny vugs are variously lined with bronzy red-brown bermanite, coarse fairfieldite cleavages, stewartite, dark brown landesite crystals, pearly cleavages with minor pink botryoidal strengite, and a delicate salmon pink, low-luster scaly variety of switzerite. Material from all three associations have been chemically analyzed (this study) and appear to all be jahnsite-(MnMnMn).

Unanalyzed jahnsite from the Lord Hill quarry, **Stoneham** consists of dark red-brown tightly clustered radiating masses of crystals (to 1 mm) in vugs in altered triplite associated with pink hureaulite, green beraunite, earthy brown mitridatite, black rockbridgeite crystals (much less than 1 mm), tan fluorian hydroxylapatite botryoids, and pinkish-brown acicular rhodochrosite/siderite. Given the similar association and paragenesis of the Lord Hill quarry material with the Emmons quarry, the Lord Hill jahnsite is included here by analogy.

janatite? - typographical error for tantalite

Paris? - *Mount Mica Q*

Janatite, a name which has not yet been assigned to any particular mineral, appeared as a typographical error in a list of minerals from Mount Mica quarry, **Paris** (MMJ, September 23, 1881): "Among the other varieties of rare minerals found at this locality may be mentioned *Brookeite* [sic], *Spodumene*, *Zircon*, *Clevelandite* [sic], *Apatite*, *Hebronite*, *Autunite*, *Childrenite*, *Yttrocerite*, *Petalite*, *Janatite*, *Halloysite*, etc." A copy of an identical-appearing independently published prospectus (manuscript, RPHL) revealed that the name intended for the eleventh position in the list of species was tantalite.

JAROSITE (Jarosite Group)



Smalls Falls Formation - **Canaan, Cornville, Fairfield, Madison, Mercer, Norridgewock, Skowhegan, Starks**

Jarosite has been sometimes proposed as a constituent of Maine pyrite-bearing ores, but the assumption has not been verified.

Osberg (1988) reported: "The rusty-weathered, black, sulfidic mica phyllite is the dominant lithology of the Smalls Falls Formation. Most outcrops are heavily coated with limonite and jarosite, so that primary features are difficult to detect, but in some well-washed stream outcrops lamination can be observed."

K

KAERSUTITE (Amphibole Group)



Auburn - *Route #202 road cut near Hackett road*

Pettengill (1982) reported of **Auburn**:

"An unusual and interesting camptonite dike outcrops at a road cut on Rt. 202, Auburn, Maine. Extremely large megacrysts, ranging in size from 1 to 7 cm, occur in the center third of the 2.5 m wide dike. The megacrysts are composed of plagioclase and an amphibole, kaersutite. The contrast between the light colored plagioclase and the dark dike is quite striking. ...

This dike is interesting because of the relative scarcity of lamprophyre dikes in Maine and the high degree of alteration shown by the kaersutite phenocrysts. These are altered to opaque minerals along cleavage traces, due to the increase of volatile gases during late stage cooling."

The kaersutite phenocrysts appear as black patches (to 1 cm) in dark gray matrix.

kalinite?

Concord?; Wales?

Kalinite from **Concord** and **Wales** was listed by Burr (1930) without description and may have been a misprint for kaolinite at some point in the list-making process. No specimens known.

KAOLINITE (Kaolinite Group)



Attean quartz monzonite - **Appleton Township, Attean, Bradstreet, Dennistown, Forsythe, Holeb, T5R7 BKP WKR; Auburn; Blue Hill; Buckfield; Concord; Denmark; Greenwood; Kittery** - *Spruce Creek A; Newry* - *Dunton Q; Paris* - *Mount Mica Q; Parsonsfield* - *Kezar Falls P; Poland; Rumford; Stoneham* - *Lord Hill Q; Stow* - *Deer Hill Q; Strong* - *glacial clay; Thomaston; Union?* - *Union Q; Wales; Warren* - *Knox P; Woolwich*

Kaolinite is not an important component of common Maine clays. Much of the "kaolinite" in Maine is probably intermingled with several other species, often with kaolinite as a very subordinate part of the sample. In glacial clays, much of the clay is composed of the illite variety of muscovite and clinocllore. Glacial clays are frequently gray-blue to ash gray in color. Kelley (1989) reported the results of a mineralogical study of 19 Maine glaciomarine clays as well as 3 Maritime Canada clays: "Kaolinite was only clearly identified from the Bay of Fundy [Canada] samples... The other possible occurrence [sic] of kaolinite, in the sample from Strong, is from a location near where Day (1980) also recognized it..." No systematic study of Maine gem pocket clays has been made. Foord et al. (1986) found a variety of clays in San Diego County, California pegmatites including: cookeite, montmorillonite, nontronite, palygorskite, sericite, Li-tosudite, and, rarely, kaolinite.

In granite pegmatites, kaolinite is frequently intergrown with montmorillonite and probably other clay materials. Kaolinite may, in fact, prove to be extremely scarce in crystal pockets, etc., although it has been historically reported. Much "kaolinite" is probably clayey/sericitic muscovite.

Albee and Boudette (1972) described the alteration of the Attean quartz monzonite, **Appleton Township, Attean, Bradstreet, Dennistown, Forsythe, Holeb, and T5R7 BKP WKR**: "The amount of alteration caused by the post-Early Devonian metamorphism differs greatly from place to place... In thin section the principal alteration products of the plagioclase appear to be "white mica," "clay," and clinozoisite-epidote. ... It was concluded that the alteration products are predominantly muscovite but that a small amount of kaolinite and possibly a mixed-layer muscovite-montmorillonite clay mineral may be present."

Landes (1925) noted of the Bennett quarry, **Buckfield**:

"A surprisingly small amount of the Buckfield feldspar is kaolinized. But spodumene was very susceptible to this alteration and fresh pieces of spodumene are rare. Many more specimens are found in which this mineral has been completely kaolinized. Usually the original structures of the spodumene are preserved, giving a true pseudomorph after spodumene. Lepidolite veins formerly cutting spodumene crystals are found in a mass of kaolin in the pocket debris.

Other minerals sometimes incipiently altered to kaolin are amblygonite, fairfieldite, cleavelandite, and topaz."

Toppan (1932) wrote of Mount Mica quarry, **Paris**: "Kaolin as a decomposition product of the feldspar was commonly found at the bottom of such pockets as were excavated." Mount Mica

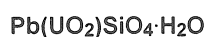
quarry pocket clay is untested, however medium to dark blue-gray to dark smoky gray kaolinite sometimes with a mud-crack-like fracture network (to several mm) is found as a filling in blue tourmaline eyes at the Mount Mica quarry (chemical analysis, XRD, this study). The kaolinite is sometimes very compact (not easily scratchable with a fingernail).

Cox (1970) observed of a prospect in Kezar Falls, **Parsonsfield**: "Galena and sphalerite occur as coarse crystals in breccia composed of fragments of dark-gray jasperoid so clouded with fine inclusions as to be opaque in thin section... The breccia is filled by microcrystalline quartz, fine comb-structured quartz, and kaolinite."

Kaolinite admixed with sericite from Lord Hill quarry, **Stoneham** forms snow-white minutely scaly mats (to several mm) formed on etched smoky quartz crystals and frequently coating phenakite (Jerry Van Velthuisen, XRD, personal communication, 1991).

Barker (1955) noted of the Union Limestone quarry, **Union**: "Kaolinite (tentative identification) - tan 'papery' matted crust on limestone..." This material needs further study. No specimens known.

KASOLITE



Greenwood - *Heikkinen Q*

Kasolite occurs as bright yellow-amber resinous masses which have contrasting earthy, very pale yellow cores of kasolite in pinkish brown albite. The two kinds of kasolite appear to be replacing crude pyramidal zircon crystals (to 3 mm). Both types of kasolite were verified by chemical analysis and XRD (this study). The earthy kasolite is very thorian, nearly equal in quantity to uranium.

kelyphite? - a micaceous alteration product

Paris - *Mount Marie Q*

Kelyphite was regarded by Dana (1892) to be a micaceous alteration, near a chlorite in composition, of garnet. A dark gray, fine-grained to micaceous mineral (to 1 cm) (HU 11008) in cleavelandite has been called kelyphite, despite its resembling damourite, from the Mount Marie quarry, **Paris**.

kermesite? = schafarzikite + metastibnite

Linneus - *Drew Hill Sulfide veins*

Red earthy masses and films of schafarzikite (q.v.) and metastibnite (q.v.) from Drew Hill sulfide veins, **Linneus**, have been misidentified as kermesite (Bjareby #4730).

kerolite (cerolite)? = a mixture of minerals

Rockland; Thomaston - *Dragon Cement Q, Williams Q; Warren* - *Knox Q*

Dana (1850) wrote: "A lamellar variety [of serpentine] in which the laminae are not separable is sometimes misnamed kerolite." Faust and Fahey (1962) indicated that most deweylites (q.v.) and kerolites are mixtures of clinochrysotile and stevensite. Brindley et al. (1977) investigated the nature of kerolite, in general, and concluded that the traditional definition suggested that the name covered a mixture of serpentine and stevensite, but that their research also suggested the name sometimes covered a fine-grained talc with layer disorder.

Houghton (1861) listed kerolite from **Rockland** and **Thomaston**. Hitchcock (1862b) retracted the listing: "ROCKLAND and THOMASTON. *White talc*, not kerolite." Morrill and Hinckley (1959) apparently continued the listing of Houghton (1861) and added the Knox quarry, **Warren**.

Kerolite from the Dragon Cement quarry, Thomaston consists of orange to brown to black fine-grained translucent waxy masses occurring in seams (to many cm thick) in impure marble.

killinite = fine-grained muscovite

Greenwood; Newry - *Dunton Q; Peru; Rumford; Warren* - *Starrett Q*

Killinite is a fine-grained muscovite which has a greasy appearance due to the invisibility of the small cleavages of the mineral and frequently is found as a replacement of spodumene, etc. The appearance of killinite might be no different than some specimens which would be called damourite.

Starbird (1934) mentioned of **Newry**: "At a small opening below the southern deposit, a very large crystal ("log") of *spodumene* may be seen. A few specimens are found showing fair crystal faces. Alteration products of *spodumene*, *killinite* and *pinitite* also occur."

Morrill et al. (1958) listed killinite from **Peru** without a specific location.

Killinite has been used variously as a fine-grained replacement mineral (Neil Wintringham, personal communication). Specimens from **Rumford** seem to be damourite partial replacements after rubellite, while **Greenwood** specimens consist of pale green replacements of spodumene in cleavelandite.

Hess et al. (1943) wrote that the Starrett quarry, **Warren** spodumene had altered to killinite.

kimolite = variant spelling of cimolite

kivuite? (Phosphuranylite Group)

Newry? - *Dunton Q*

Kivuite from Maine was first reported by King (1987a) based on a verbal report. The only specimen was subsequently acquired by Tony Nickischer (personal communication, 1994) who revealed that the actual specimen was from the Ruggles mine, Grafton, New Hampshire.

*KOSNARITE

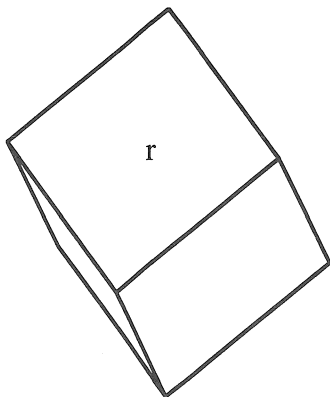


Newry?; **Paris** - *Mount Mica Q*; **Rumford** - *Black Mountain Q*

The Mount Mica quarry, Paris and the Black Mountain quarry, Rumford are the co-type localities for kosnarite (Brownfield et al., 1993). Tealdi (1993) prematurely announced Newry as a kosnarite location before the suspected specimens were proved to be whitlockite (q.v.).

Kosnarite from Mount Mica quarry, **Paris** is found in siderite - blue tourmaline eyes in cleavelandite. The crystals of kosnarite (to 1 mm) are pseudocubic with small "c" pinacoids, transparent to translucent, and are very pale blue-green to almost colorless. Crystals are frequently tightly clustered. Associated species include eosphorite, fluorapatite, "roscherite," quartz, and rarely zircon. The mineral has been mistaken for goyazite. Some kosnarite specimens show tiny crystals grouped in sugary-textured fashion without resolvable individuals.

Kosnarite from Black Mountain quarry, **Rumford** has been mistaken for goyazite or whitlockite in the past. The kosnarite is found in the siderite assemblage and the 1-2 mm crystals show vitreous luster. The habit is a combination of the pseudocubic rhombohedron, "c" pinacoid, and occasional hexagonal prism and the color is clear to greenish amber. Tan to colorless sub-transparent fluorapatite crystals with multiple growth terminations, producing a fibrous appearance, on blocky rhombohedral to pseudo-hexagonal siderite crystals (to 1 mm) with "c" pinacoids are the matrix for some kosnarite.



Kosnarite, Mount Mica Q, Paris

kryzhanovskite?

Greenwood - *Emmons Q*

Kryzhanovskite from the Emmons quarry, **Greenwood** was originally reported by Thompson et al. (1988), but recent review of nomenclature suggests that the alteration is actually landesite (q.v.).

kunzite = a pink, gem-variety of spodumene

Andover? (= Black Mountain?); **Auburn** - *Pulsifer Q*; **Georgetown** - *Tourmaline P*; **Newry** - *Dunton Q*

Pink, non-gem spodumene has been found at several places in Maine. Occasional small gemmy fragments have been found, but no gemstones have been cut from Maine material. True kunzite probably has not been found. The name should be used for gem material, not merely pink spodumene. The "kunzite" reported from Andover (Sterrett, 1907, 1908) may have come from the Black Mountain quarry, **Rumford** or the Dunton quarry, **Newry**. See locality discussions under spodumene and hiddenite.

Transparent etched pink spodumene has been found at the Tourmaline prospect, **Georgetown**, but the color is extremely photosensitive and the few pieces known are now almost completely bleached to colorless specimens.

KYANITE (Aluminosilicate Group)



Berwick - *northwest Berwick A*; **Bowdoinham?**; *pelitic member of Cushing Formation* - **Freedom**, **Palermo**, **Pittston**, **Whitefield**, **Windsor**; **Gorham**; **Grafton** - *Black Brook A*; **Litchfield?**; **Paris?**; **Raymond**; **Sabattus** - *Ray's Corner A*; **Saint George** - *Clark Island*; **Standish**; **Union** - *cemetery hill A*; **Upton/Grafton** - *Ammonoosuc Volcanics, Partridge Formation*; *south of Back Street*; **Waldoboro?**; **Warren**; **Westbrook**; **Windham** - *Cook Road L, Dundee Falls A*

Kyanite is a mineral of metamorphic origin which is found in a number of localities in schists. To date, only Windham has produced collector-quality specimens. Some reported occurrences undoubtedly represent finds of float boulders or are misidentifications. The aluminosilicate group consists of three polymorphs: kyanite, andalusite, and sillimanite. These polymorphs occur under well defined temperature and pressure conditions (e.g. Holdaway, 1971), but one or more aluminosilicate(s) may be present metastably in association with another aluminosilicate. Deer et al. (1962) indicated that aluminosilicates may change with respect to the persistent conditions experienced by a rock, and recrystallize into other polymorphs. The transition may be so slow that two or three aluminosilicates may be present

in a rock. The association of more than one aluminosilicate in a rock does not imply, unambiguously, a particular set of pressure/temperature conditions. Caution is required in interpreting the significance of the association.

Fisher (1941) reported kyanite and chloritoid (q.v.) in: "Scattered outcrops northwest of Berwick ..." No specimens available for description.

Morrill et al. (1958) wrote of Dennis Hill, **Litchfield**: "Zircon Xls (to 1 1/2" x 1", sharp, brown) (in Kyanite)." The locality is outside of areas known to be geologically suitable for kyanite formation (Charles Guidotti, personal communication, 1990). A "Litchfield, Me." specimen observed from an "old" collection consisted of green and blue kyanite blades with biotite schist and resembles kyanite from Litchfield, Connecticut.

Pankiwskyj (1978) noted in northern **Palermo**: "Cushing Formation - Typical fine-grained, biotitic, salt-and-pepper felsic metavolcanic rock. Walking west on the overgrown woods road: (1) after 45 paces is a small pavement outcrop of rocks much like a road; (2) after 60 paces on the left and after 67 paces on the right are large outcrops of coarse-grained, weakly rusty-weathering kyanite-staurolite mica schist altering to chlorite-serpentine-white mica and cordierite." Guidotti (1989) indicated that kyanite had been found "restricted to a narrow zone about 35 km long and lying just west of the Norumbega fault zone... The kyanite occurs in a thin pelitic unit within the Cushing Formation..." The thin sulfidic pelitic unit marked *Ozcr* on the *Bedrock Geologic Map of Maine* (Osberg et al., 1985) extends approximately from the **Randolph/Pittston** area, curving into **Whitefield**, **Windsor/China**, **Palermo**, and finally into **Freedom**. (The unit was mapped as the Sandy Pond Member of the Cushing Formation in Palermo and Freedom by Pankiwskyj et al. (1976).)

Burr (1917) listed kyanite from "**Paris(?)**," but the assemblage of rocks in the town is sillimanite-bearing.

Fisher (1941) wrote of **Sabattus**: "Kyanite has been noted in minor amounts in the quartz-mica-sillimanite-graphite schist of Ray's Corner, west of Sabattus, where it is partially replaced by sillimanite... It is more abundant in the Windham - Cornish - Limerick area, mapped as Berwick [Formation] by Katz, and in the Berwick quartz-mica phyllite near the village of Berwick in southwestern Maine." This report requires modern verification (Charles Guidotti, personal communication, 1991).

Cheney (1967) reported of **Union**: "The tentative identification of kyanite in the folded and faulted quartzites of the cemetery hill which is next to the chialstolite-bearing Round Pond facies suggests tectonic 'over pressure'." The tentative nature of the identification of kyanite in this area was noted, but the occurrence is doubtful (Charles Guidotti, personal communication, 1991).

Moench and Pankiwskyj (1988) noted of some "mixed volcanic rocks" of the Old Speck Mountain quadrangle: "The felsic rocks are light colored and are mainly low-potassium rhyolite or dacite in composition, predominantly tuffaceous, and widely altered prior to metamorphism to bleached pyritic quartz-sericite-albite schist and, locally, to kyanite-bearing assemblages

(Milton, 1961) and quartz-kyanite gneiss." Milton (1961) specified in **Upton**:

"The kyanite schist is a unit of small extent in the Ammonoosuc volcanics, but its distinct and unusual character justifies mapping as a member. It can be traced as a band several hundred feet thick from the farmhouse at the south end of Back Street (the road near the quadrangle boundary in southern Upton) eastward to the Upton-Grafton town line near the crest of the hill.

The kyanite schist consists mainly of bedded, weakly schistose, granular, light colored rock. ...

Kyanite occurs in colorless poikilitic blades a few millimeters long. As kyanite was found in most, although not all, specimens from this member and in only very few from other map units, the member is called the kyanite schist. Andalusite occurs less commonly. Garnet and staurolite were found in a few specimens."

Milton (1961) further indicated kyanite locations on the mountain in Upton, west of Route #26 at an elevation 1960 feet, and in the Partridge Formation [**Upton/Grafton**], and the Ammonoosuc Volcanics, near Black Brook, **Grafton**. Milton (1961) commented: "Sillimanite and the less common kyanite and andalusite are almost invariably fresh. This contrasts with the extensive sericitization of sillimanite and andalusite in comparable areas in New Hampshire and elsewhere." See also Milton (1960).

Perkins (1924a) wrote of **Westbrook**: "Large bluish crystals of cyanite have been found at Westbrook. They occur in the metamorphosed sediments associated with the granite intrusives."

The Dundee Falls area, **Windham** produces the best kyanite from Maine. Ilmenite, biotite, and staurolite are found in the Dundee Falls area specimens. The individual blue blades can be up to 15 x 3 cm and pure kyanite clusters have been found to 30 x 20 cm. Kunz (1892a) noted crystals to 15 cm. Associated minerals include quartz, muscovite, and ilmenite. A few samples with flat sloping terminations have been found. The mineral was listed by Houghton (1861). Jackson (1839) wrote: "A mass of cyanite is said to have been found in this town, but we could not learn where it occurred, and there was none in any of the rocks *in place*." The Cook Road locality has produced a few small pale blue kyanite crystals associated with the excellent staurolite crystals of the area. Thomson and Guidotti (1989) mapped the kyanite distribution from Windham to Gorham and wrote:

"The kyanite zone is characterized by the key mineral assemblage quartz + plagioclase + biotite + muscovite ± garnet ± staurolite ± kyanite (and ± some Mg-rich chlorite). ...

Garnet is either inclusion-free or poikiloblastic. Helicitic overprint texture is observed in many specimens (Fig. 5b). ...

Kyanite, although commonly associated with quartz pods, is also found as euhedral porphyroblasts within the groundmass. The porphyroblasts truncate the foliation at their grain boundaries without any deflection (Fig. 5g)."

Burr (1939b) listed kyanite from **Standish**.

Morrill et al. (1958), additionally, listed kyanite without description from **Bowdoinham** and **Waldoboro**, but no speci-

mens are known and undoubtedly are misidentifications. The pressure/temperature regimes experienced by these areas are unreasonable for the production of this species.

Mineral Photographs

SCALE DEFINITIONS

The dimensions of a mineral specimen are of some diagnostic use in identifying minerals as well as useful collecting information. Specific dimensions of crystals are not indicated here due to the cumbersome captions which would result. The caption of each photograph indicates the size category of each specimen or indicates the relative size of the field of view if the illustration shows only a part of the specimen. The following caption abbreviations are tied to familiar size categories, though some might object to the arbitrary dimensions chosen.

mm = micromount. Micromount-size crystals require microscopic examination.
Normal sizes range from 0.5 to 3 mm.

t/n = thumbnail. Thumbnail-size specimens are generally 1-2 cm.

min = miniature. Miniature specimens, for the purposes of this listing, are 2-4 cm.

sc = small cabinet. Small cabinet specimens are generally 4-6 cm.

cab = cabinet. Cabinet-size specimens are generally 6-10 cm.

L = large. Large specimens are generally more than 10 cm.

PHOTOGRAPHERS

Illustrations are essential to a work of this kind and many photographers have come forward with excellent illustrations to enhance the text. Each photographer has been credited whenever one of their images appears, but they should be united in a gallery here and be recognized. Initials correspond to photo credits. Uncaptioned illustrations were photographed by Vandall T. King.

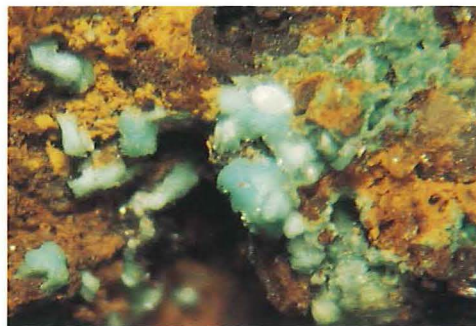
Peter Bancroft, Fallbrook, California [PB]
Dan Behnke, Northbrook, Illinois [DB]
Gerry Cinnamon, Unity, Maine [GC]
Rock Currier, Arcadia, California [RC]
Al Falster, New Orleans, Louisiana [AF]
Wayne Flanders, Norway, Maine [WF]
Gene Foord, Denver, Colorado [GF]
Charles Guidotti, Orono, Maine [CG]
Greg Hart, Augusta, Maine [GH]
Natalie Linden, Bloomfield Hills, Michigan [NL]
Jim Mann, Bethel, Maine [JM]
Lou Perloff, Tryon, North Carolina [LP]

John Poisson, Livermore Falls, Maine [JBP]
Bob Prouty, Brownfield, Maine [BP]
Jeff Scovill, Tucson, Arizona [JS]
Ben Shaub, Northampton, Massachusetts [BS]
Ray Sprague, Andover, Massachusetts [RS]
Woodrow Thompson, Wayne, Maine [WT]
Unrevealed [UR]
Harold and Erica Van Pelt, Los Angeles, California . . [VP]
Julius Weber, Mamaroneck, New York [JW]
John White, Philadelphia, Pennsylvania [JoW]
Wendell Wilson, Tucson, Arizona [WW]

SOURCES OF MINERAL SPECIMENS

Numerous organizations and individuals have graciously allowed photographs to be taken of their specimens. Initials in curved brackets following the caption indicate the source of the specimen. Specimens from the editors' collections are not specifically credited. Uncaptioned specimens are from the Vandall T. King collection.

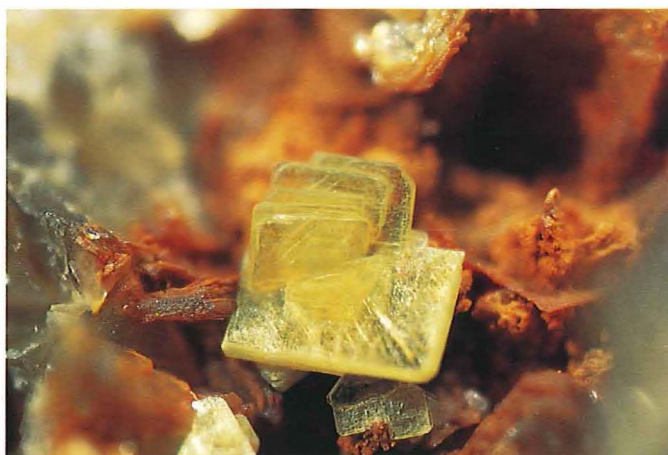
American Museum of Natural History	{AMNH}	Jim Mann.	{JM}
Henry Barbour.	{HB}	John Marshall	{Ma}
John Barlow.	{JB}	Joseph Martin	{JoM}
Gene Bearss	{GB}	Dean McCrillis	{DM}
Russell Behnke	{RB}	Arthur Montgomery	{AM}
Bryn Mawr College.	{BMC}	Maine State Museum	{MSM}
Colby College	{CC}	Museum of Science - Boston	{BMS}
Larry Conklin	{LC}	Northeastern University	{NEU}
Donald Corson.	{DC}	Paterson Museum of Science and Technology . .	{PMS}
Cranbrook Institute	{CI}	Perham's of West Paris	{PWP}
Dennis Creaser	{DeC}	Lou Perloff	{LP}
Hugh Durgin	{HD}	Joseph Pollack.	{JP}
Al Falster.	{AF}	Bob Prouty	{BP}
Mark Feinglos	{MF}	Smithsonian Institution.	{SIM}
Cal Graeber	{CG}	Ray Sprague	{RS}
Gardiner Gregory	{GG}	Nestor Tamminen	{NT}
Duddy Groves	{DG}	Woodrow Thompson.	{WT}
Harvard University	{HU}	University of Maine	{UM}
Richard Hauck.	{RH}	Unrevealed	{UR}
Don Joyner	{DJ}	Sidney A. Williams	{SW}
Richard and Tresa Kosnar	{RK}	Neil Wintringham	{NW}
Ron Larrivee	{RNL}	Ray Woodman.	{RW}
Ray Lasmanis	{RL}	Yale University	{YU}
Maine Geological Survey	{MGS}		



Above: Aurichalcite mm, Barrett P (Dolsan Pit),
Pembroke

Left: Almandine mm, Groves Q, Auburn

Below: Autunite mm, Lord Hill Q, Stoneham

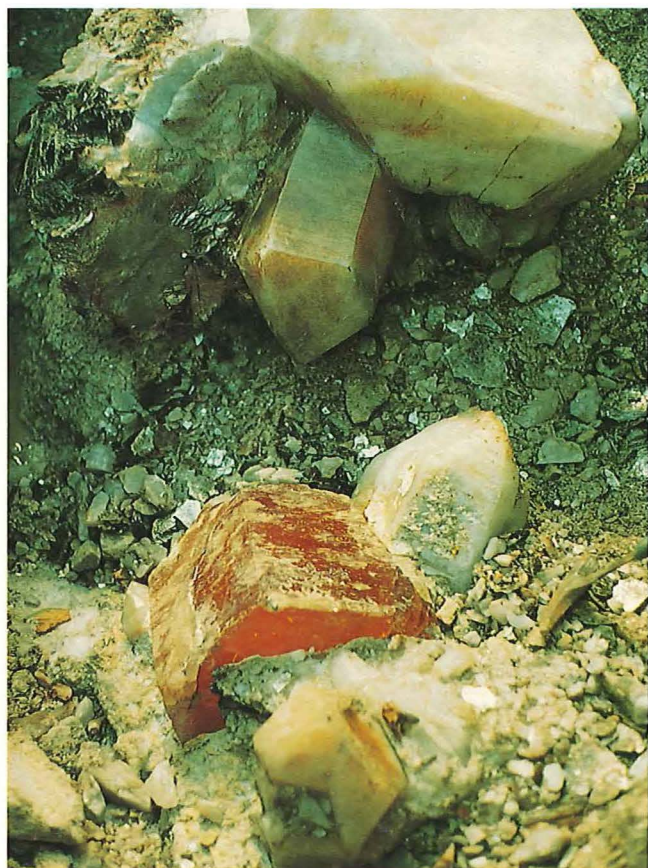


Above: Almandine mm, Groves Q, Auburn

Right: Azurite mm, Callahan M (= Cape Rosier
M), Brooksville

Below: Azurite and cerussite mm, Callahan M
(= Cape Rosier M), Brooksville

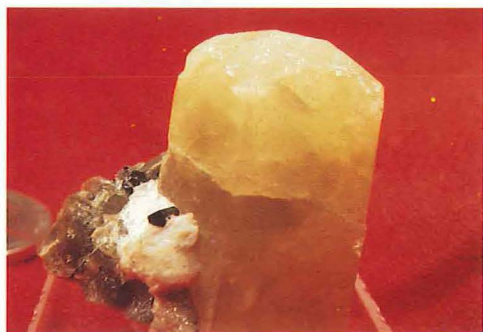




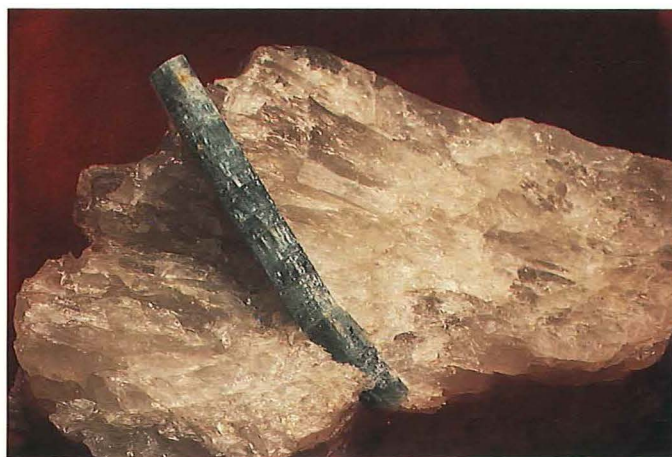
Beryl (Rose of Maine) L, Bennett Q, Buckfield [WF]



Beryl (Rose of Maine) L, Bennett Q, Buckfield [WF]



Beryl min, LaChance Q, Brunswick {GB}



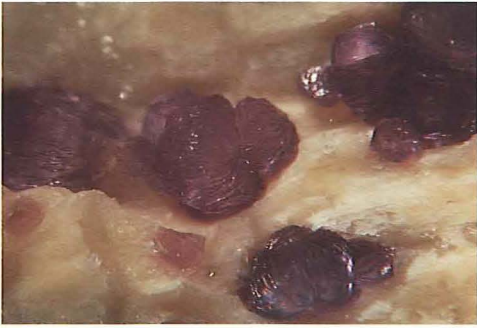
Beryl cab, Songo Pond Q, Albany {JM}



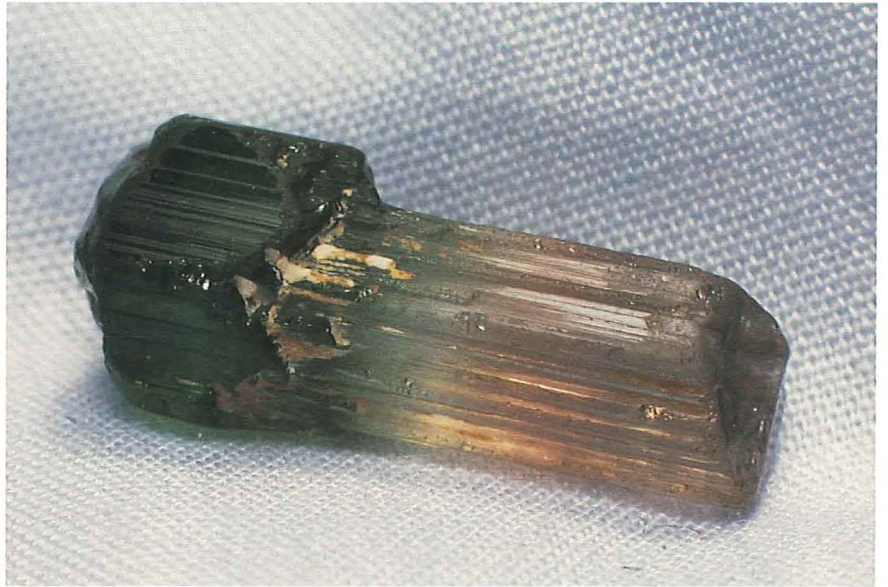
Beryl sc, Trenton Q, Topsham {HU}



Beryl (The Peach) cab, Bennett Q, Buckfield {HU}



Above: Cookeite mm, Pulsifer Q, Auburn



Right: Elbaite t/n, Smith Q, Auburn {JM}

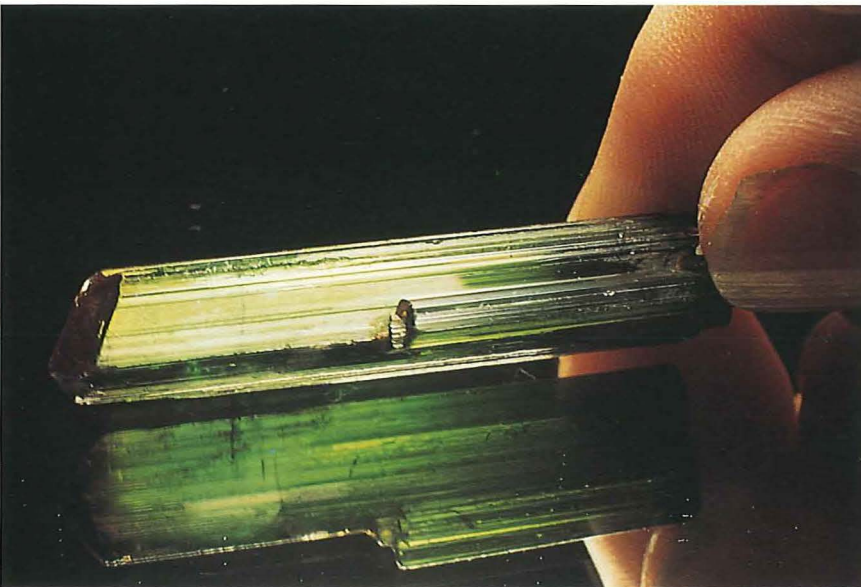
Below: Elbaite min, Greenlaw Q, Auburn {NEU}

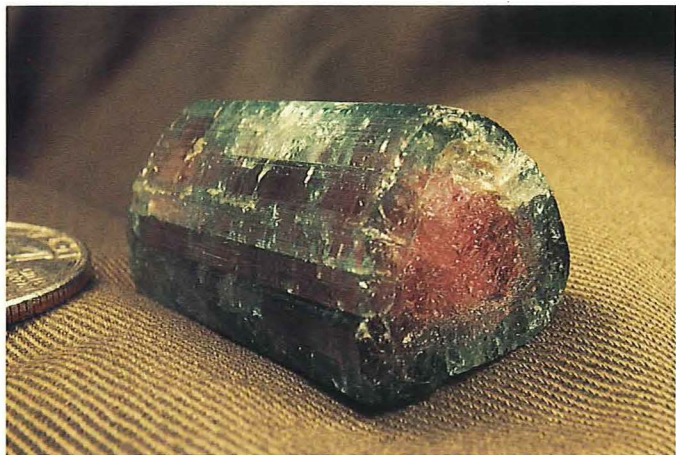


Above: Elbaite min, Groves Q, Auburn {DG}

Left: Elbaite t/n, Bennett Q, Buckfield

Below: Elbaite t/n, Keith Q, Auburn {RW}





Elbaite min, Maine Feldspar Q, Auburn {HU}



Elbaite min, Bennett Q, Buckfield



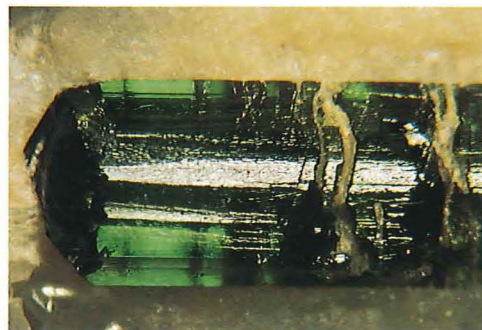
Elbaite min, Pulsifer Q, Auburn {RK}



Elbaite sc, Mount Rubellite Q, Hebron [WW]{HU}



Elbaite min, Tourmaline P, Georgetown {RW}



Elbaite t/n, Harvard Q, Greenwood



Elbaite min, Dunton Q, Newry {Ma}



Elbaite cab, Mount Rubellite Q, Hebron {BMC}



Elbaite min, Dunton Q, Newry {Ma}



Elbaite (Jolly Green Giant) L,
Dunton Q, Newry {SIM}



Elbaite min, Dunton Q, Newry {Ma}



Elbaite cab, Dunton Q, Newry {LC}



Elbaite t/n, Dunton Q, Newry {Ma}



Elbaite sc, Dunton Q, Newry {Ma}



Elbaite t/n, Dunton Q, Newry {Ma}



Elbaite min, Dunton Q, Newry {Ma}



Elbaite (slab = 6.2 cm), Dunton Q, Newry [WW]{SIM}



Elbaite t/n, Dunton Q, Newry



Elbaite sc, Mount Mica Q, Paris [WW]{HU}



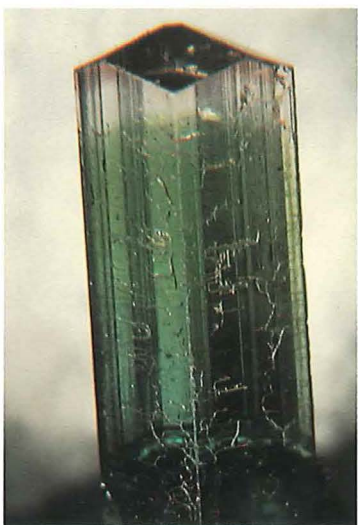
Elbaite cab, Dunton Q, Newry



Elbaite L, Dunton Q, Newry [WW]{HU}



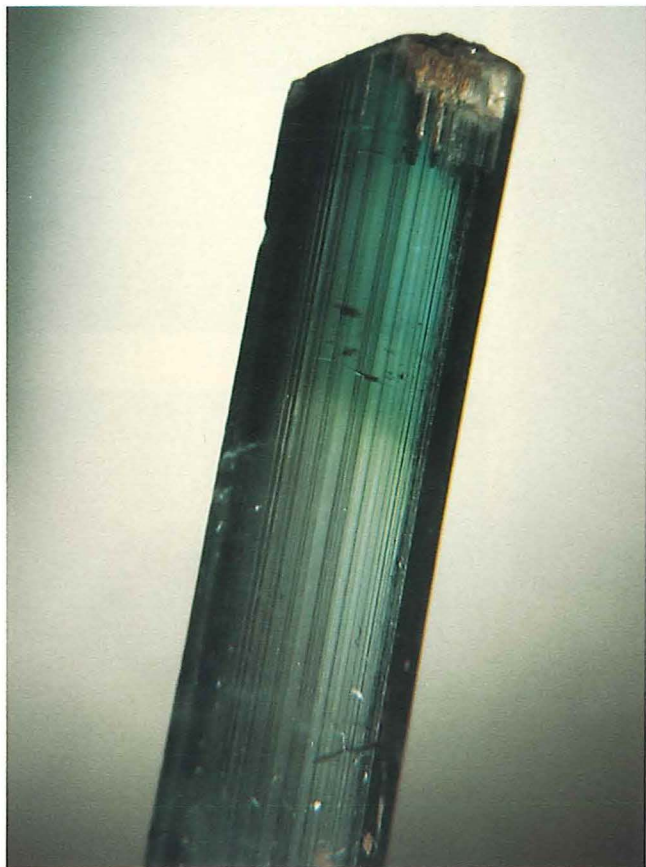
Elbaite (etched) t/n, Mount Mica Q, Paris



Elbaite t/n, Mount Mica Q, Paris



Elbaite min, Mount Mica Q, Paris {Ma}



Above: Elbaite t/n, Mount Mica Q, Paris



Elbaite t/n, Mount Mica Q, Paris

Below left: Elbaite min, Mount Mica Q, Paris [UR]{UR}



Elbaite t/n, Mount Mica Q, Paris



Elbaite t/n, Mount Mica Q, Paris

Below right: Elbaite sc, Mount Mica Q, Paris {BMC}





Above: Elbaite min,
Mount Mica Q, Paris
[WW]{HU}



Left: Elbaite t/n,
Havey Q, Poland
{UR}



Elbaite cab, Mount Mica Q, Paris [WW]{SIM}



Elbaite min, Havey Q, Poland {RW}



Elbaite sc, Mount Mica Q, Paris [WW]{SIM}



Elbaite min, Havey Q, Poland [WW]{HU}



Elbaite mm, Fisher Q, Topsham



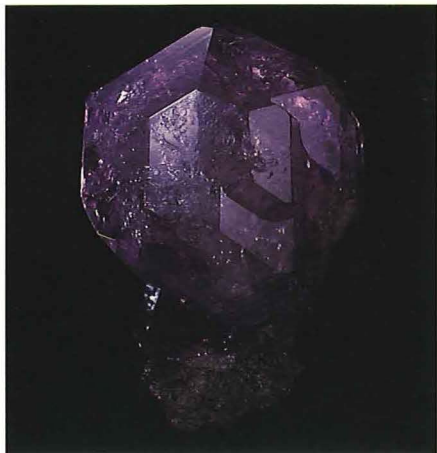
Eosphorite mm, Nevel Q, Newry [JW]



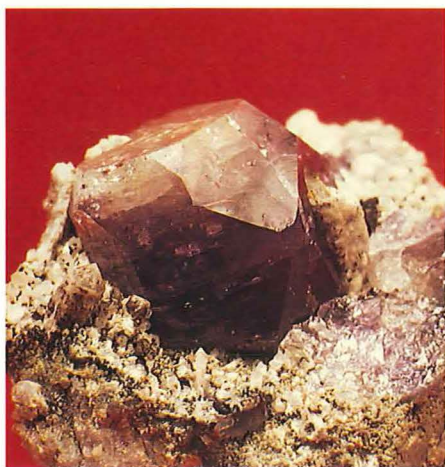
Elbaite sc, Havey Q, Poland {RW}



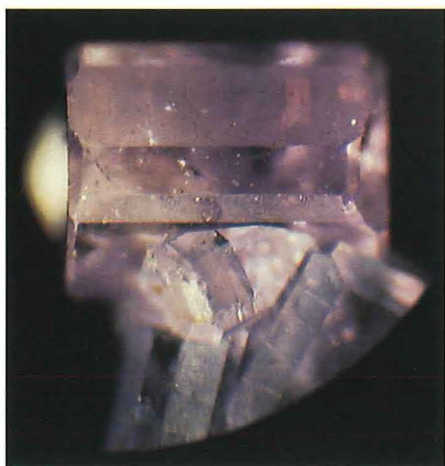
Eosphorite mm, Newry [LP]{LP}



Fluorapatite [Roebeling Apatite] sc,
Pulsifer Q, Auburn [WW]{SIM}



Fluorapatite sc, Groves Q, Auburn {DG}



Fluorapatite mm, Pulsifer Q, Auburn



Fluorapatite t/n, Pulsifer Q, Auburn [VP]{JB}



Fluorapatite L, Pulsifer Q, Auburn {RK}



Above: Fluorapatite min, Pulsifer Q, Auburn [PB]{PMS}



Fluorapatite min, Pulsifer Q, Auburn {MF}



Fluorapatite L, Pulsifer Q, Auburn {HU}



Below right: Fluorapatite mm, Pulsifer Q, Auburn [LP]{LP}

Below left: Fluorapatite mm, Pulsifer Q, Auburn [LP]{LP}



Fluorapatite cab, Harvard Q, Greenwood {HU}



Fluorapatite mm, Harvard Q, Greenwood [LP]{LP}



Fluorapatite mm, Harvard Q, Greenwood [LP]{LP}



Fluorapatite sc, Harvard Q, Greenwood {NW}



Fluorapatite t/n, Mount Rubellite Q, Hebron {JM}



Fluorapatite cab, Mount Rubellite Q, Hebron {HU}



Fluorapatite mm, Dunton Q, Newry



Fluorapatite mm, Havey Q, Poland



Fluorapatite sc, Havey Q, Poland {NEU}



Fluorapatite mm, Lord Hill Q, Stoneham



Gainesite min, Nevel Q, Newry [LP]{SIM}



Gold t/n, Milford



Kyanite min, Dundee Falls L, Windham



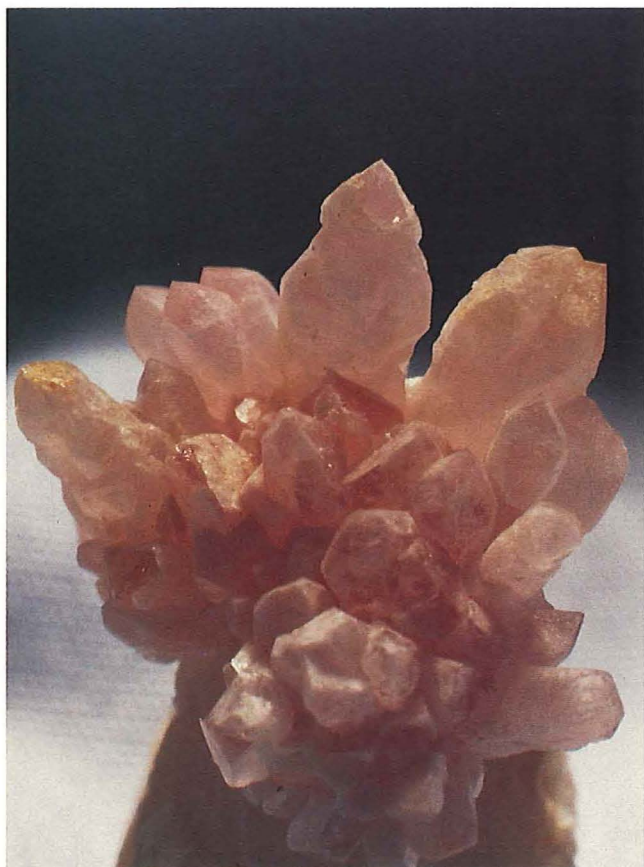
Perhamite mm, Bell Pit, Newry



Plagioclase series - Albite (peristerite) sc,
Swamp #1 Q, Topsham



Malachite mm, Barrett P (= Dolsan Pit), Pembroke



Above: Quartz min, Rose Quartz Crystal L, Newry {JM}

Below left: Quartz sc, Rose Quartz Crystal L, Newry {JM}

Below right: Quartz sc, Rose Quartz Crystal L, Newry [RC]{DG}



Quartz min, Rose Quartz Crystal L, Newry {JoM}

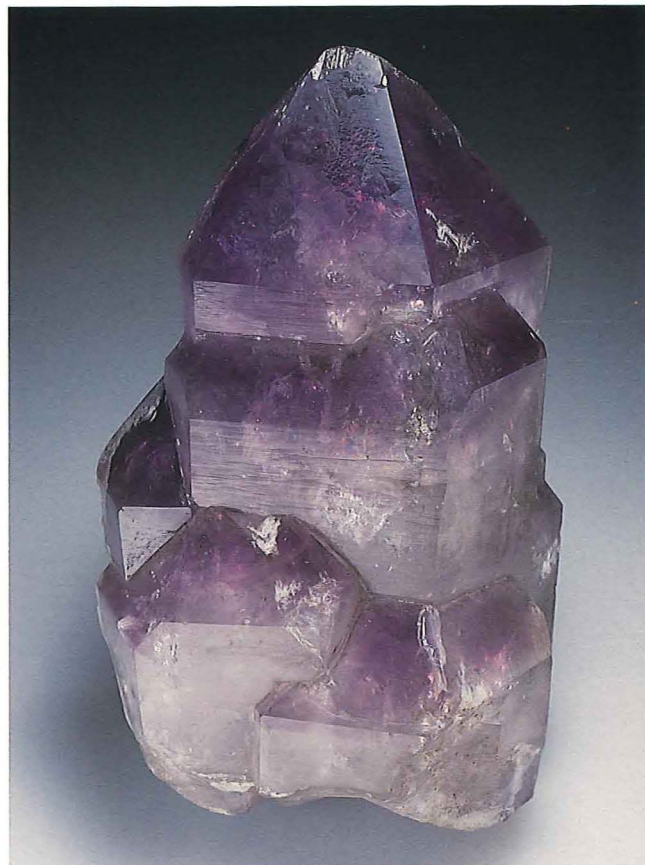


Quartz cab, Dunton Q, Newry





Quartz sc, Pleasant Mountain L, Denmark {BMS}



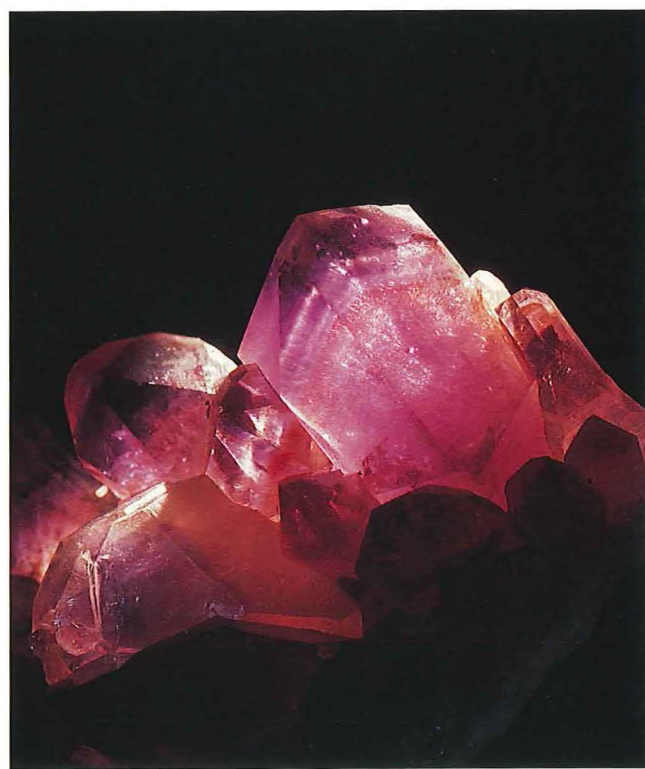
Quartz L, Deer Hill L, Stow [WW]{RB}



Quartz (amethyst), Intergalactic Pit, Stow [JBP]{DeC}



Quartz cab, Deer Hill L, Stow

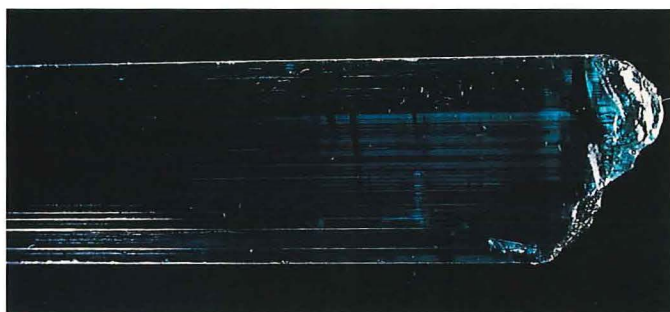


Quartz (amethyst) min, Saltman Prospect, Sweden [JBP]{WT}



Above left: Rhodochrosite (Twin Peaks) min, Bennett Q, Buckfield [JBP]{JM}

Above right: Sodalite cab, Dennis Hill A, Litchfield {AMNH}



Schorl min, Mount Mica Q, Paris [NL]{CI}

Below left: Wulfenite mm, Upper Colton Hill P, Stow

Below right: Whitmoreite mm, Bell Pit, Newry [LP]{LP}

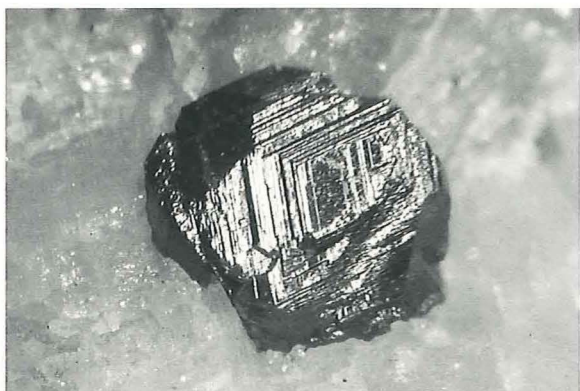




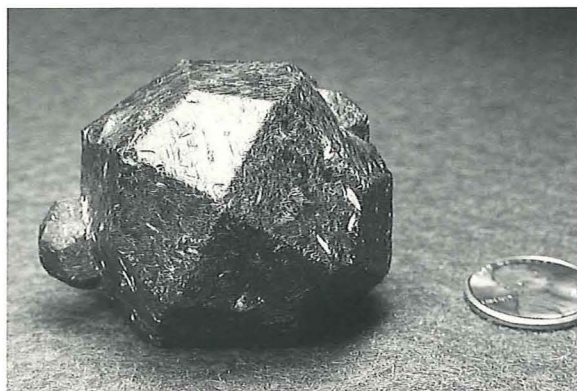
Actinolite mm, Little Deer Isle A, Deer Isle



Allanite-(Ce) sc, Topsham



Almandine mm, Groves Q, Auburn



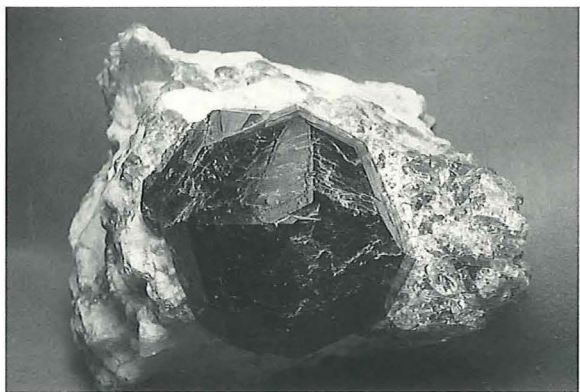
Almandine min, Maine Feldspar Q, Auburn



Almandine sc, Hedgehog Hill Q, Peru



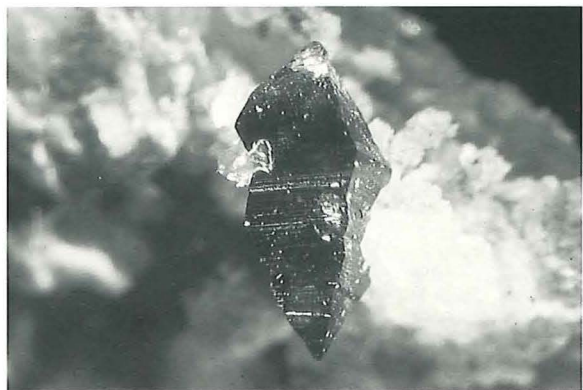
Almandine L, Standpipe Hill A, Topsham {HU}



Almandine cab, Willes #1 Q, Topsham {RH}



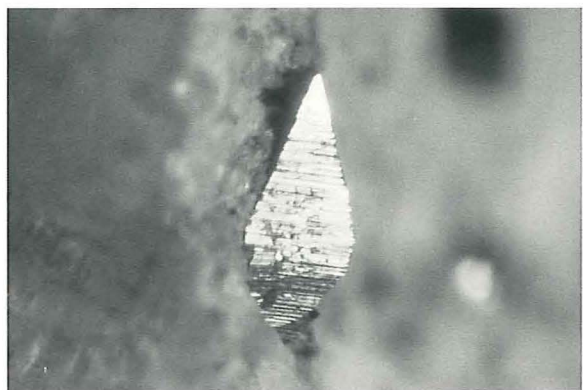
Analcime mm, Loring Cove A, Perry



Anatase mm, Route #117 road cut, Bridgton [LP]{LP}



Anatase mm, Duntun Q, Newry



Anatase mm, Consolidated #2 Q, Topsham



Andalusite sc, Kingfield



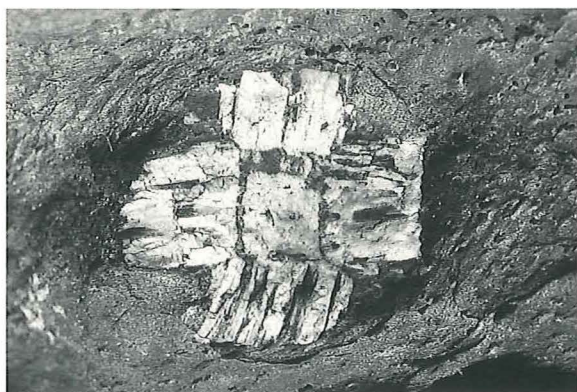
Andalusite sc, Small Point A, Phippsburg



Andalusite min, Standish {AMNH}



Andalusite sc, Standish {AMNH}



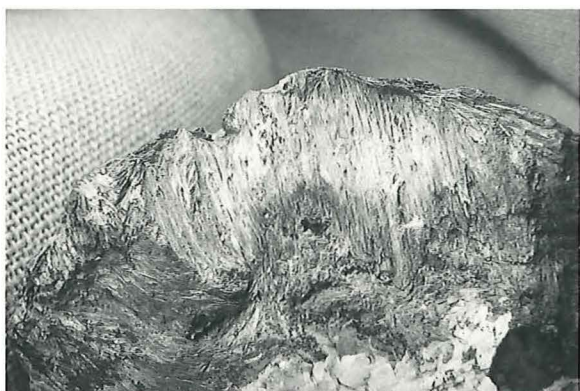
Andalusite [chiastolite] sc, Smalls Falls L, Township E



Anglesite mm, Lubec M, Lubec



Ankerite cab, Route #2 road cut, Mexico



Anthophyllite min, Dunton Q, Newry {HB}



Aragonite mm, Barrett P (Dolsan Pit), Pembroke



Aragonite mm, Route #220 road cut, Unity



Arsenopyrite mm, Acton M, Acton



Arsenopyrite mm, Dunton Q, Newry



Arsenopyrite mm, Dunton Q, Newry



Arsenopyrite mm, Limestone Q, Rockport



Augelite mm, Bell Pit, Newry



Augelite mm, Bell Pit, Newry



Augelite mm, Bell Pit, Newry



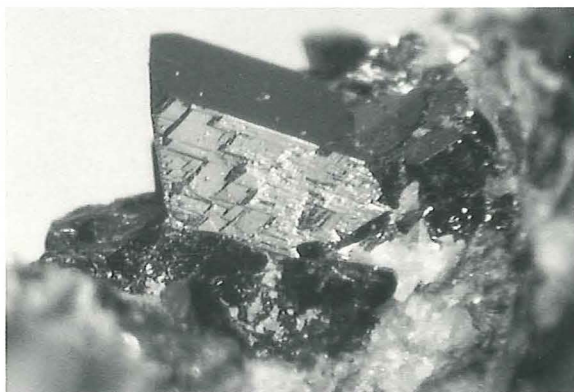
Autunite mm, Dunton Q, Newry



Autunite min, Lord Hill Q, Stoneham



Azurite mm, Barrett P (Dolsan Pit), Newry



Babingtonite mm, City Q, Bath



Barite t/n, Morse Brook L, Grafton



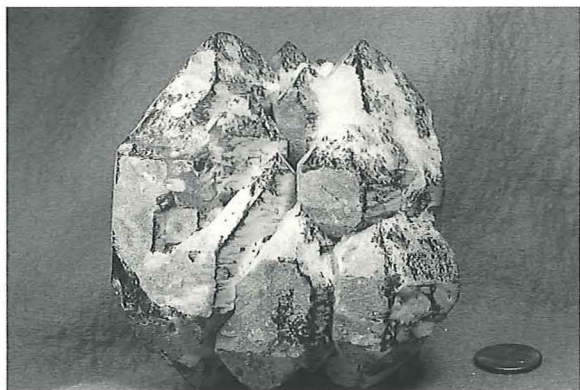
Barite mm, Barrett P (Dolsan Pit), Pembroke



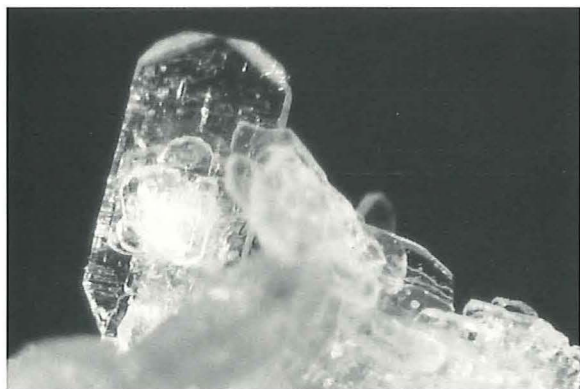
Beraunite [eleonorite] mm, Bell Pit, Newry



Beraunite mm, Dunton Q, Newry



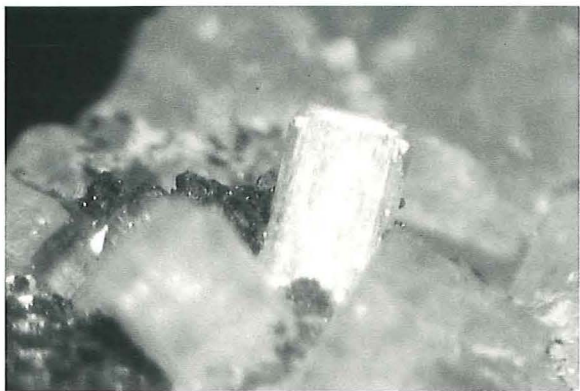
Bertrandite [selective coating] cab, Emmons Q, Greenwood



Bertrandite mm, Harvard Q, Greenwood



Bertrandite mm, Waisanen Q, Greenwood



Bertrandite mm, Waisanen Q, Greenwood



Bertrandite twin t/n, W Hayes Ledge Q, Greenwood



Bertrandite twin mm, W Hayes Ledge Q, Greenwood



Bertrandite mm, Bell Pit, Newry



Bertrandite mm, Nevel Q, Newry



Bertrandite min, BB #7 Q, Norway {NT}



Bertrandite mm, Lord Hill Q, Stoneham



Bertrandite mm, Bemis Stream P, Township D



Beryl L, Bumpus Q, Albany



Beryl L, Songo Pond Q, Albany {JM}



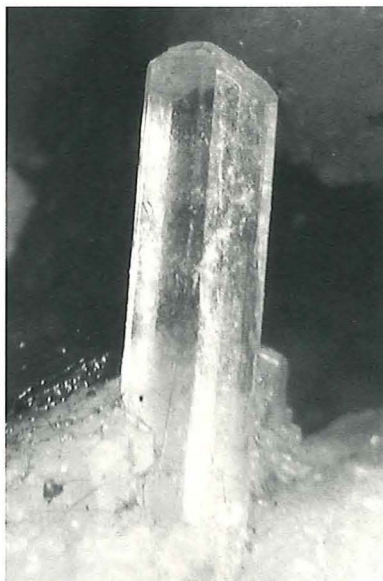
Giant beryl crystals, Mr. Cummings and assistant, ~1928, Bumpus Q, Albany. Photograph courtesy Ben Shaub



Beryl L, Auburn



Beryl [in situ] L, Songo Pond Q, Albany [JM]{JM}



Beryl mm, Booker Q, Bowdoinham



Beryl (Rose of Maine) L, Dennis Holden (left), Ronald Holden (right), Bennett Q, Buckfield [WF]



Beryl [morganite] min, Bennett Q, Buckfield {RW}



Beryl cab, Bennett Q, Buckfield {RW}



Beryl min, Freeport {HU}



Beryl (rubidian) L, Mount Mica Q, Paris {HU}



Beryl sc, Mount Mica Q, Paris {Ma}



Beryl t/n, Wicked Good Beryl L, Phippsburg



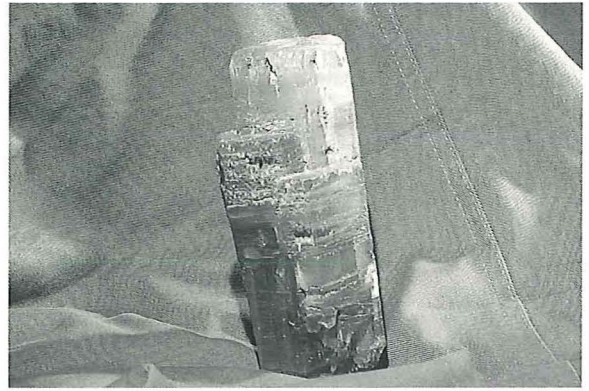
Beryl L, Thomas Q, Phippsburg {HU}



Beryl cab, Aldrich Q, Stoneham



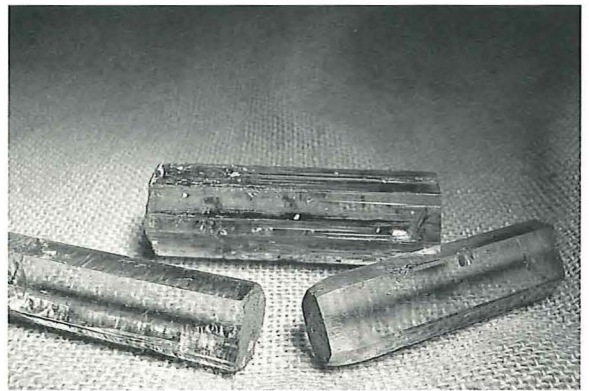
Beryl L, Barbour P, Stoneham [BP]{BP}



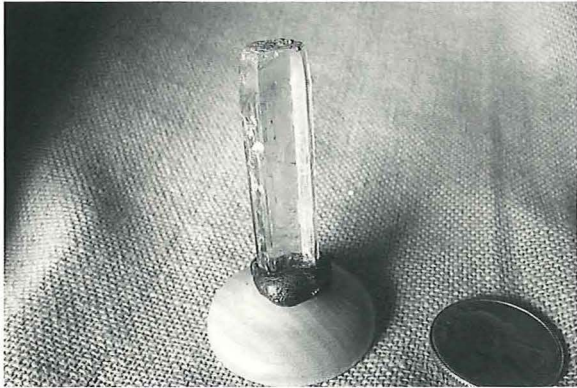
Beryl L, Topsham {AMNH}



Beryl cab, Trenton Q, Topsham {HU}



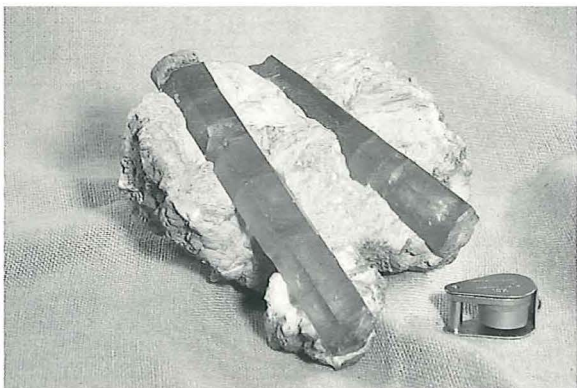
Beryl min, Trenton Q, Topsham {BMC}



Beryl min, Trenton Q, Topsham {BMC}



Beryl min, Trenton Q, Topsham {AMNH}



Beryl L, (Willes #1 Q?), Topsham {NEU}



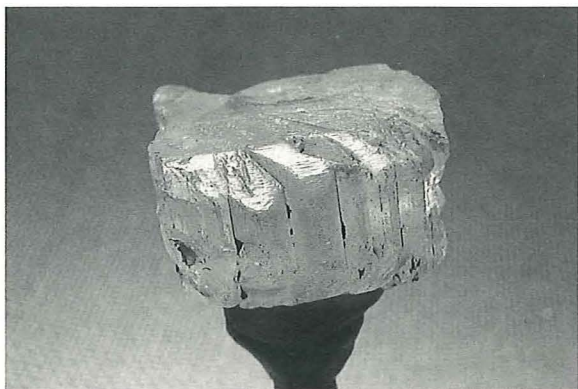
Beryllonite mm, Bell Pit, Newry



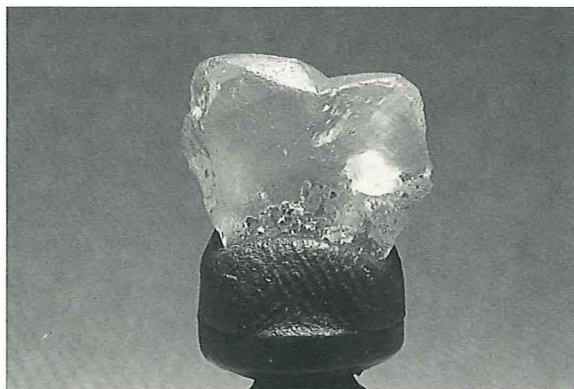
Beryllonite t/n, Dunton Q, Newry



Beryllonite cab, Dunton Q, Newry {RW}



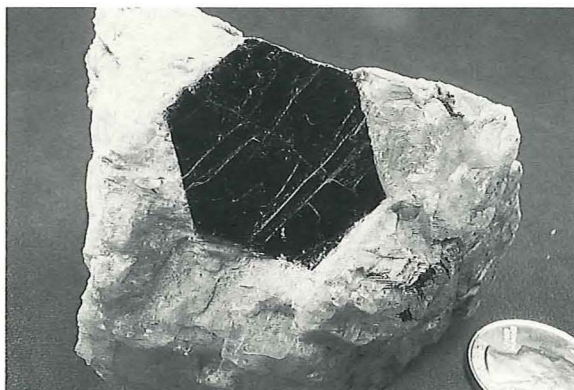
Beryllonite t/n, Beryllonite L, Stoneham {BMC}



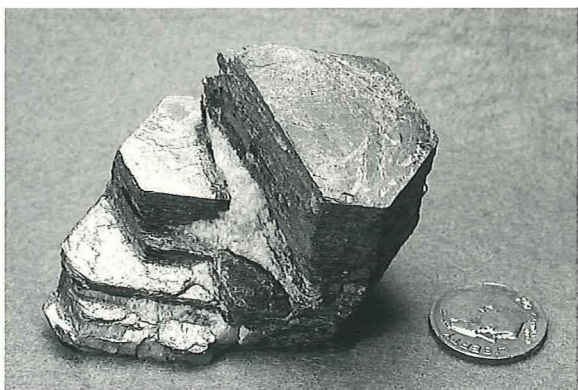
Beryllonite twin t/n, Beryllonite L, Stoneham {BMC}



Beryllonite min, Beryllonite L, Stoneham



Biotite Series - Annite sc, Topsham {HU}



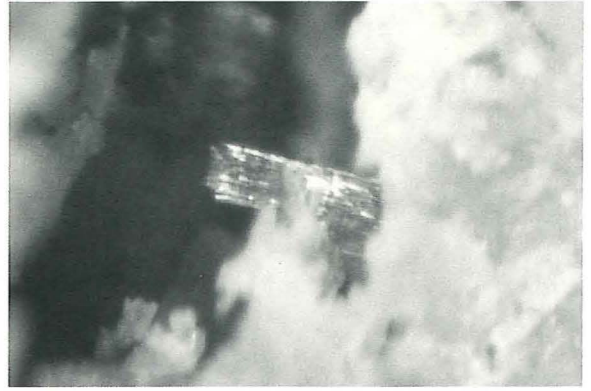
Biotite Series - Annite sc, Topsham



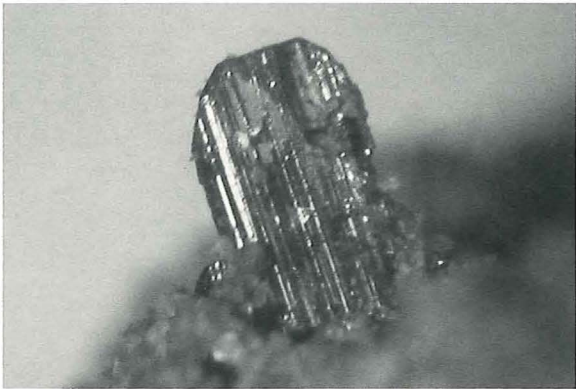
Bismutite mm, Lord Hill Q, Stoneham



Brazilianite mm, Bell Pit, Newry



Brochantite mm, Cape Rosier M, Brooksville



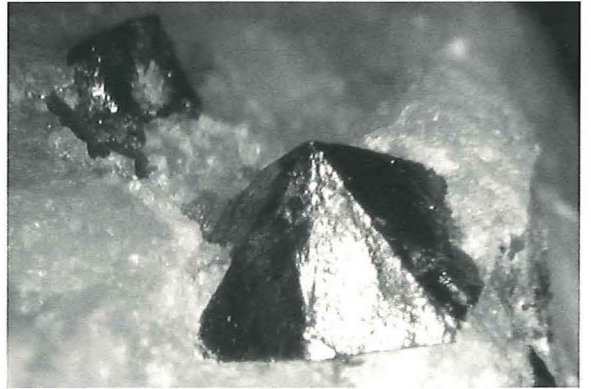
Brookite mm, Consolidated #2 Q, Topsham



Cancrinite cab, Dennis Hill A, Litchfield {NEU}



Cassiterite mm, Bennett Q, Buckfield [JBP]



Cassiterite mm, Harvard Q, Greenwood



Cassiterite mm, Dunton Q, Newry



Cassiterite mm, Dunton Q, Newry



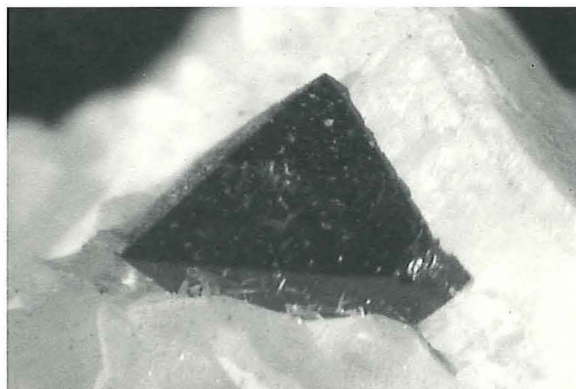
Cassiterite mm, Dunton Q, Newry



Cassiterite sc, Martin P, Newry {JoM}



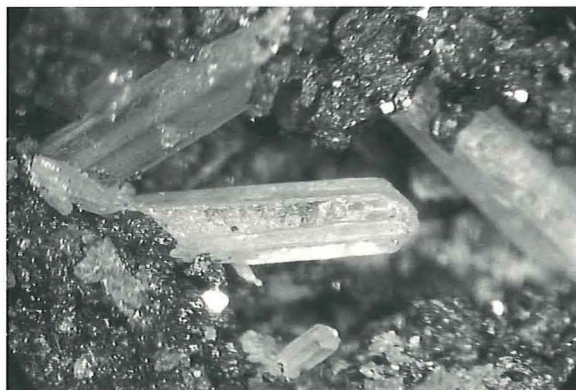
Cassiterite mm, Mount Mica Q, Paris



Cassiterite mm, Black Mountain Q, Rumford



Cerussite mm, Callahan M, Brooksville



Cerussite mm, Callahan M, Brooksville



Cerussite mm, Callahan M, Brooksville



Chalcopyrite mm, Black Hawk M, Blue Hill {HD}



Childrenite mm, Red Hill A, Rumford



Chloritoid mm, Mayfield Corners A, Mayfield



Chrysoberyl t/n, Witt Hill L, Greenwood



Chrysoberyl twin sc, Witt Hill L, Greenwood



Chrysoberyl min, Ragged Jack Mountain L, Hartford



Chrysoberyl cab, Ragged Jack Mountain L, Hartford {HU}



Chrysoberyl L, Hoopers Ledge Q, Paris {HU}



Chrysoberyl twin mm, road cut, Standish



Chrysoberyl twin mm, road cut, Standish



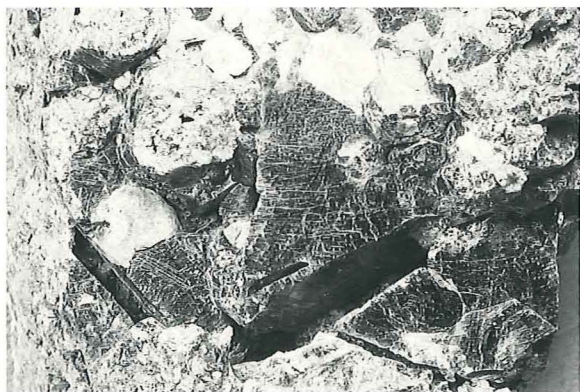
Chrysoberyl twin mm, road cut, Standish



Clinochlore mm, Route #15 road cut, Monson



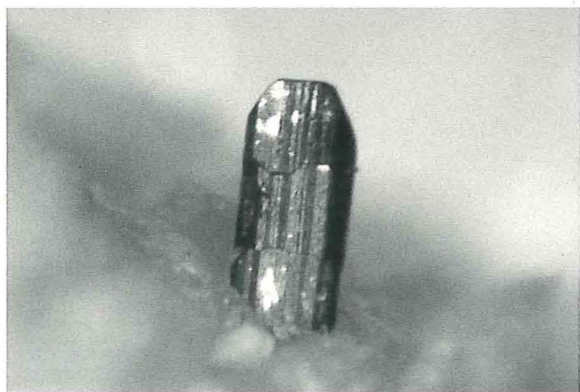
Clinozoisite sc, Day Hill L, Cornish {HU}



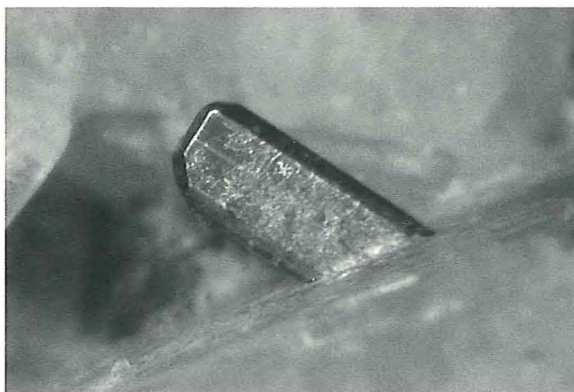
Clinozoisite cab, Basin L, Phippsburg {RW}



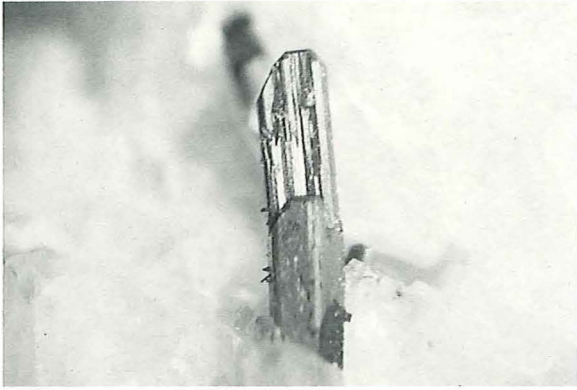
Clinozoisite sc, 200 m P, Sanford {HU}



Columbite mm, Johnson Q, Albany



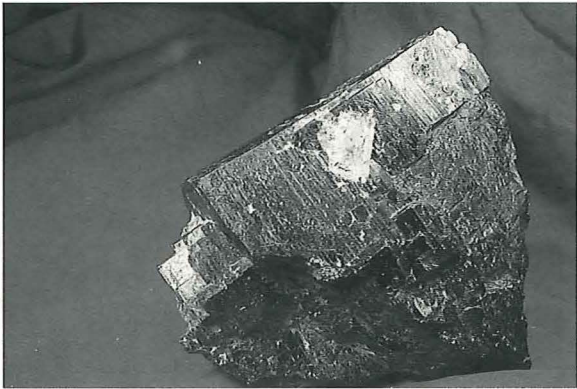
Columbite mm, Johnson Q, Albany



Columbite mm, Johnson Q, Albany



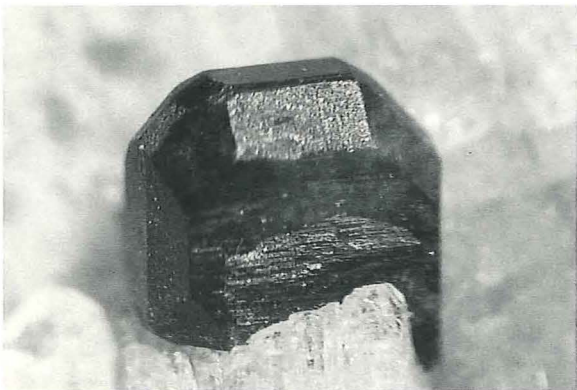
Columbite mm, Booker Q, Bowdoinham



Columbite L, Bell Pit, Newry {HU}



Columbite cab, Standish {AMNH}



Columbite mm, Lord Hill Q, Stoneham



Columbite mm, Lord Hill Q, Stoneham



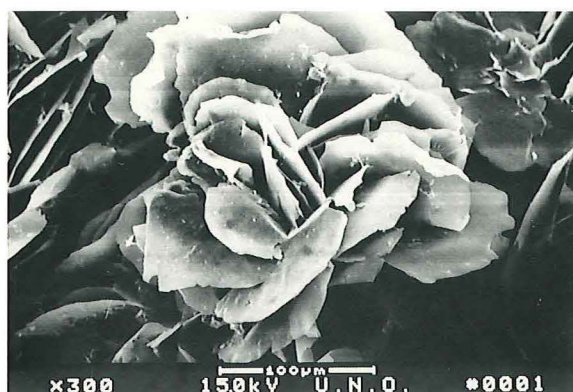
Columbite min, Fisher Q, Topsham



Columbite sc, Willes #1 Q, Topsham



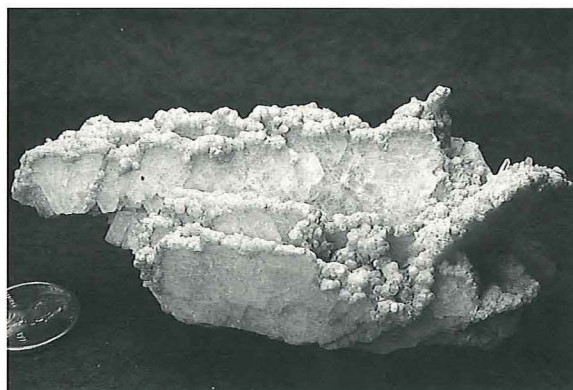
Cookeite t/n, (Pulsifer Q), Auburn {HU}



Cookeite mm, Bennett Q, Buckfield [AF]{AF}



Cookeite t/n, Bennett Q, Buckfield



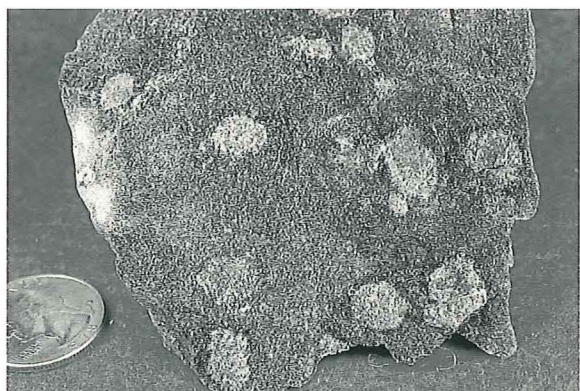
Cookeite sc, Bennett Q, Buckfield



Cookeite mm, Harvard Q, Greenwood



Cookeite mm, Mount Mica Q, Paris



Cordierite cab, Black Hawk M, Blue Hill



Crandallite mm, Dunton Q, Newry



Crandallite mm, Mount Mica Q, Paris {GB}



Cuprite mm, Barrett P (Dolsan Pit), Pembroke



Datolite mm, Loring Cove A, Perry



Dendrite mm, Consolidated #2 Q, Topsham



Diadochite mm, Dunton Q, Newry



Diopside mm, Webster P, Sanford



Diopside mm, Webster P, Sanford



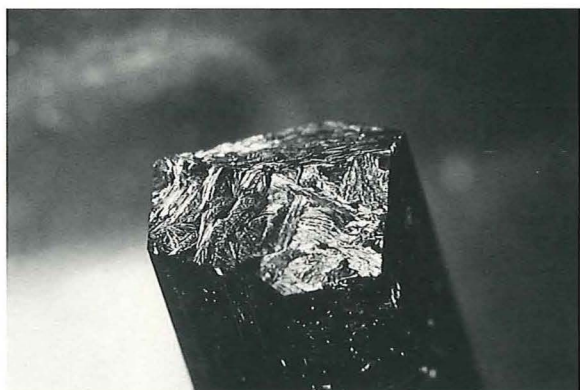
Diopside sc, Warren {HU}



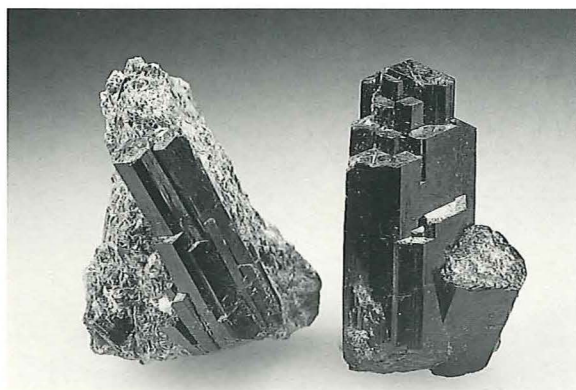
Dolomite mm, Route #27 road cut, Boothbay Harbor



Dravite min, Dunton Q, Newry



Dravite min, Dunton Q, Newry



Dravite min, Dunton Q, Newry [WW]{HU}



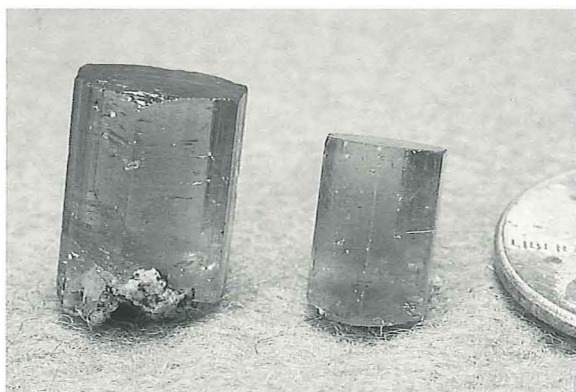
Earlshannonite mm, Dunton Q, Newry



Elbaite sc, Hatch Farm P, Auburn [JS]{CG}



Elbaite cab, Keith Q, Auburn {BMS}



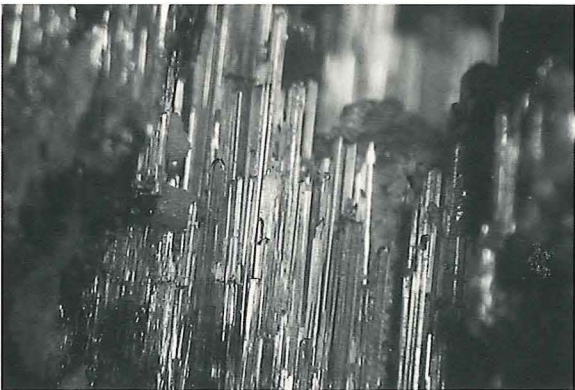
Elbaite t/n, Keith Q, Auburn {RW}



Elbaite mm, Pulsifer Q, Auburn



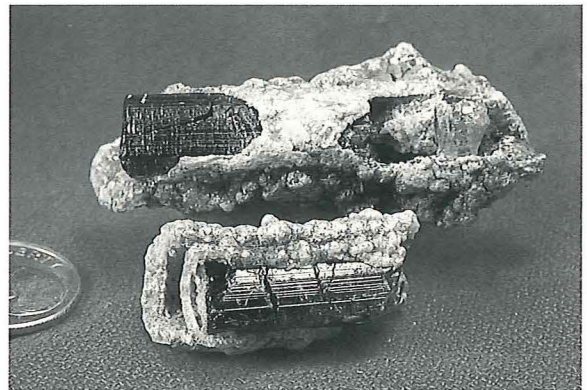
Elbaite (nodule) t/n, Bennett Q, Buckfield



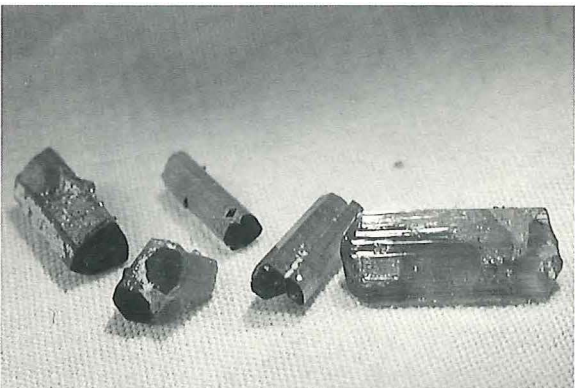
Elbaite mm, Bennett Q, Buckfield



Elbaite t/n, Pulsifer Q, Auburn



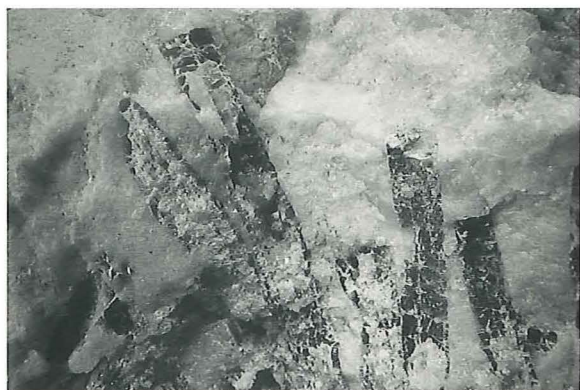
Elbaite in cookeite min, Bennett Q, Buckfield



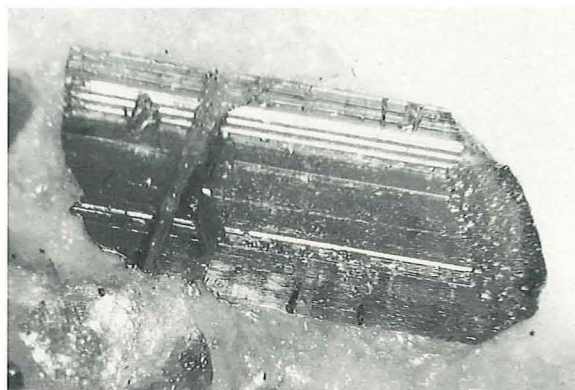
Elbaite "Blue Hat" t/n, Emmons Q, Greenwood



Elbaite mm, Harvard Q, Greenwood



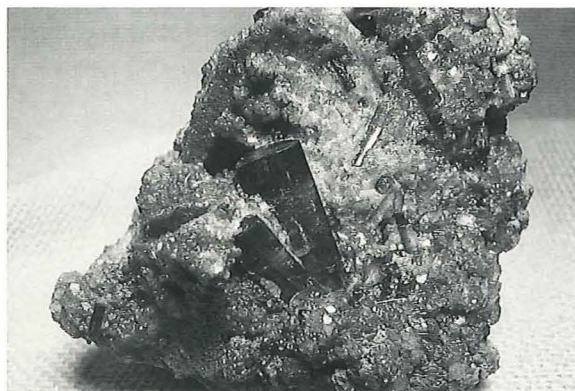
Elbaite with cookeite cores sc, Harvard Q, Greenwood



Elbaite mm, Harvard Q, Greenwood



Elbaite L, Tamminen Q, Greenwood



Elbaite in lepidolite sc, Mount Rubellite Q, Hebron {BMC}



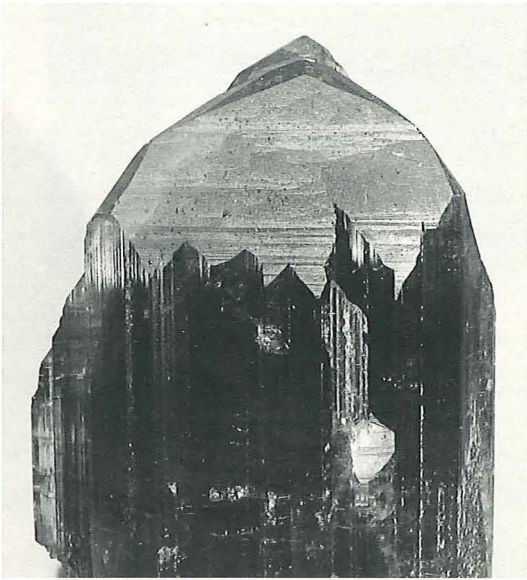
Elbaite cab, Crooker P, Newry



Elbaite (eyes) sc, Dunton Q, Newry



Elbaite sc, Dunton Q, Newry {JB}



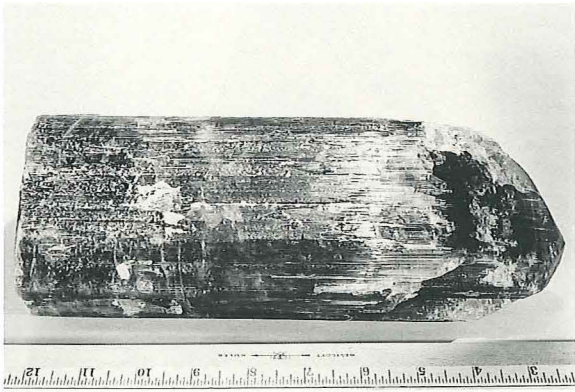
Elbaite [Jolly Green Giant, reverse side] L, Dunton Q, Newry [JoW]{SIM}



Elbaite sc, Dunton Q, Newry [RC]{DM}



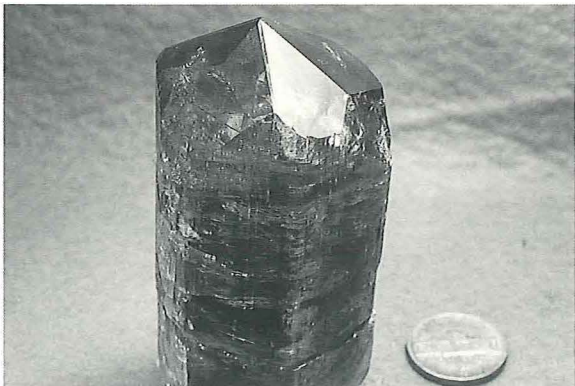
Elbaite t/n, Mount Mica Q, Paris



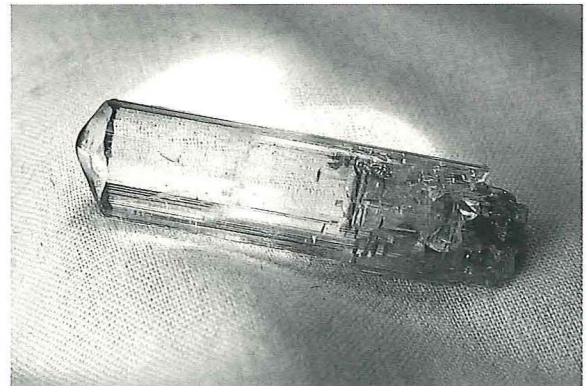
Elbaite [Jolly Green Giant] L, Dunton Q, Newry [JoW]{SIM}



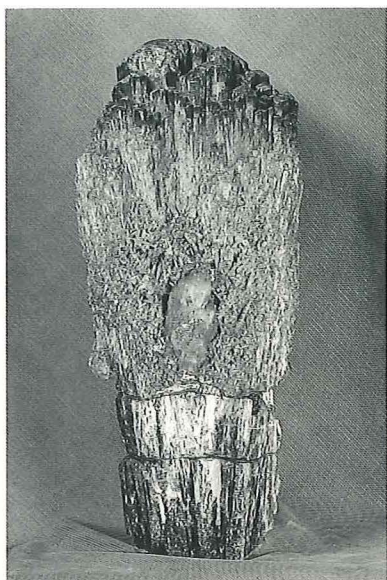
Elbaite min-t/n, BB #7 Q, Norway {PWP}



Elbaite sc, Dunton Q, Newry {Ma}



Elbaite (achroite) min, Mount Mica Q, Paris



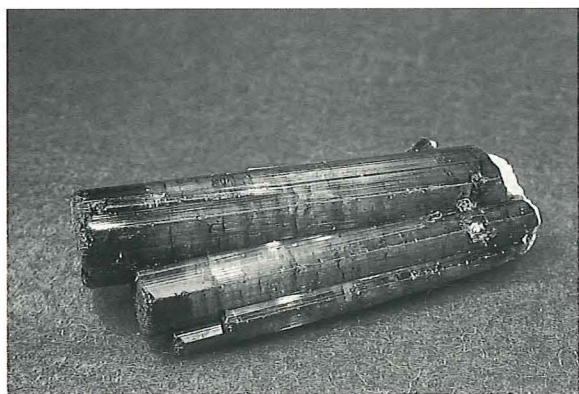
Elbaite L, Mount Mica Q, Paris
[BS]{HU}



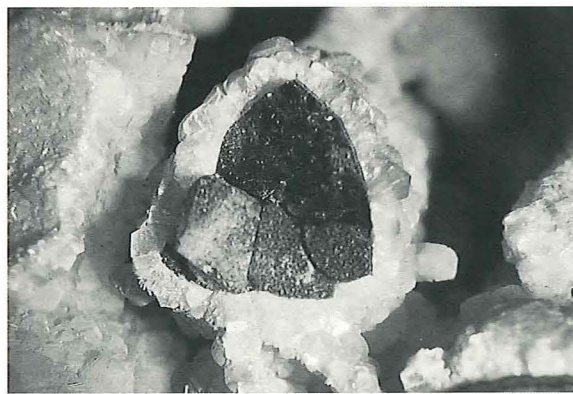
Elbaite min, Mount Mica Q, Paris [NL]{CI}



Elbaite sc, Mount Mica Q, Paris



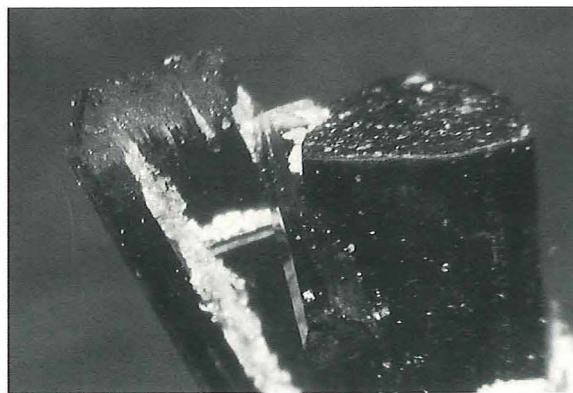
Elbaite min, Mount Mica Q, Paris {HU}



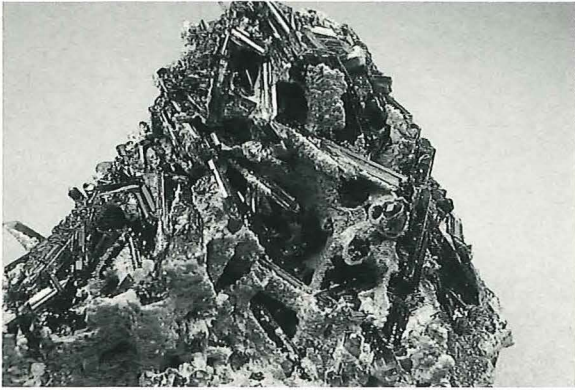
Elbaite and cookeite mm, Mount Mica Q, Paris



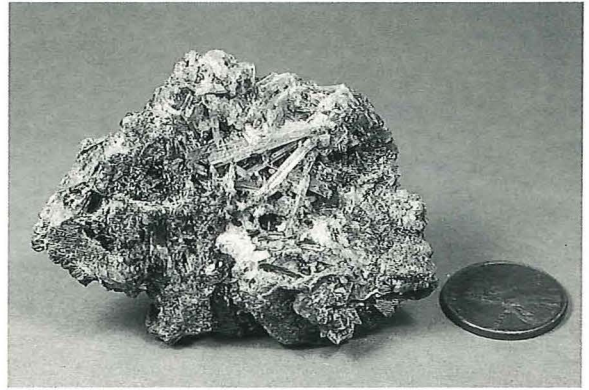
Elbaite mm, Route #26 road cut, Paris



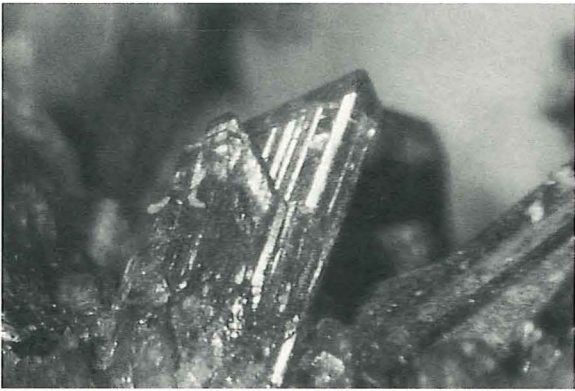
Elbaite mm, Fisher Q, Topsham



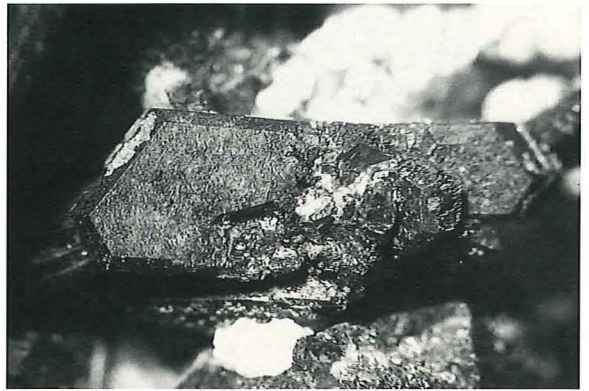
Elbaite sc, Fisher Q, Topsham {HU}



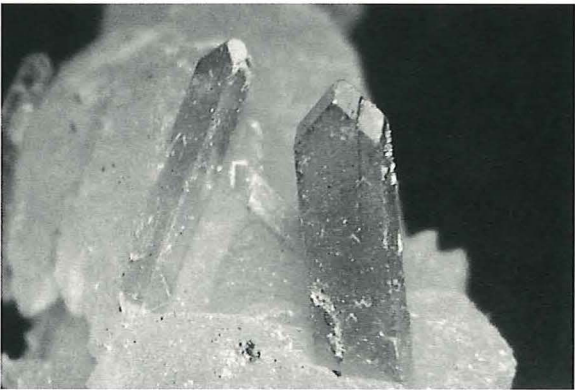
Eosphorite sc, Bennett Q, Buckfield {HU}



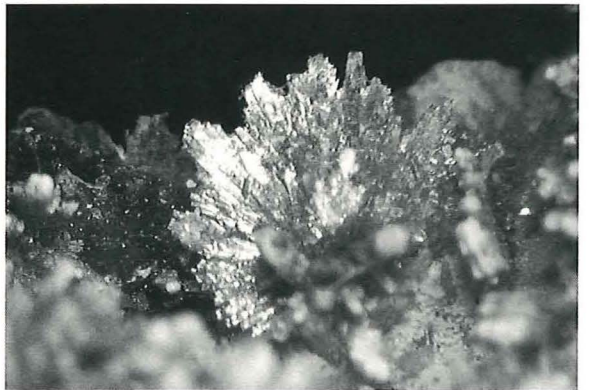
Eosphorite mm, Consolidated Q, Georgetown



Eosphorite min, Mount Rubellite Q, Hebron



Eosphorite mm, Nevel Q, Newry



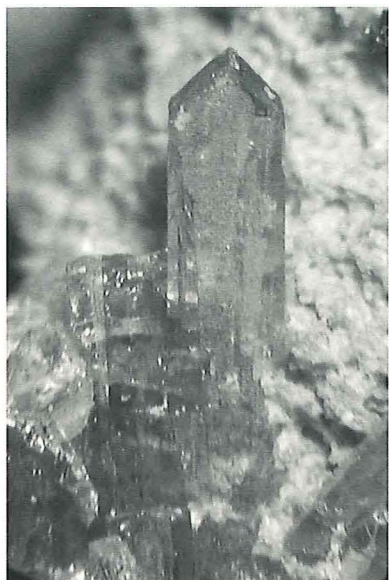
Eosphorite mm, Rose Quartz Crystal L, Newry



Eosphorite mm, Rose Quartz Crystal L, Newry



Eosphorite mm, Black Mountain Q, Rumford



Eosphorite mm, Mount Mica Q, Paris



Eosphorite mm, Black Mountain Q, Rumford



Eosphorite mm, Black Mountain Q, Rumford



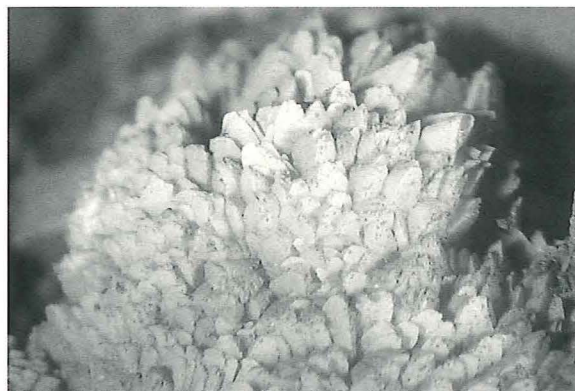
Euclase mm, West Fisher P, Topsham [AF]{AF}



Fairfieldite sc, Bennett Q, Buckfield {HU}



Fairfieldite mm, Bell Pit, Newry



Fairfieldite t/n, Nevel Q, Newry



Fairfieldite mm, Nevel Q, Newry



Fairfieldite mm, Nevel Q, Newry



Fairfieldite min, Nevel Q, Newry {AMNH}



Fairfieldite mm, Nevel Q, Newry



Fluorapatite mm, Johnson Q, Albany



Fluorapatite t/n, Songo Pond Q, Albany {JM}



Fluorapatite sc, Songo Pond Q, Albany {JM}



Fluorapatite sc, Greenlaw Q, Auburn {RK}



Fluorapatite sc, Hatch Farm P, Auburn {NEU}



Fluorapatite cab, Bennett Q, Buckfield {RW}



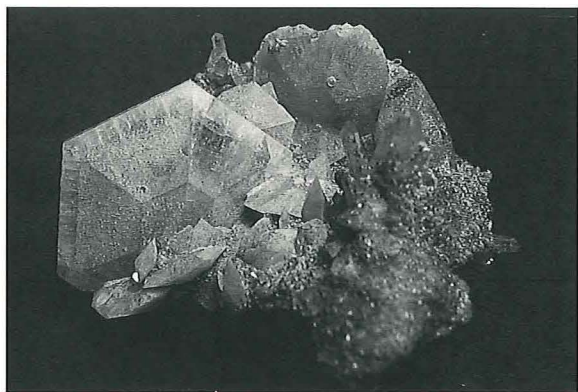
Fluorapatite and muscovite cab, Bennett Q, Buckfield {NEU}



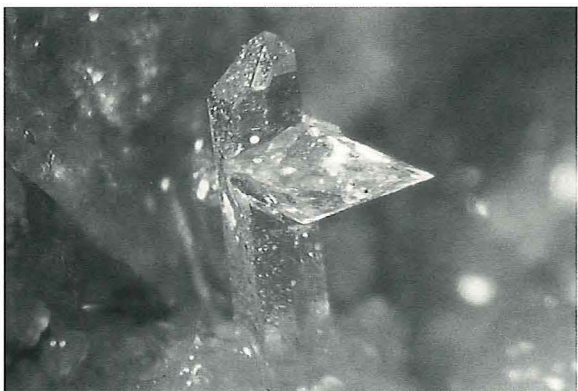
Fluorapatite (manganoan) mm, Harvard Q, Greenwood



Fluorapatite t/n, Harvard Q, Greenwood



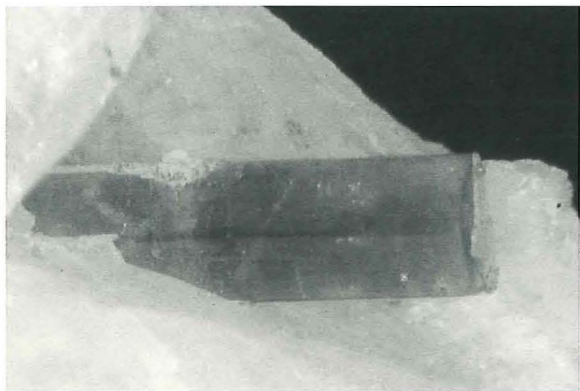
Fluorapatite min, Mount Rubellite Q, Hebron {HU}



Fluorapatite min, Mount Rubellite Q, Hebron



Fluorapatite min, Dunton Q, Newry



Fluorapatite mm, Dunton Q, Newry



Fluorapatite mm, Dunton Q, Newry



Fluorapatite min, Dunton Q, Newry



Fluorapatite mm, BB #7 Q, Norway



Fluorapatite mm, Hoopers Ledge Q, Paris



Fluorapatite mm, Black Mountain Q, Rumford



Fluorapatite - variety Francolite coating eosphorite mm, Black Mountain Q, Rumford



Fluorapatite mm, Lord Hill Q, Stoneham



Fluorapatite on muscovite mm, Lord Hill Q, Stoneham {DC}



Fluorapatite sc, Lord Hill Q, Stoneham



Fluorapatite mm, Lord Hill Q, Stoneham {DC}



Fluorapatite mm, Lord Hill Q, Stoneham {DC}



Fluorite in topaz mm, Lord Hill Q, Stoneham



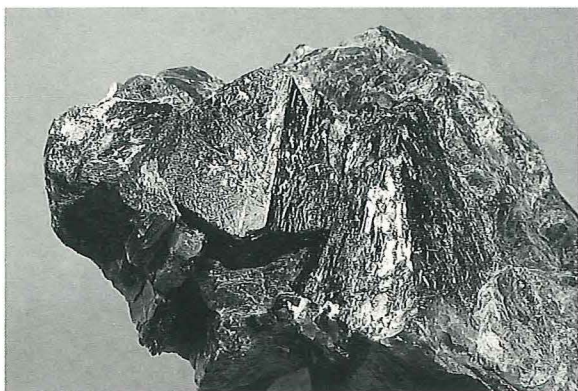
Fluorite mm, Dragon Cement Q, Thomaston {DC}



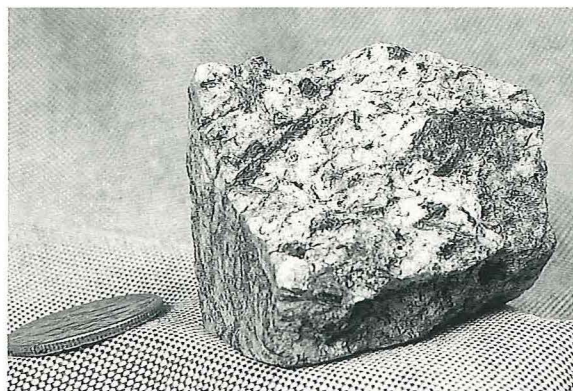
Gahnite min, Groves Q, Auburn



Gahnite sc, Pulsifer Q, Auburn {HU}



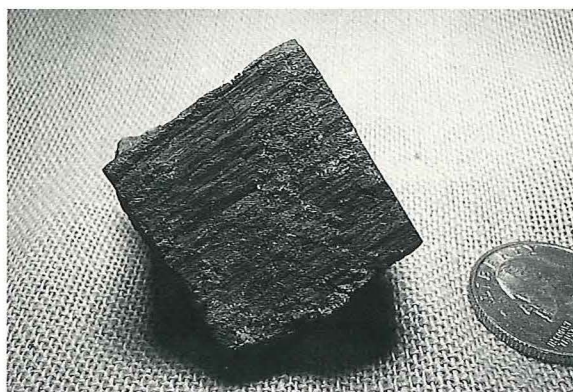
Gahnite sc, Coombs Q, Bowdoin {DJ}



Gedrite min, Grafton {HU}



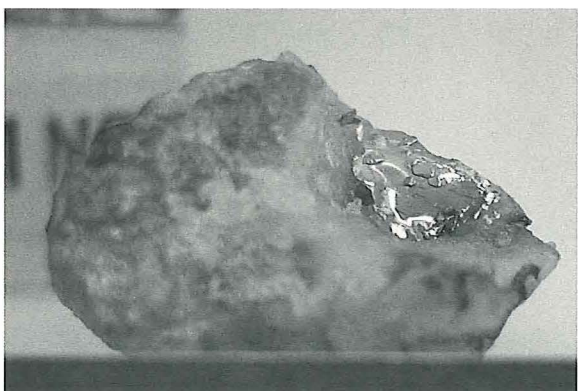
Goethite sc, Little Deer Isle A, Deer Isle



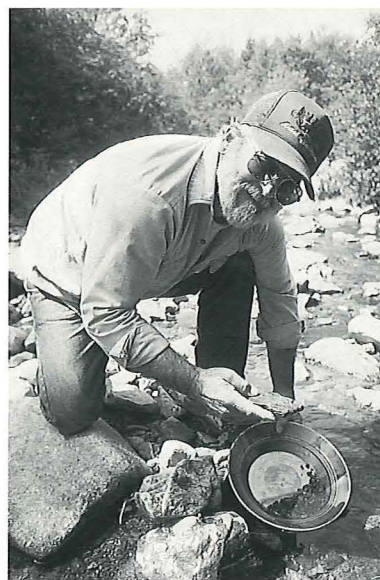
Goethite min, Seal Cove {BMC}



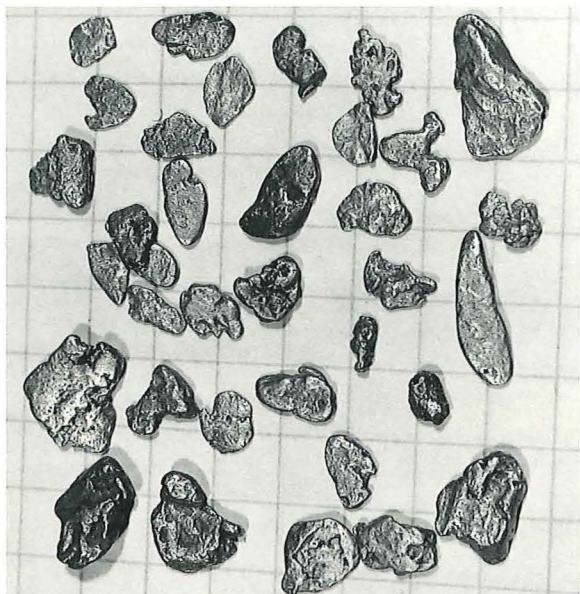
Goethite in muscovite mm, Consolidated Q, Topsham



Gold min, Kibby Stream A, Kibby {PWP}



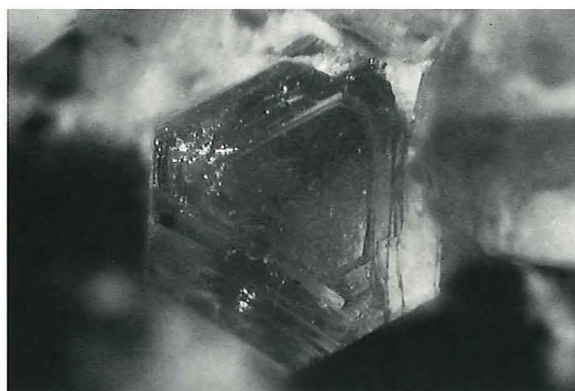
Yukon King gold panning on Kibby Stream, Kibby



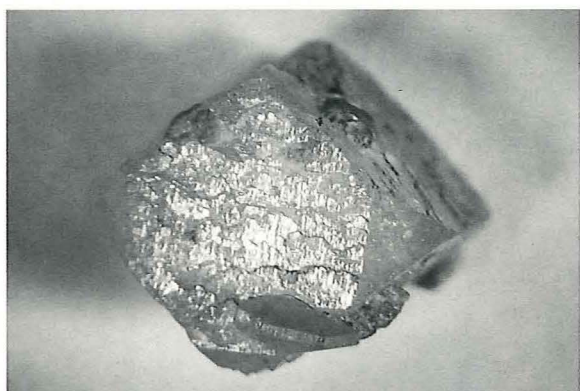
Gold (6.3 mm grid), East Branch Swift River, Byron.
Photograph courtesy Ben Shaub.



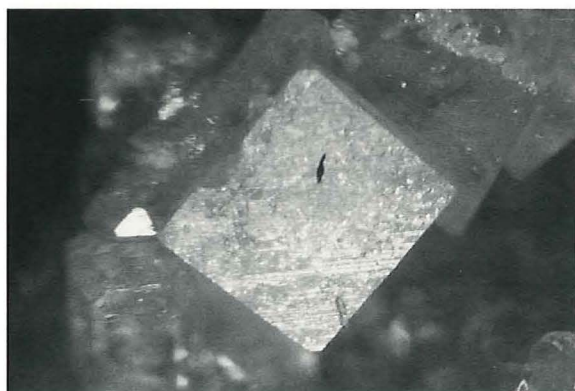
Gold mm, Nile Brook, Rangeley



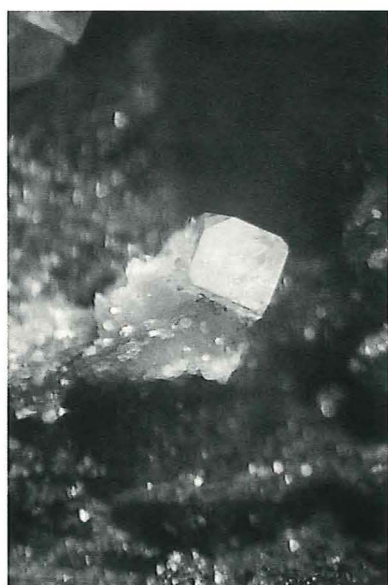
Goyazite mm, Harvard Q, Greenwood [LP]{LP}



Gorceixite mm, Bennett Q, Buckfield



Goyazite mm, Bell Pit, Newry



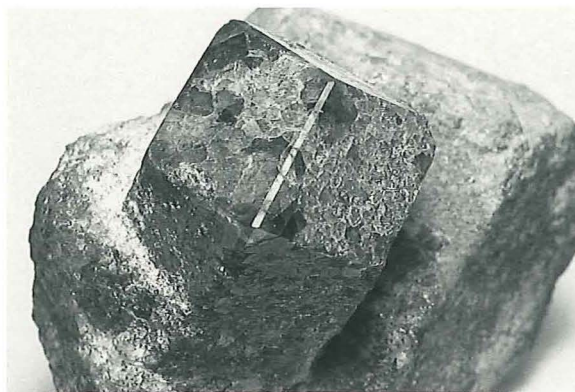
Goyazite mm, Lord Hill Q, Stoneham {JP}



Graphite mm, Perham Q, West Paris



Grossular cab, Cornish {HU}



Grossular sc, Pitts-Tenney Q, Minot



Grossular cab, Pitts-Tenney Q, Minot



Grossular cab, Raymond {AMNH}



Gypsum mm, Cape Rosier M, Brooksville



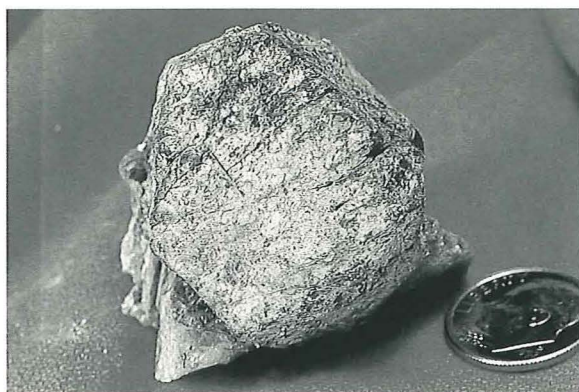
Halite mm, Schoodic Point, Winter Harbor



Hematite t/n, Waterford {HU}



Hemimorphite mm, Callahan M, Brooksville



Heterosite after triphylite min, Plumbago Mountain A, Newry



Hureaulite (bastinite) mm, Dunton Q, Newry



Hureaulite mm, Mount Mica Q, Paris {GB}



Hureaulite mm, Lord Hill Q, Stoneham



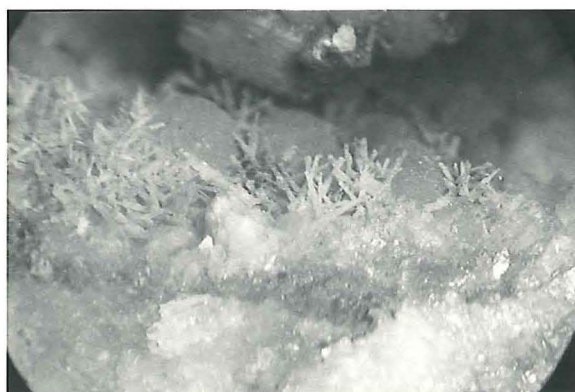
Hureaulite mm, Lord Hill Q, Stoneham



Hurlbutite mm, Black Mountain Q, Rumford {SW}



Hydroxylapatite mm, Dunton Q, Newry



Hydroxylapatite mm, Rose Quartz Crystal L, Newry



Hydroxylapatite mm, Rose Quartz Crystal L, Newry



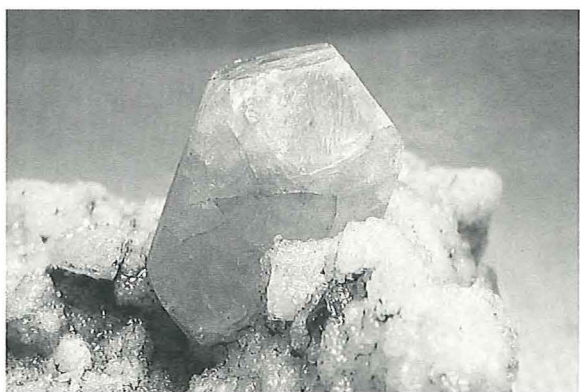
Hydroxylapatite mm, Black Mountain Q, Rumford



Hydroxyl-herderite t/n, Auburn {YU}



Hydroxyl-herderite t/n, Auburn {NEU}



Hydroxyl-herderite min, Auburn {NEU}



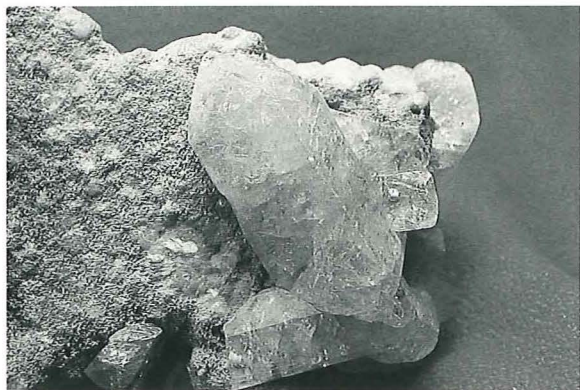
Hydroxyl-herderite twin mm, Auburn



Hydroxyl-herderite twin min, Keith Q, Auburn {HU}



Hydroxyl-herderite min, Keith Q, Auburn {HU}



Hydroxyl-herderite min, Keith Q, Auburn {HU}



Hydroxyl-herderite double-twin t/n, Bennett Q, Buckfield



Hydroxyl-herderite mm, Bennett Q, Buckfield



Hydroxyl-herderite min, Bennett Q, Buckfield [JBP]{RW}



Hydroxyl-herderite min, Waisanen Q,
Greenwood [RC]{AM}



Hydroxyl-herderite t/n (twin), Emmons Q, Greenwood



Hydroxyl-herderite min, Waisanen Q, Greenwood {HU}



Hydroxyl-herderite t/n, Waisanen Q, Greenwood



Hydroxyl-herderite twin t/n, Waisanen Q, Greenwood



Hydroxyl-herderite mm, Waisanen Q, Greenwood



Hydroxyl-herderite t/n, Waisanen Q, Greenwood



Hydroxyl-herderite mm, Dunton Q, Newry



Hydroxyl-herderite mm, Dunton Q, Newry



Hydroxyl-herderite mm, Dunton Q, Newry



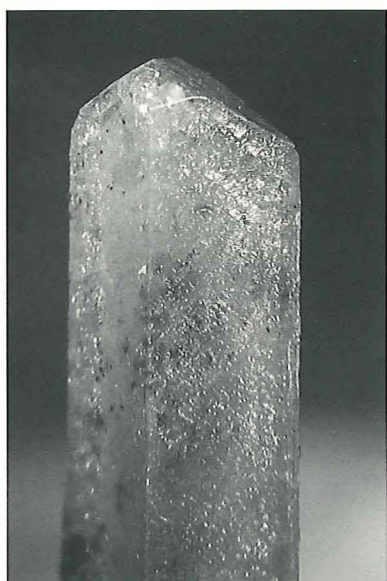
Hydroxyl-herderite mm, Havey Q, Poland



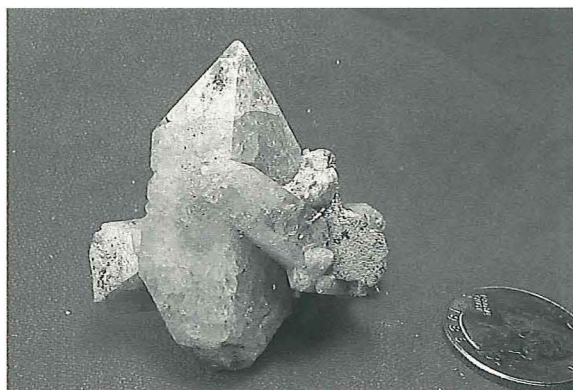
Hydroxyl-herderite twin mm, Havey Q, Poland



Hydroxyl-herderite mm, Lord Hill Q, Stoneham



Hydroxyl-herderite t/n, Ski Pike Q,
West Paris



Hydroxyl-herderite min, Fisher Q, Topsham {HU}



Hydrozincite mm, Big Hill M, Pembroke



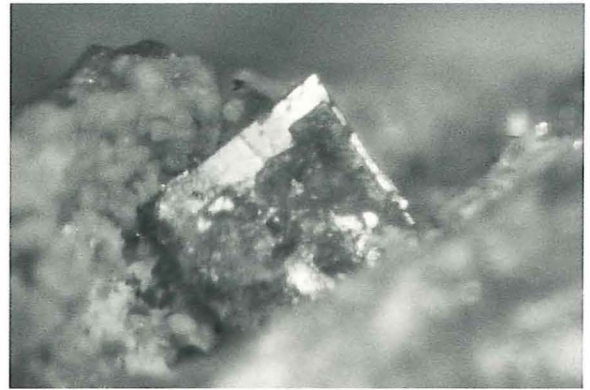
Ice mm, Auburn



Jahnsite-(CaMnFe) mm, Bell Pit, Newry



Jahnsite-(MnMnMn) mm, Emmons Q, Greenwood



Kosnarite mm, Mount Mica Q, Paris



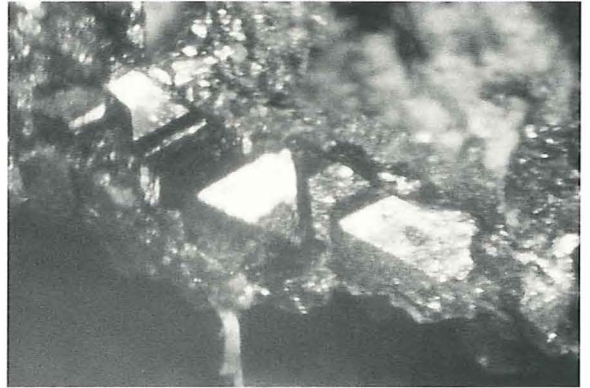
Kosnarite mm, Black Mountain Q, Rumford



Kyanite min (terminated), Dundee Falls L, Windham



Kyanite cab, Dundee Falls L, Windham



Landesite mm, Emmons Q, Greenwood {GB}



Laucite mm, Dunton Q, Newry [JW]



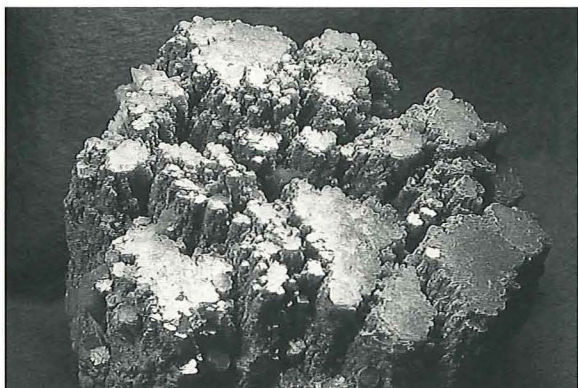
Lepidolite sc, Auburn {NEU}



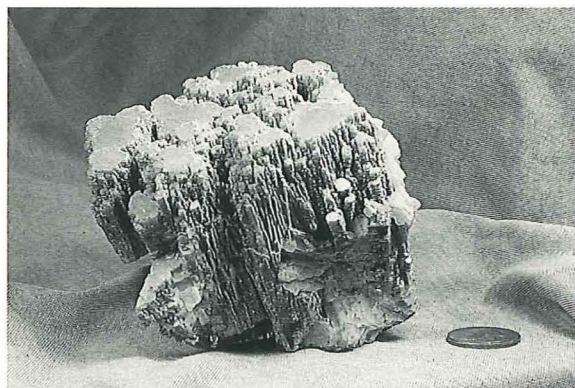
Lepidolite sc, Auburn {HU}



Lepidolite cab, Pulsifer Q, Auburn {BMS}



Lepidolite sc, Bennett Q, Buckfield {RW}



Lepidolite sc, Bennett Q, Buckfield {RW}



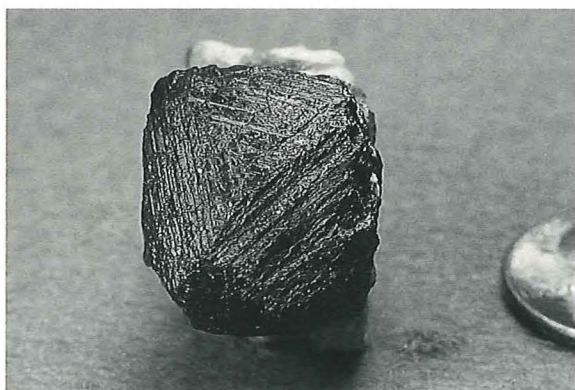
Lepidolite sc, Dunton Q, Newry



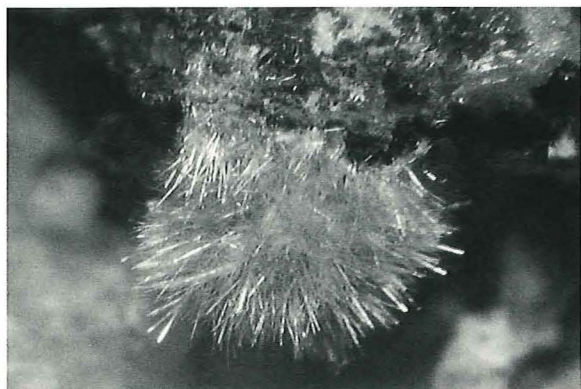
Linarite mm, Callahan M, Brooksville



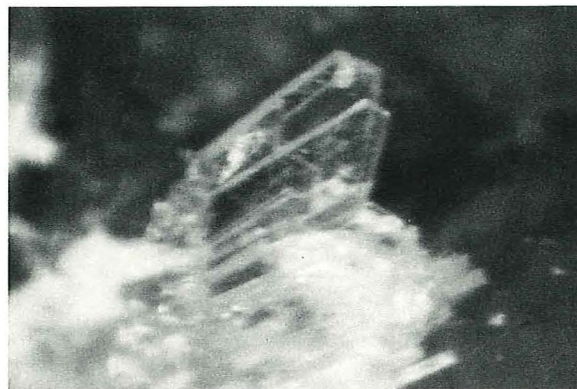
Lithiophilite sc, Tamminen Q, Greenwood {NT}



Magnetite t/n, Mount Ararat Q, Topsham {RW}



Malachite mm, Barrett P (Dolsan Pit), Pembroke



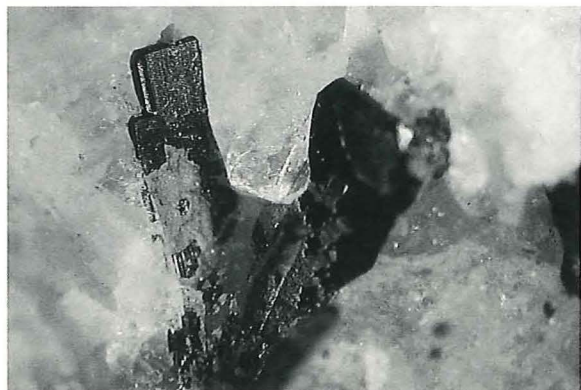
Mangangordonite mm, Dunton Q, Newry



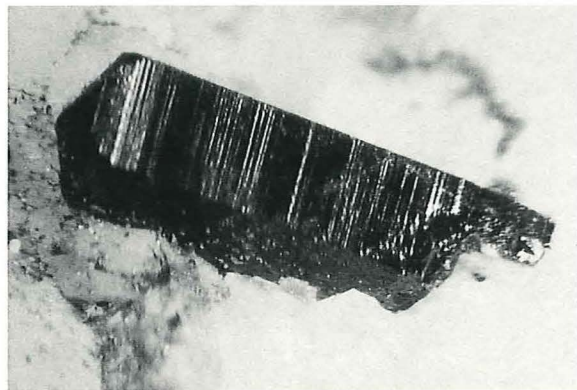
Manganocolumbite sc, Dunton Q, Newry



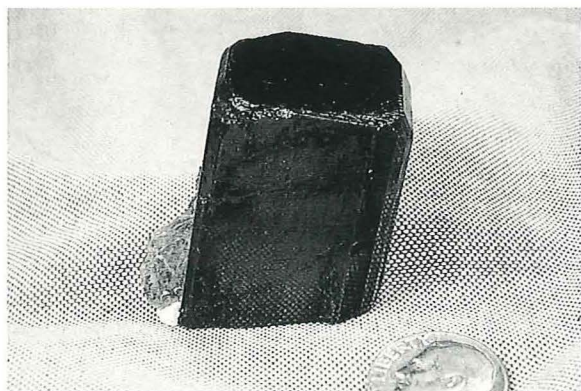
Manganocolumbite mm, Black Mountain Q, Rumford



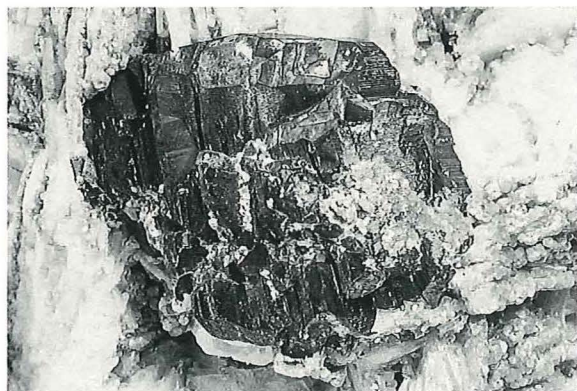
Manganocolumbite mm, Black Mountain Q, Rumford



Manganocolumbite mm, Black Mountain Q, Rumford



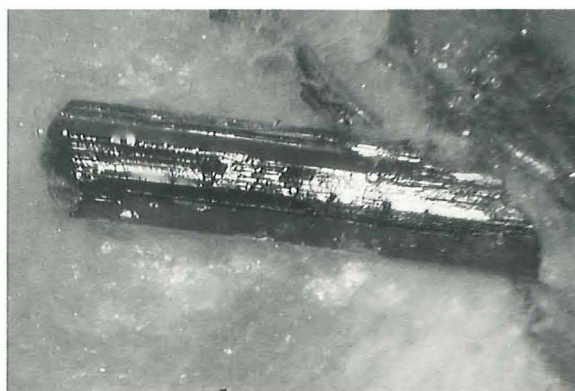
Manganocolumbite t/n, Topsham {HU}



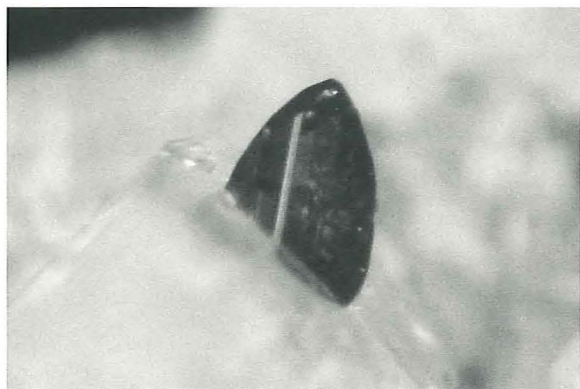
Manganotantalite L, Bennett Q, Buckfield {RW}



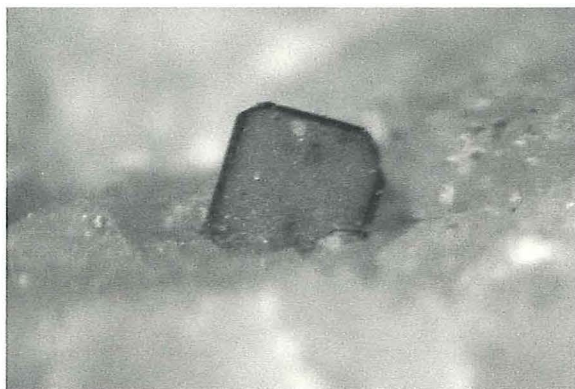
Manganotantalite cab, Bennett Q, Buckfield



Manganotantalite mm, Dunton Q, Newry



Manganotantalite mm, Black Mountain Q, Rumford



Manganotantalite mm, Black Mountain Q, Rumford



Manganotantalite mm, Black Mountain Q, Rumford



Manganotantalite mm, Black Mountain Q, Rumford



Mccrillsite mm, Mount Mica Q, Paris [GF]{SIM}



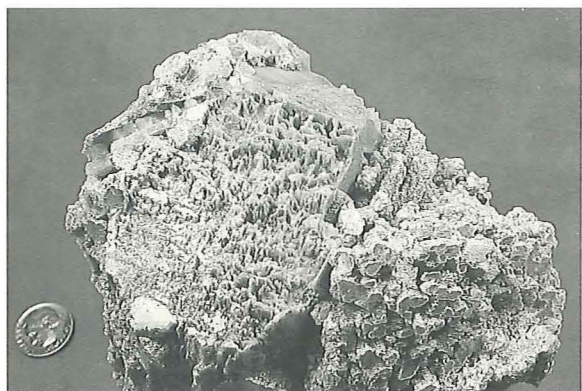
Meionite sc, Berry Ledge L, Cornish



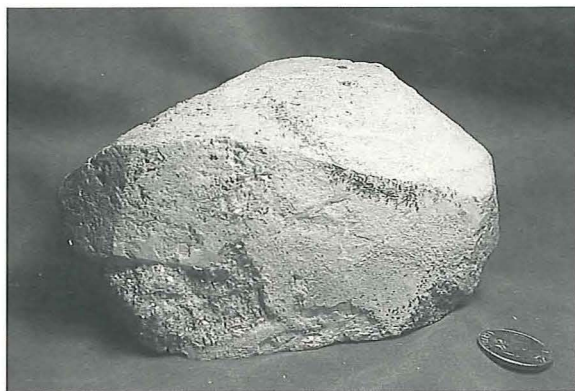
Meionite mm, U.S. Route #2 road cut, Farmington



Microcline sc, Wardwell Q, Albany



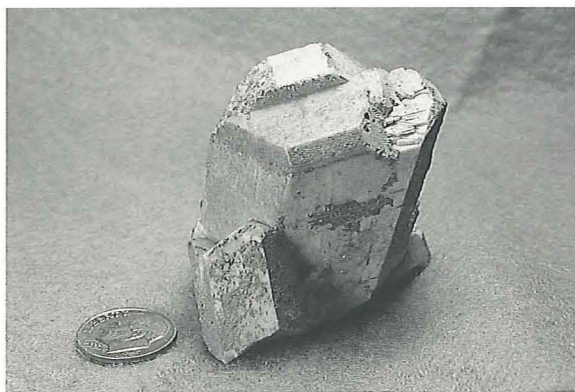
Microcline (etched) sc, Bennett Q, Buckfield



Microcline sc, Harvard Q, Greenwood {YU}



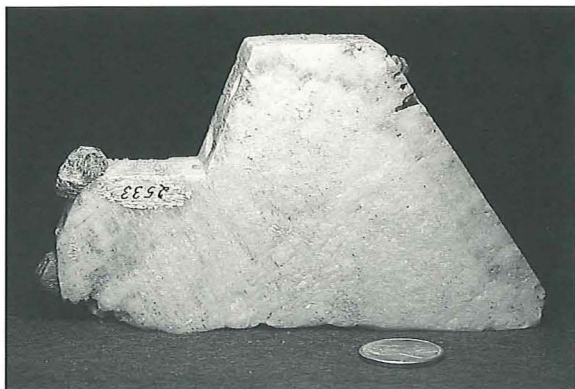
Microcline sc, Nubble Q, Greenwood



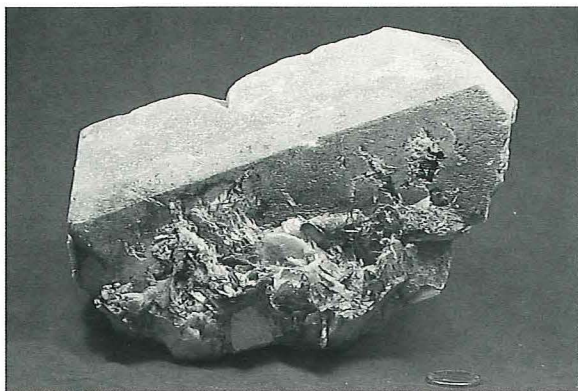
Microcline min, Tamminen Q, Greenwood



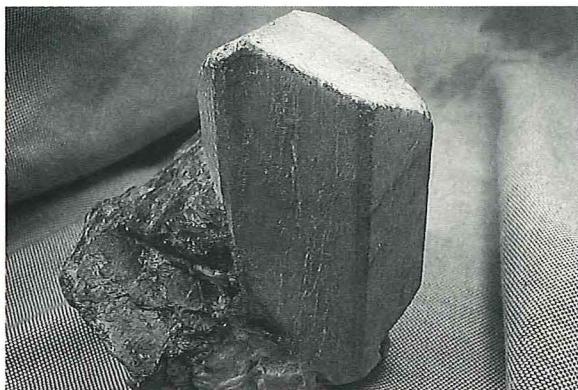
Microcline mm, Route #15 road cut, Monson



Microcline cab, Dunton Q, Newry {UM}



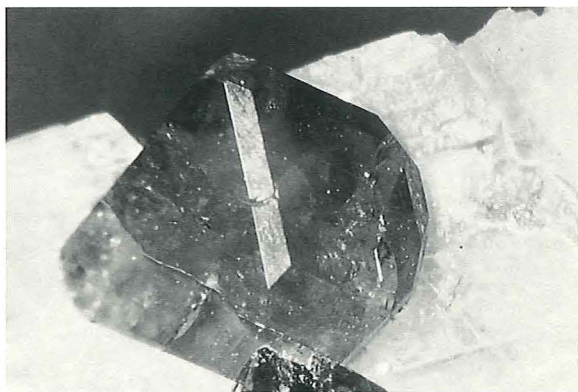
Microcline L, Nevel Q, Newry {HU}



Microcline sc, Little Bradbury Mountain A, Pownal {CC}



Microcline L (Baveno twin), Little Bradbury Mountain A, Pownal {CC}



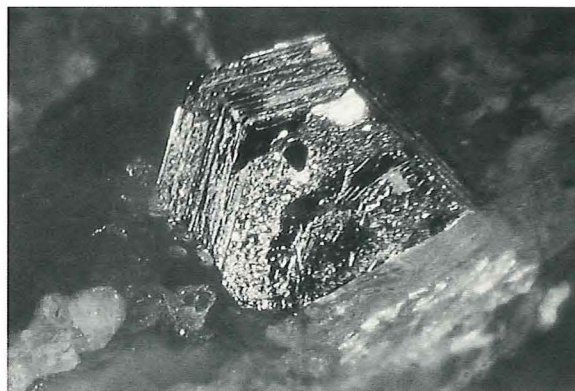
Microlite mm, Dunton Q, Newry



Microlite mm, Fisher Q, Topsham



Mimetite mm, Preble Hill M, Garland



Molybdenite mm, Webster P, Sanford



Molybdenite t/n, Catherine Hill P, Township 10 SD



Monazite-(Ce) mm, dam excavation, Topsham



Monazite-(Ce) t/n, Swamp #1 Q, Topsham



Monazite-(Ce) mm, Yedlin L, Topsham



Montebrasite sc, Harvard Q, Greenwood



Montebrasite mm, Bell Pit, Newry



Montebrasite mm, Bell Pit, Newry



Montebrasite mm, Bell Pit, Newry



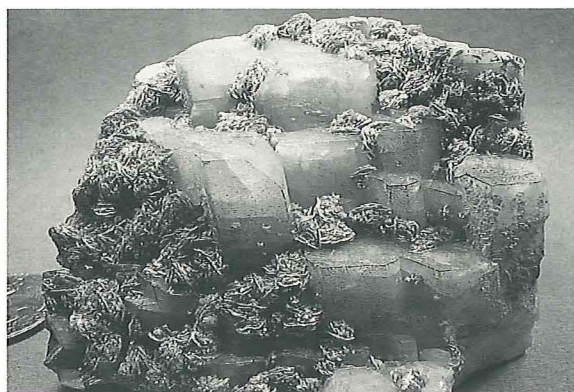
Montebbrasite mm, Bell Pit, Newry [LP]{LP}



Montebbrasite min, (Nevel Q), Newry [RC]{YU}



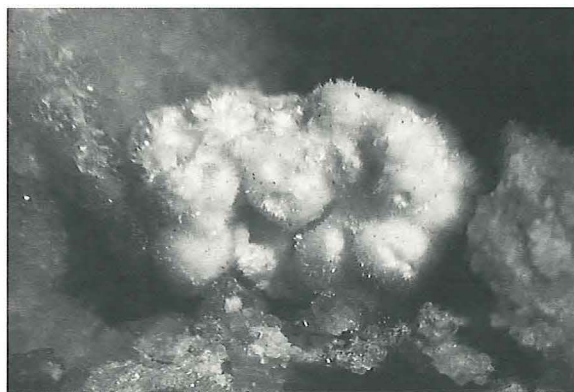
Montebbrasite sc, Nevel Q, Newry {HU}



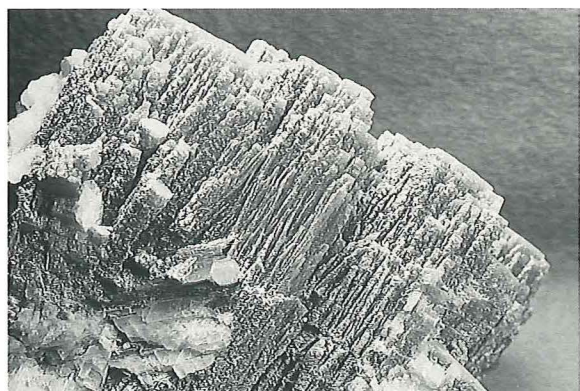
Moraesite mm, Bell Pit, Newry [LP]{LP}



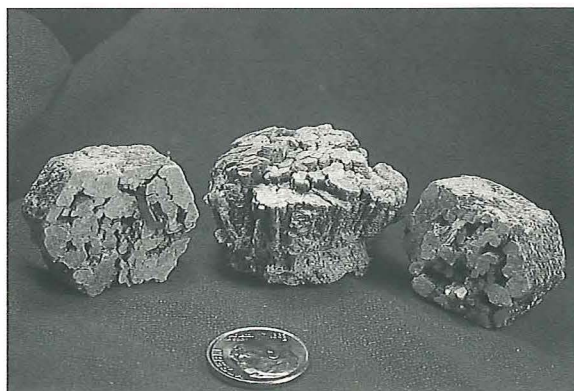
Moraesite mm, Dunton Q, Newry



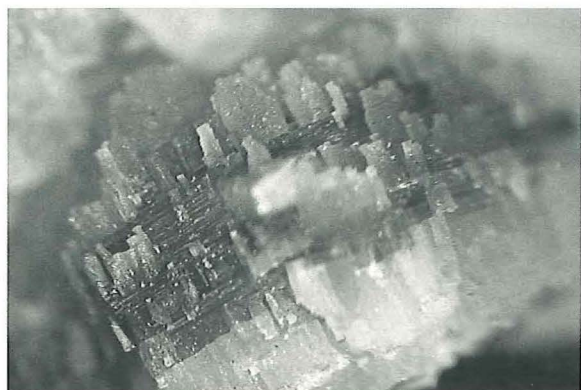
Muscovite sc, Auburn {HU}



Muscovite min, Maine Feldspar Q, Auburn



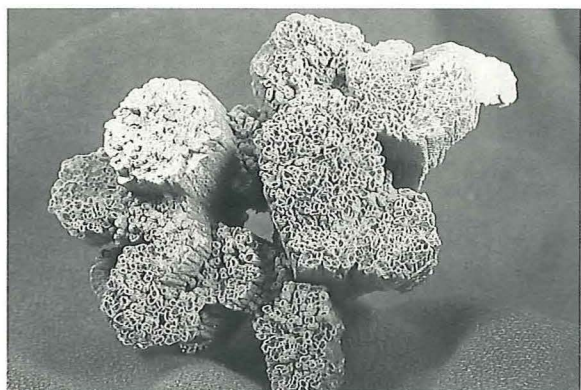
Muscovite sc, Bennett Q, Buckfield



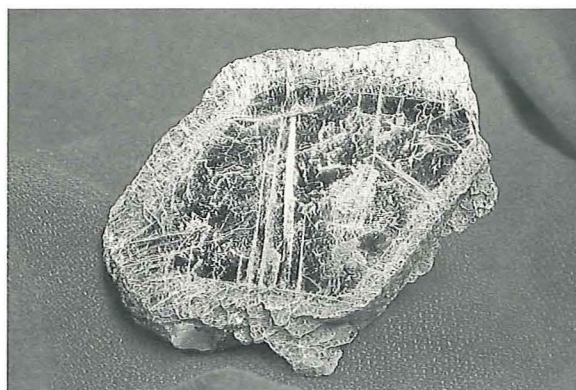
Muscovite mm, Bennett Q, Buckfield



Muscovite mm, Emmons Q, Greenwood



Muscovite min, Emmons Q, Greenwood



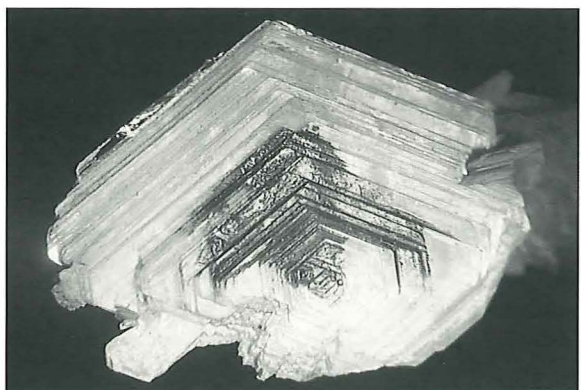
Muscovite rim on muscovite min, Emmons Q, Greenwood



Muscovite cab, Gross P, Greenwood



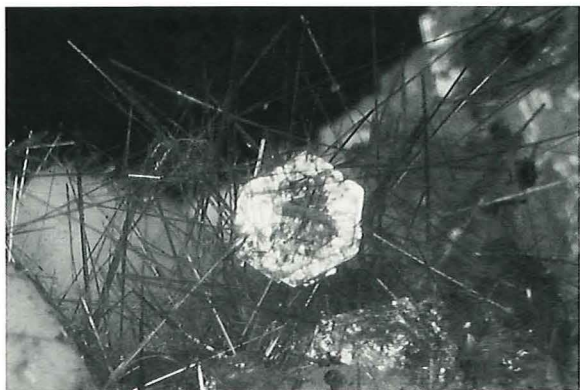
Muscovite sc, Tiger Bill Q, Greenwood



Muscovite mm, Rose Quartz Crystal L, Newry



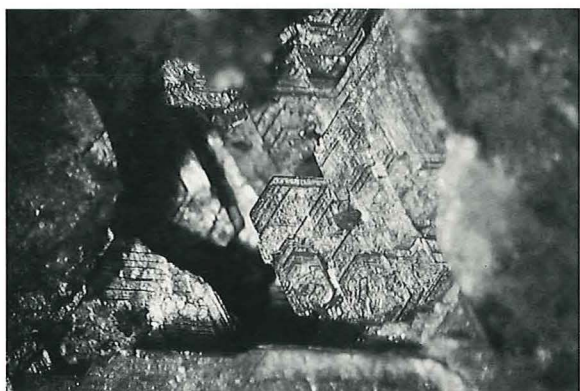
Muscovite on elbaite min, Mount Mica Q, Paris {HU}



Muscovite mm, Route #26 road cut, Paris



Muscovite mm, Black Mountain Q, Rumford



Muscovite mm, Lord Hill Q, Stoneham



Muscovite after staurolite L, Township D [CG]



Orthoclase mm, Newfield



Perhamite mm, Emmons Q, Greenwood [LP]{LP}



Perhamite mm, Emmons Q, Greenwood



Perhamite mm, Emmons Q, Greenwood [RS]{RS}



Perhamite mm, Bell Pit, Newry



Perhamite mm, Dunton Q, Newry



Perhamite mm, Ski Pike Q, West Paris [RS]{RS}



Perhamite t/n, Ski Pike Q, West Paris [RS]{RS}



Phenakite twin sc, (Albany){RNL}



Phenakite mm, Lord Hill Q, Stoneham



Phosphophyllite mm, Bell Pit, Newry [LP]{LP}



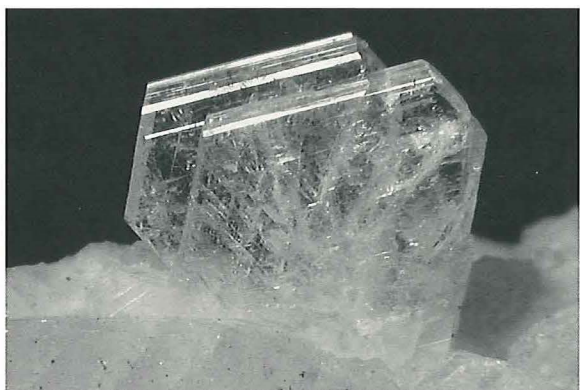
Phosphophyllite mm, Dunton Q, Newry {GG}



Phosphophyllite (twinned) mm (thin section), Mount Mica Q, Paris



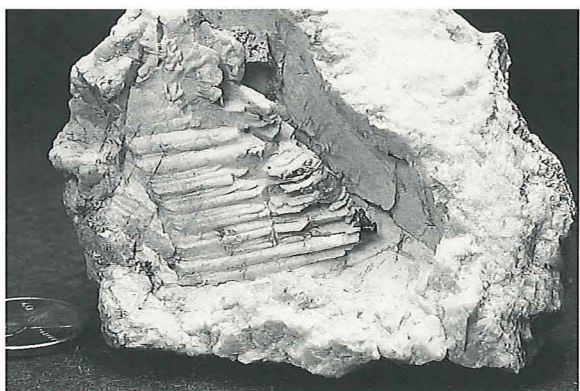
Phosphophyllite min, Red Hill A, Rumford



Plagioclase series - Albite mm, Johnson Q, Albany



Plagioclase series - Albite mm, Johnson Q, Albany



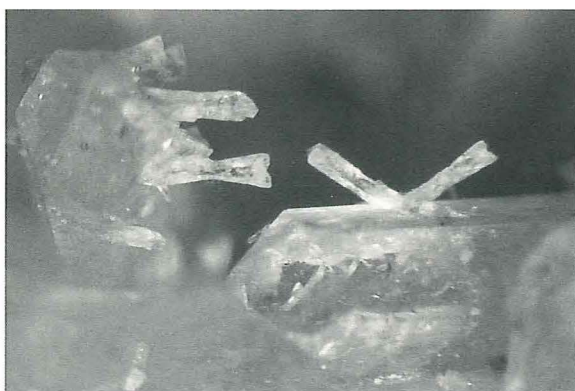
Plagioclase series - Albite cast sc, Emmons Q, Greenwood



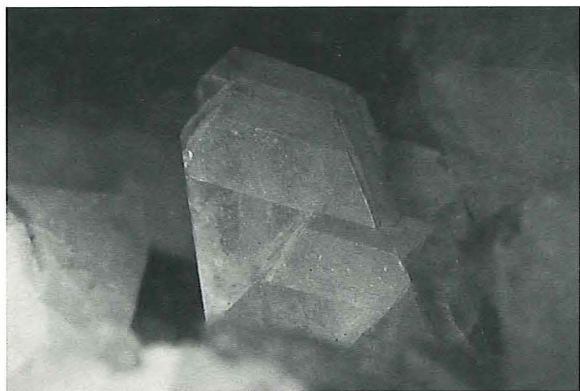
Plagioclase series - Albite t/n, Tiger Bill Q, Greenwood



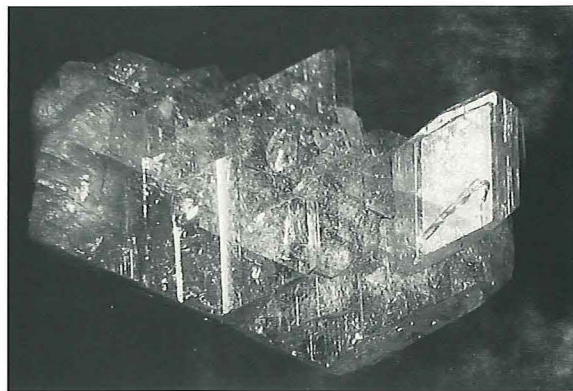
Plagioclase series - Albite min, Dunton Q, Newry



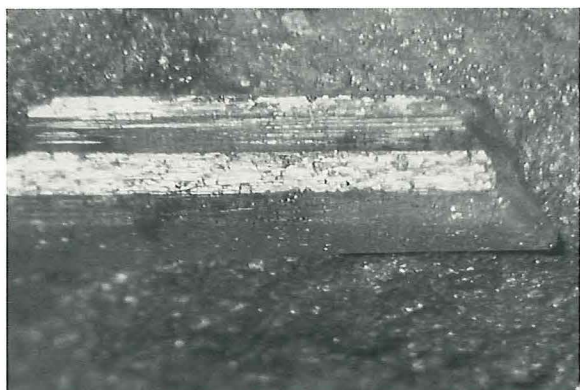
Plagioclase series - Albite mm, Dunton Q, Newry



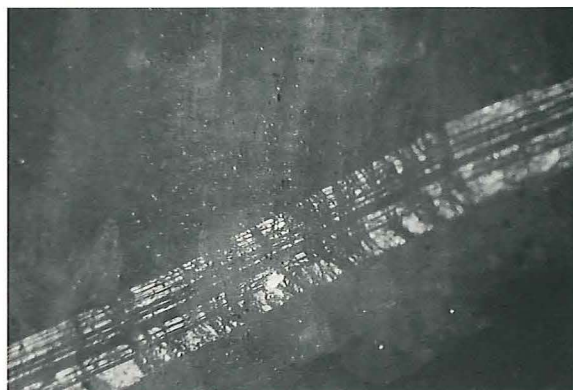
Plagioclase series - Albite mm, Dunton Q, Newry



Plagioclase series - Albite mm, Aldrich Q, Stoneham



Plagioclase series - Albite mm, Fisher Q, Topsham



Plagioclase series - Albite mm, Fisher Q, Topsham



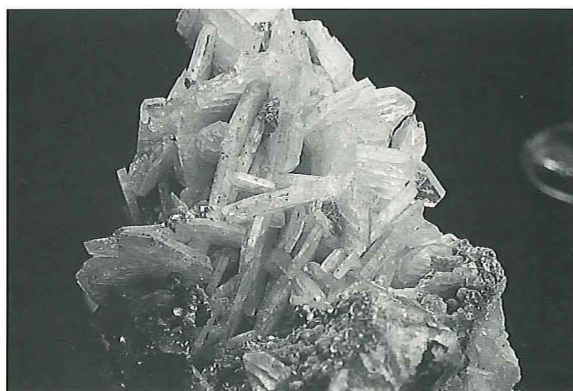
Plagioclase series - Albite mm, Fisher Q, Topsham



Plagioclase series - Albite cab, Trenton Q, Topsham {BMS}



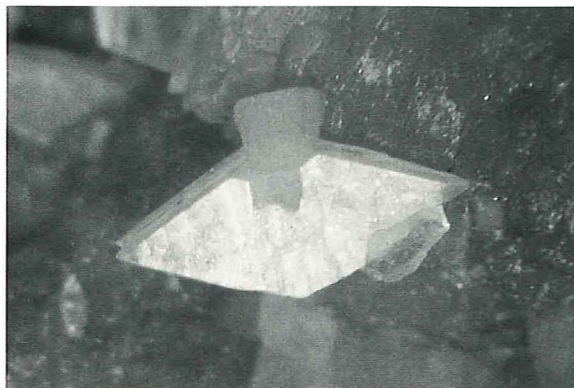
Plagioclase series - Albite, variety Cleavelandite sc, Bennett Q,
Buckfield



Plagioclase series - Albite, variety Cleavelandite L, Bennett Q,
Buckfield [JBP]{MGS}



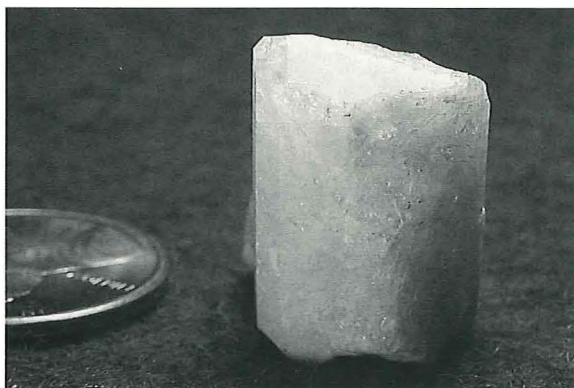
Plagioclase series - Albite (valencianite) sc, Mount Mica Q, Paris



Plagioclase series - Albite (zygadite) mm, Dunton Q, Newry



Plagioclase series - Albite (zygadite) mm, Dunton Q, Newry



Plagioclase series - Andesine t/n, Day Hill L, Cornish



Plagioclase series - Andesine and clinozoisite cab, 200 m L, Sanford



Pollucite min, Bennett Q, Buckfield



Pollucite mm, Tamminen Q, Greenwood {HU}



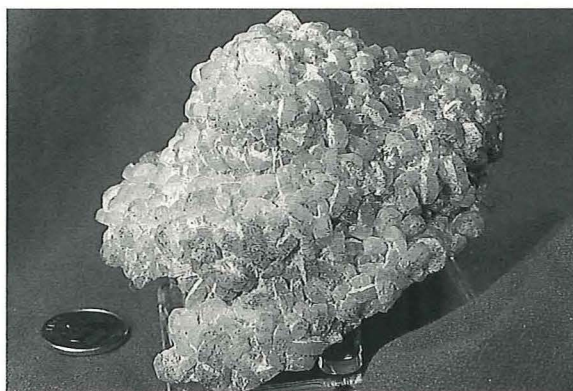
Prehnite mm, U.S. Route #1 road cut, Calais



Prehnite mm, U.S. Route #1 road cut, Calais



Prehnite mm, U.S. Route #1 road cut, Calais



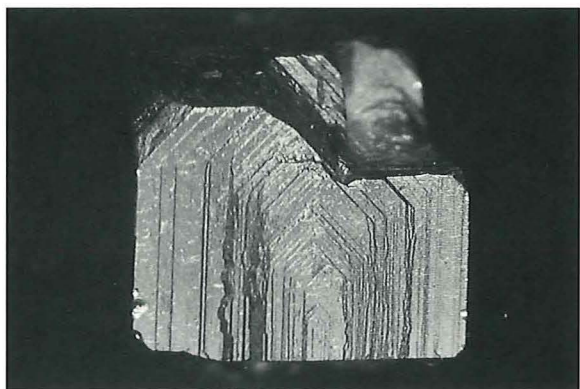
Prehnite sc, U.S. Route #1 road cut, Calais



Pumpellyite-(Mg) mm, Loring Cove A, Perry



Pyrite mm, Black Hawk M, Blue Hill



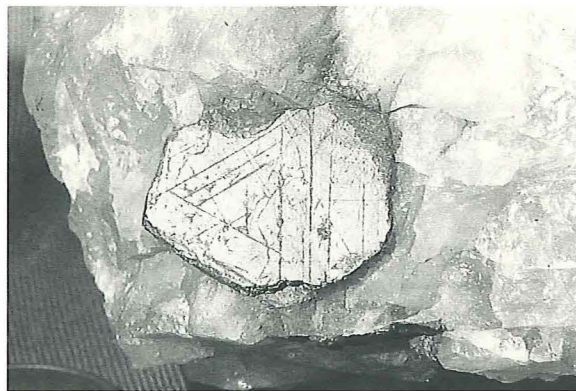
Pyrite mm, Lake Wesserunsett shore, East Madison



Pyrite mm, Dunton Q, Newry



Pyrite mm, Duntun Q, Newry



Pyrrhotite sc, Standish {AMNH}



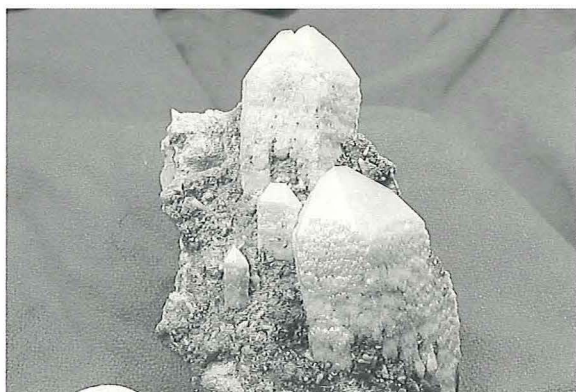
Pyrrhotite sc, Standish {AMNH}



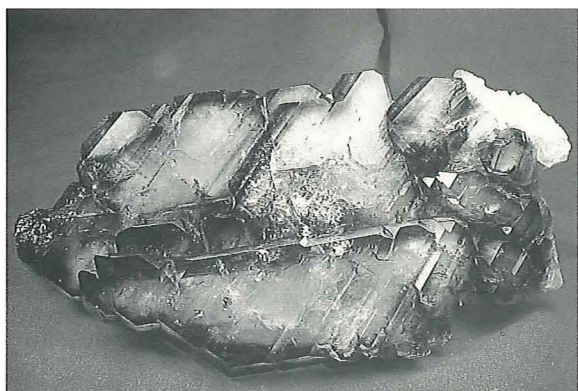
Quartz (radiation burns) min, Scribner Q, Albany



Quartz cab, Auburn {BMC}



Quartz cab, Pulsifer Q, Auburn {HU}



Quartz sc, Smith Q, Auburn {HU}



Quartz sc, Bennett Q, Buckfield



Quartz L, Bennett Q, Buckfield



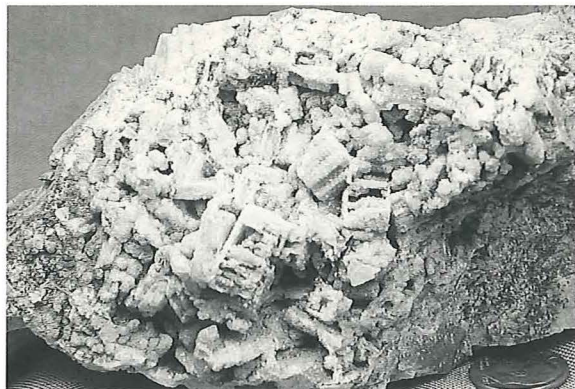
Quartz sc, Bennett Q, Buckfield {RW}



Quartz (amethyst) sc, Pleasant Mountain L, Denmark {BMS}



Quartz (pseudomorph) sc, Harvard Q, Greenwood



Quartz after fluorapatite cab, Harvard Q, Greenwood {HU}



Quartz sc, Tamminen Q, Greenwood



Quartz (pseudocubic) sc, Tamminen Q, Greenwood



Quartz (pseudocubic) t/n, Tamminen Q, Greenwood



Quartz mm, Tamminen Q, Greenwood



Quartz cab, Mount Rubellite Q, Hebron {JM}



Quartz (pseudocubic) mm, Bell Pit, Newry



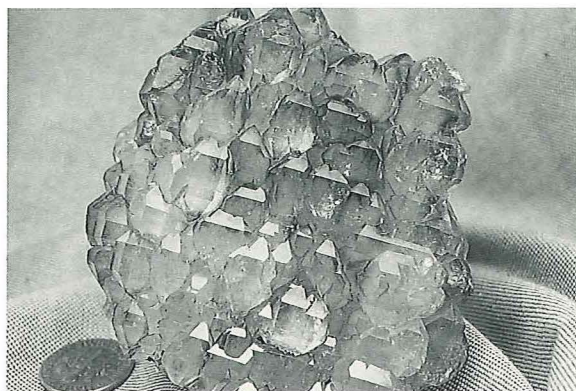
Quartz mm, Rose Quartz Crystal L, Newry



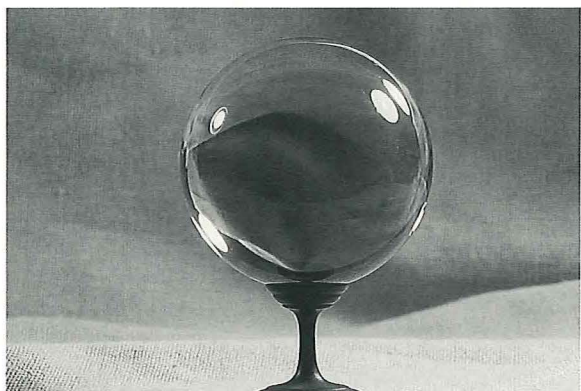
Quartz t/n, Scotty Q, Newry



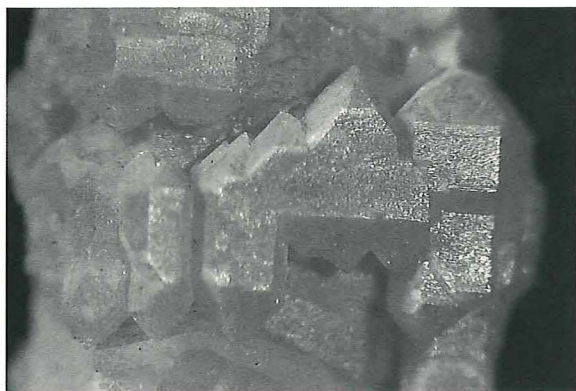
Quartz (quartzoid) mm, Bell Pit, Newry



Quartz cab, Perham Q, Paris {HU}



Quartz cab, Havey Q, Poland {NEU}



Quartz mm, Black Mountain Q, Rumford



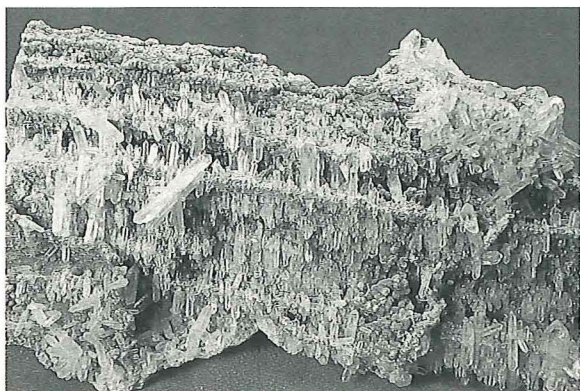
Quartz (amethyst) L, Intergalactic Pit,
Stow [JBP]{MGS}



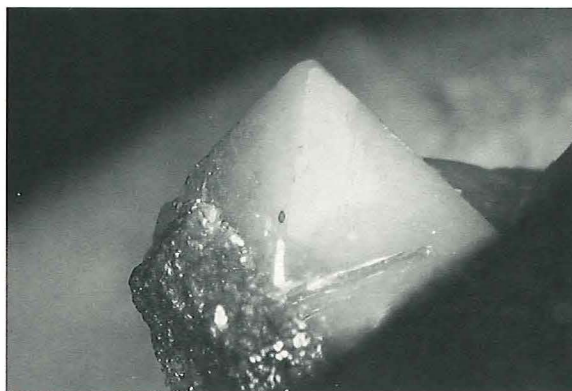
Quartz cab, Lord Hill Q, Stoneham



Quartz (amethyst) sc, Intergalactic Pit, Stow



Quartz cab, Fisher Q, Topsham {HU}



Reddingite mm, Berry-Havey Q, Poland



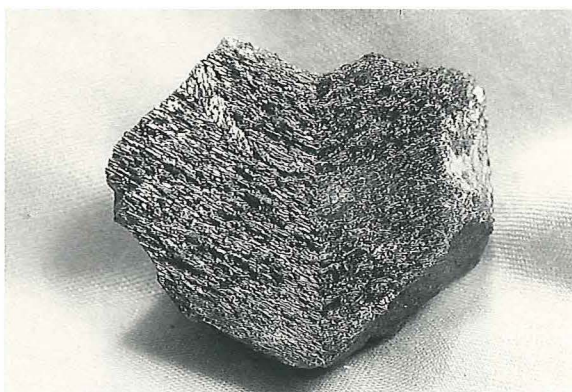
Rhodochrosite t/n, Bennett Q, Buckfield



Rhodochrosite on siderite mm, Bell Pit, Newry



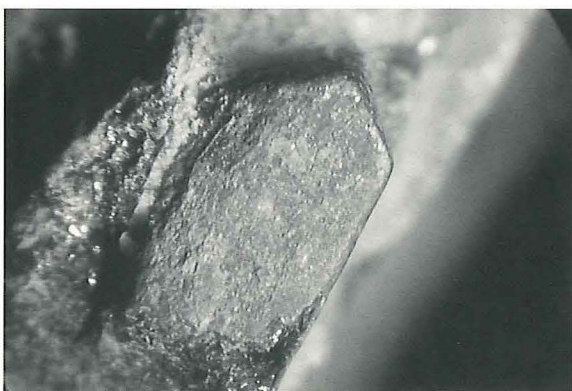
Rockbridgeite mm, Dunton Q, Newry



Rutile min, Songo Pond Q, Albany {JM}



Rutile mm, Consolidated #2 Q, Topsham



Samarskite-[Y] t/n, Yedlin L, Topsham



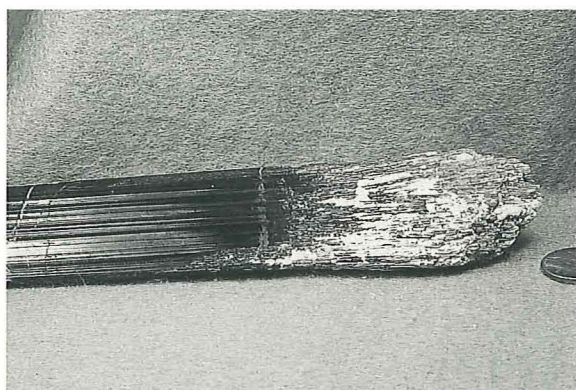
Scheelite mm, Long Island A, Blue Hill



Schorl sc, Bumpus Q, Albany



Schorl min, Auburn [WW]{HU}



Schorl L, Bennett Q, Buckfield {RW}



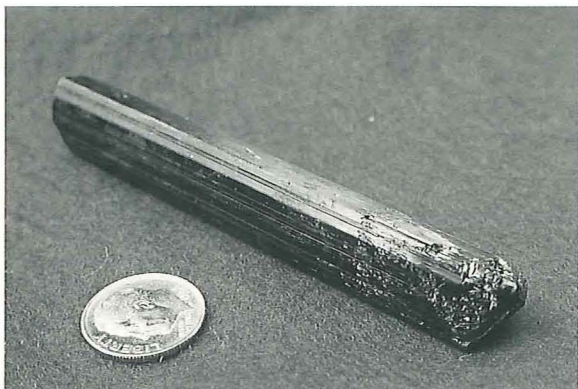
Schorl cab, Bennett Q, Buckfield
[JBP]{RW}



Schorl sc, Bennett Q, Buckfield



Schorl sc, Nubble Q, Greenwood {NT}



Schorl sc, Martin P, Newry



Schorl min, Havey Q, Poland {RW}



Schorl sc, Municipal Q, Portland {HU}



Schorl cab, Porcupine Hill Q, Topsham {HU}



Schorl L, Porcupine Hill Q, Topsham {HU}



Siderite mm, Black Hawk M, Blue Hill {HD}



Siderite t/n, Pleasant Mountain A, Bridgton {RW}



Siderite mm, Bell Pit, Newry



Siderite mm, Bell Pit, Newry



Siderite mm, Bell Pit, Newry



Siderite mm, Black Mountain Q, Rumford



Siderite mm, Black Mountain Q, Rumford



Sillimanite L, Small Point A, Phippsburg



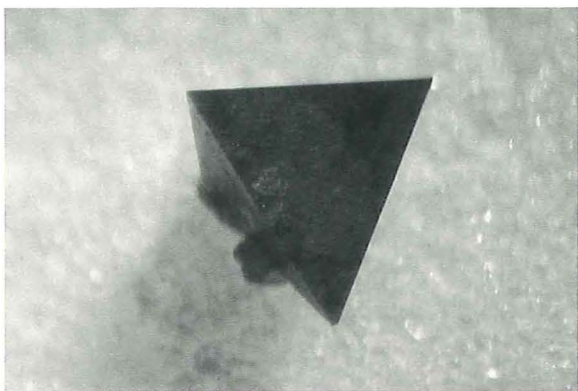
Sillimanite t/n, railroad depot A, Warren



Smithsonite mm, Callahan M, Brooksville



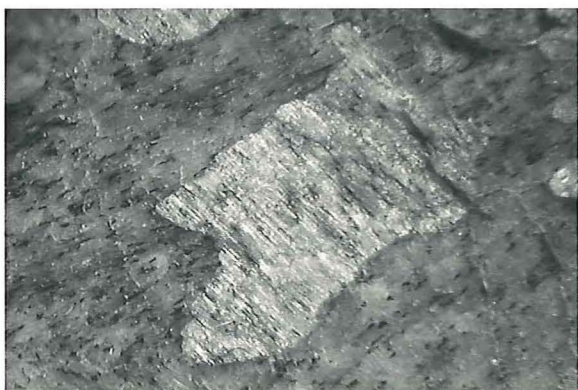
Smithsonite mm, Barrett P (Dolsan Pit), Pembroke



Sphalerite mm, Black Hawk M, Blue Hill {HD}



Spodumene in pollucite mm, Bennett Q, Buckfield



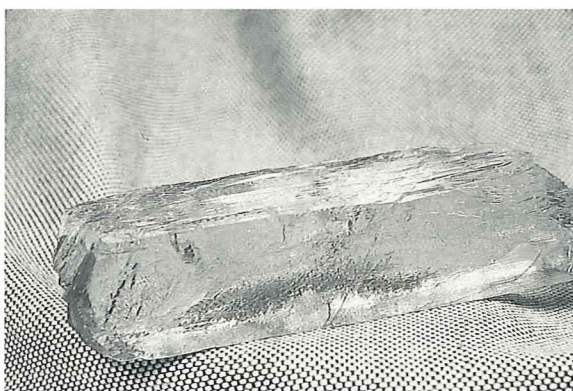
Spodumene in pollucite t/n, Bennett Q, Buckfield



Spodumene in pollucite min, Bennett Q, Buckfield



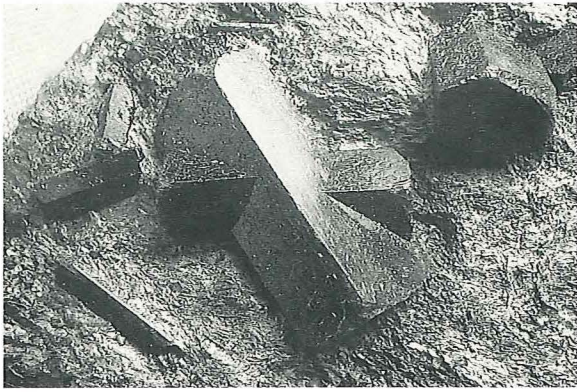
Spodumene cab, Nevel Q, Newry {CC}



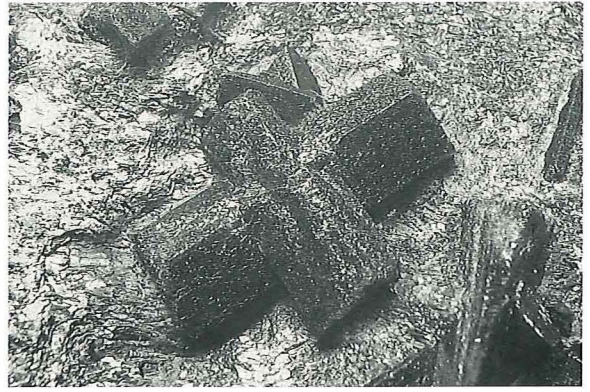
Spodumene min, Tourmaline P, Georgetown {HU}



Spodumene sc, Nevel Q, Newry



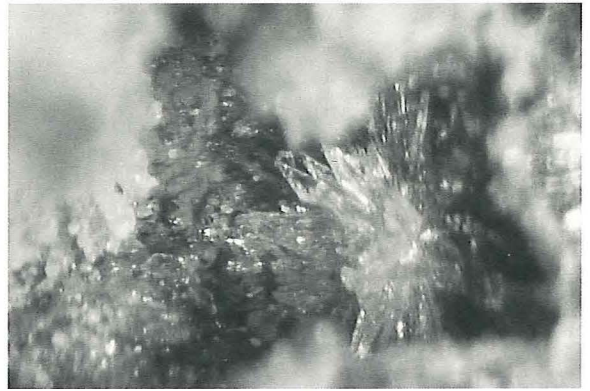
Staurolite (St. Andrews twin) min, Cook Road L, Windham



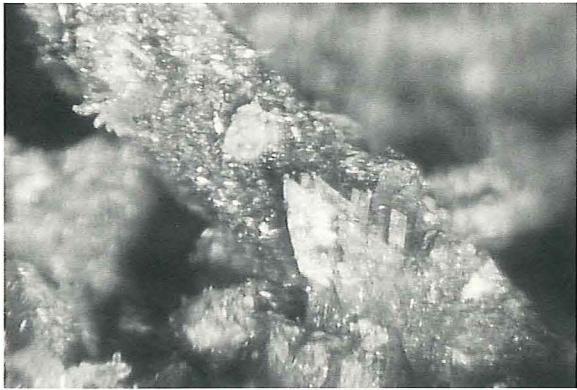
Staurolite (Maltese Cross twin) min, Cook Road L, Windham



Stellerite mm, Hall Quarry village, Mount Desert Island



Stewartite mm, Dunton Q, Newry



Stewartite mm, Berry-Havey Q, Poland



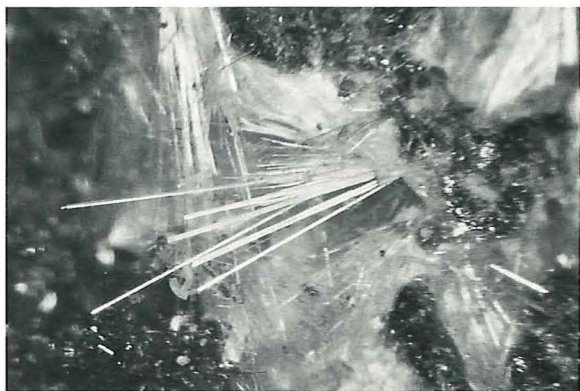
Stibnite mm, Drew Hill M, Linneus



Stilbite mm, U.S. Route #1 road cut, Calais



Stilpnomelane min, Route #27 road cut, Jim Pond



Strunzite mm, Bell Pit, Newry



Strunzite mm, BB #7 Q, Norway



Strunzite t/n, Havey Q, Poland



Strunzite mm, Red Hill A, Rumford



Switzerite mm, Bell Pit, Newry



Tapiolite t/n, Mount Mica Q, Paris {YU}



Tapiolite min, Fisher Q, Topsham {YU}



Tetradymite and gold (arrow) cab, Golden Circle M, Sorrento {HU}



Titanite t/n, Black Hawk M, Blue Hill {HD}



Titanite min, 200 m P, Sanford



Titanite mm, Crotch Island Q, Stonington



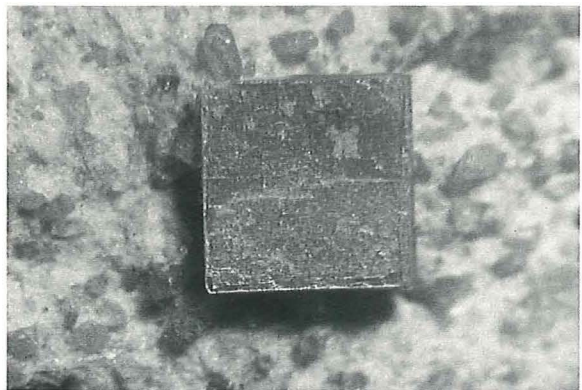
Todorokite mm, Berry-Havey Q, Poland



Topaz mm, Lord Hill Q, Stoneham



Topaz min, Lord Hill Q, Stoneham {HU}



Torbernite mm, Lord Hill Q, Stoneham



Torbernite mm, Consolidated #2 Q, Topsham



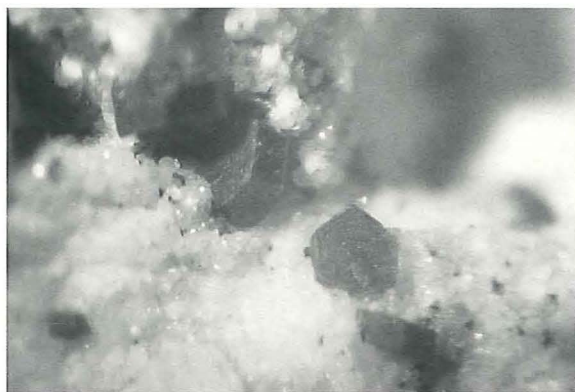
Tremolite min, Rockland



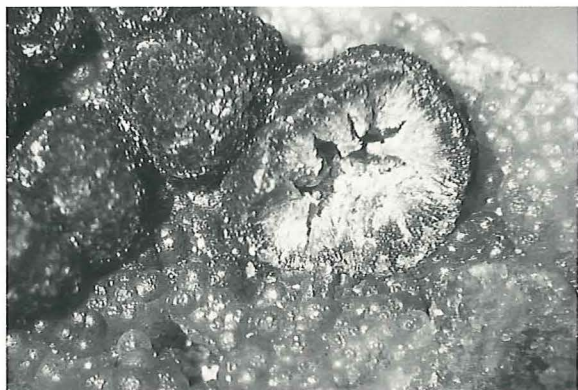
Triphylite t/n, Nevel Q, Newry



Unknown #1 mm, Grenci Q, Hall Quarry, Mount Desert Island



Unknown #3 mm, Dunton Q, Newry



Unknown #3 mm, Dunton Q, Newry



Unknown #3 mm, Black Mountain Q, Rumford



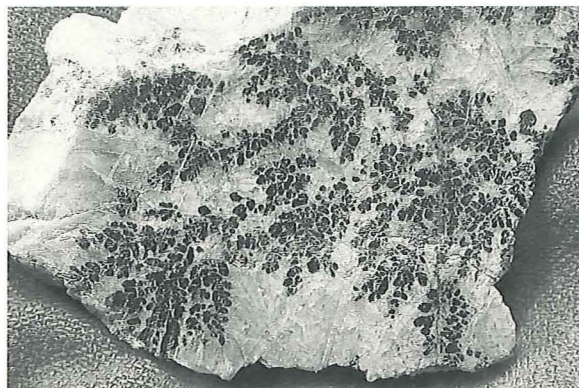
Unknown #5 mm, Dunton Q, Newry



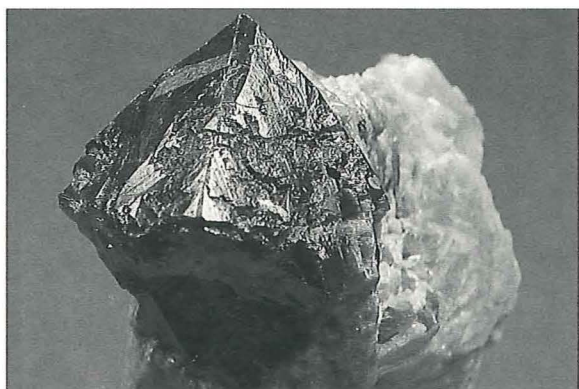
Uralolite mm, Dunton Q, Newry



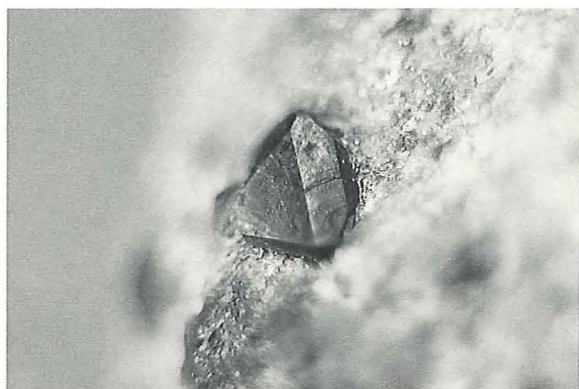
Uralolite mm, Dunton Q, Newry



Uraninite min, Newry



Uraninite min, Bell Pit, Newry {HU}



Uraninite min, Scotty Q, Newry {RL}



Uraninite and zircon mm, Scotty Q, Newry



Uraninite mm, Scotty Q, Newry



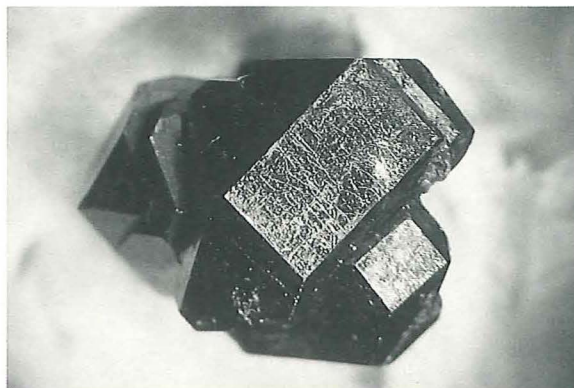
Uraninite mm, Hinkley P, Pownal {DJ}



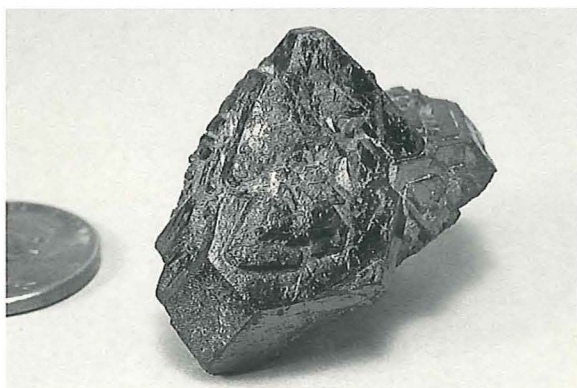
Uraninite t/n, Swamp #1 Q, Topsham



Uraninite t/n, Swamp #1 Q, Topsham



Uraninite t/n, Swamp #1 Q, Topsham



Uraninite min, Swamp #1 Q, Topsham



Uranophane mm, Wardwell Q, Albany



Vesuvianite cab, Chute P, Casco



Vesuvianite min, Auburn {HU}



Vesuvianite cab, Webster P, Sanford {NEU}



Vivianite mm, Nevel Q, Newry



Vivianite mm, Nevel Q, Newry



Vivianite mm, Nevel Q, Newry



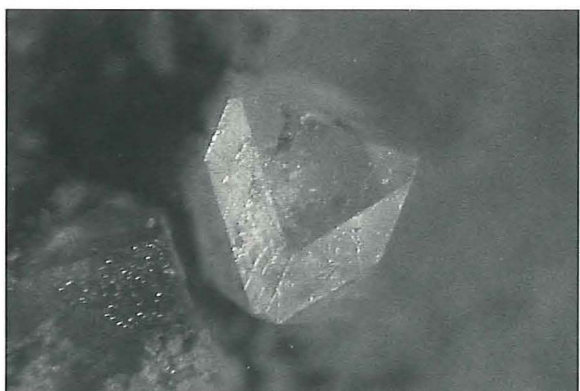
Wardite mm, Bell Pit, Newry



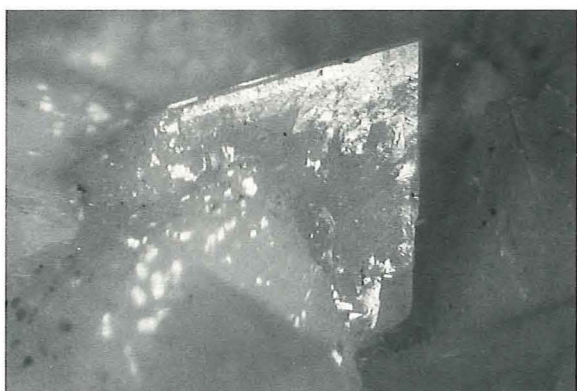
Wardite and hydroxyl-herderite mm, Dunton Q, Newry [GC]



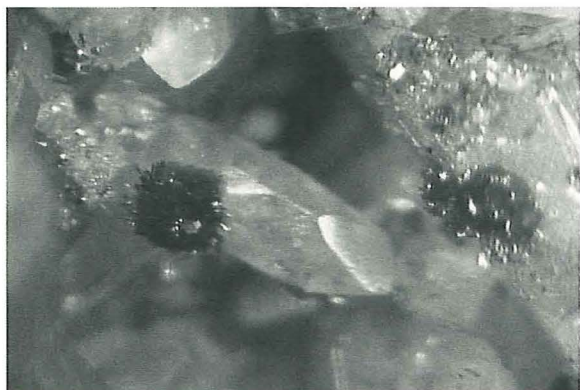
Wardite mm, Berry-Havey Q, Poland



Whitlockite mm, Bell Pit, Newry



Whitlockite mm, Dunton Q, Newry



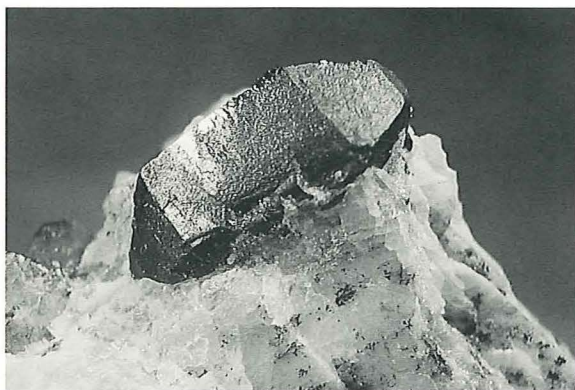
Whitmoreite mm, Bell Pit, Newry



Wodginite mm, Dunton Q, Newry



Wodginite mm, Dunton Q, Newry



Wodginite min, Rose Quartz Crystal L, Newry {JM}



Wulfenite mm, Lubec M, Lubec



Wurtzite mm, Bell Pit, Newry



Xanthoxenite min, Dunton Q, Newry



Xanthoxenite min, Red Hill A, Rumford



Xenotime-[Y] mm, Havey #2 Q, Topsham



Zanazziite mm, Bell Pit, Newry



Zanazziite mm, Martin P, Newry



Zircon mm, Bumpus Q, Albany



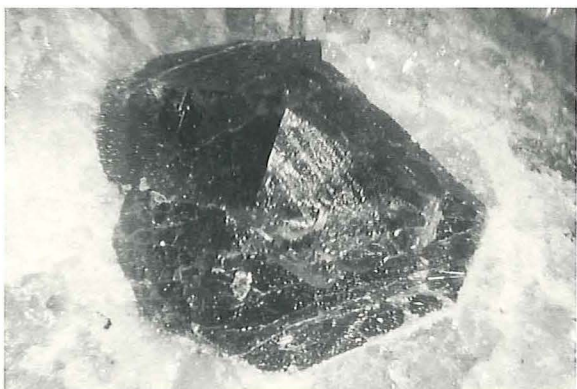
Zircon min, Songo Pond Q, Albany {RNL}



Zircon mm, Sterns Q, Albany



Zircon in almandine mm, Witt Hill L, Greenwood



Zircon mm, Bell Pit, Newry



Zircon min, Dunton Q, Newry [GH]{MSM}



Zircon mm, Dunton Q, Newry



Zircon t/n, Rattlesnake Mountain A, Stoneham {DJ}



Zircon t/n, Rattlesnake Mountain A, Stoneham {DJ}



Zoisite mm, U.S. Route #1 road cut, Calais

L

labradorite (Feldspar Group) - see plagioclase series

LACROIXITE (Amblygonite Group)

$\text{NaAl(PO}_4\text{)F}$

Hebron - Mount Rubellite Q

Lacroixite (La-Krwah-ite), the sodium analog of amblygonite, is found as a cloudy microscopic alteration of the amblygonite at Mount Rubellite quarry, **Hebron** (Fransolet, 1989). The mineral is not visible in hand specimen and was detected only through the use of X-ray diffraction techniques, etc. Fransolet (1989) said of amblygonite from Hebron that it: "... contains lacroixite in amounts roughly similar to those observed in Buranga material." Fransolet (1989) said of Buranga, Rwanda montebrasite: "As is evident in Figure 3, the backscattered-electron image as well as the mapping of Na in such a 'turbid zone' provide evidence for the existence of minute inclusions of a Na-rich mineral within a Na-free host." The figure cited contained blocky to elongated patches (to $75\text{ }\mu\text{m} = 0.000075\text{ cm}$) with some straight edges suggesting cleavage traces of the host mineral. An amblygonite from Chursdorf, Saxony, Germany (Groat et al., 1990) showed a lacroixite alteration as a pattern of "chicken tracks" in the host mineral.

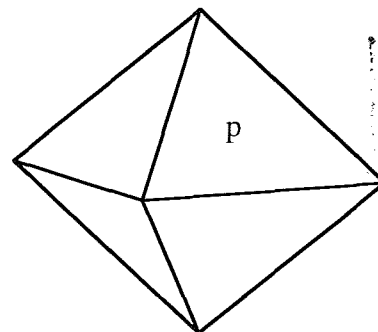
Lacroixite was found in both amblygonite and montebrasite, from worldwide sources, by Fransolet (1989). Groat et al. (1990) studied amblygonite/montebrasite using the same samples as Černá et al. (1973), except their Hebron specimen (AF-55). They found no sodium in a [Dunton quarry], Newry specimen (USNM #5906) and also no lacroixite in that montebrasite. Groat et al. (1990) did note: "... none of the Na-bearing samples of this study [all amblygonite] was free of fine veins of lacroixite."

***LANDESITE** (Reddingite Group)

$(\text{Fe}^{3+}, \text{Mn}^{2+}, \text{Fe}^{2+})\text{Mn}^{2+}_2[(\text{OH}), (\text{H}_2\text{O})]_3(\text{PO}_4)_2$

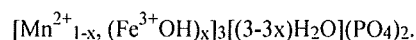
Buckfield - Bennett Q; **Greenwood** - Emmons Q; **Newry?** - Dunton Q; **Poland** - Berry-Havey Q; **Stoneham** - Lord Hill Q

The Berry-Havey quarry, **Poland** is the type locality for landesite (Berman and Gonyer, 1930). The general formula of landesite has varied considerably in interpretation and to the extent that some people felt that the mineral was no different than



Landesite, Berry-Havey Q, Poland

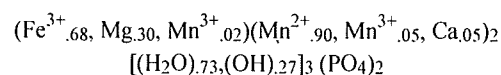
slightly oxidized reddingite. The original formula derived by Berman and Gonyer (1930) was $3\text{Fe}_2\text{O}_3 \cdot 20\text{MnO} \cdot 8\text{P}_2\text{O}_5 \cdot 27\text{H}_2\text{O}$ or, more familiarly, $\text{Fe}^{3+}_6\text{Mn}^{2+}_{20}(\text{PO}_4)_{16}\text{O}_5 \cdot 27\text{H}_2\text{O}$. Moore (1964) revised the formula to:



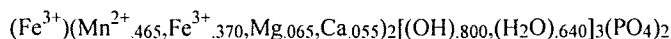
The current definition of landesite, based on crystal structure determinations (Moore and Araki, 1976; Moore et al., 1980), is $M(1)M(2)_2[\text{H}_2\text{O}, (\text{OH})]_3(\text{PO}_4)_2$ where $M(1)$ is Fe^{3+} and $M(2)$ is Mn^{2+} . When 3+ valence cations are present, a corresponding number of coordinating water molecules are substituted by, or converted to, hydroxyls to compensate for the "excess" charge. The following table (after Moore et al. 1980) indicates some of the species possible in the reddingite group:

$M(1)$	$M(2)$	Name
Mn^{2+}	Mn^{2+}	Reddingite
Mn^{3+}	Mn^{2+}	unnamed
Fe^{2+}	Mn^{2+}	unnamed
Fe^{3+}	Mn^{2+}	Landesite
Fe^{2+}	Fe^{2+}	Phosphoferrite
Fe^{3+}	Fe^{2+}	unnamed
Fe^{3+}	Fe^{3+}	Kryzhanovskite

When Berman and Gonyer's (1930) chemical analysis of landesite is recast into this formula type (Moore et al., 1980), it yields:



The apportioning of elements in the formula was based on the relative sizes of the two sites and the relative sizes of the elements available as suggested by the crystal structure analysis of Moore et al. (1980): "The compounds are highly ordered with the smaller cations partitioned into the M(1) site." Kryzhanovskite has been considered to be the ferric analog of landesite, but considering the extreme ordering of iron with respect to manganese found by Moore et al. (1980), the relationship is more complex. Recalculation of the original analysis of kryzhanovskite (Ginzburg, 1950) in light of the structural findings of Moore et al. (1980) gave:



The ordering of the iron, therefore, requires that kryzhanovskite can only be derived from a phosphoferrite with Fe:Mn = 2.0±:0.999- or $(\text{Fe}^{2+})(\text{Fe}^{2+}, \text{Mn}^{2+})_2[\text{H}_2\text{O}]_3(\text{PO}_4)_2$. If it were not for the ordering of iron as it enters the growing framework of the mineral, phosphoferrite and its oxidation pseudomorph, kryzhanovskite, would be names for minerals of this series where Fe:Mn > 1:1, rather than Fe:Mn > 2:1. Kryzhanovskite would be a very rare mineral. The report of kryzhanovskite from the Emmons quarry, Greenwood (Thompson et al., 1988) has been revised to landesite. The only members of the above series that have been firmly established in Maine are reddingite from the Bennett quarry, Buckfield, as well as landesite and a reddingite-like mineral from Poland. All other reddingites and landesites in Maine have been identified with varying degrees of informality.

Bennett quarry, **Buckfield** landesite is composed of chocolate brown to reddish brown veinlets (to 1 cm across and many centimeters long) of coarsely crystalline mineral in light brown lithiophilite. A few etched cavities are known with bipyramidal crystals. Bundles (to 2 mm) of dark brown unknown phosphate are sometimes associated (Landes, 1925).

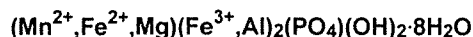
Emmons quarry, **Greenwood** is famous for its interesting phosphate minerals. Kryzhanovskite was originally suggested (Thompson et al., 1988) for the identification of unanalyzed coffee-brown opaque landesite cleavages with bronzy luster as well as bipyramidal pseudo-octahedral landesite crystals (to 3 mm) in manganese-rich association: rhodochrosite, stewartite, hureaulite, eosphorite, fairfieldite, moraesite, jahnsite-(MnMnMn), earlshannonite, rockbridgeite/frondelite, etc., but based on the above arguments, the material is better classed as a landesite until further study is done (Robinson and King, 1991a,b). Clear quartzoids (to 1 mm) are found associated with this landesite in vugs in rhodochrosite, sometimes with hydroxylapatite. The matrix includes montebasite and quartz. The Emmons quarry material shows a full spectrum of the oxidation sequence from apparently fresh transparent pink reddingite through various shades of pinkish to chocolate browns. The landesite crystals can have many surface irregularities which suggest interrupted growth due to twinning or sub-parallel

growth. Striations parallel to the *a* and *b* axes are common, but give the crystal an undulatory appearance more than a ruled one.

Landesite has been listed from the Dunton quarry, **Newry** (King, 1975b; Seaman, 1975c), but no specimens are known.

Landesite from the type location, the Berry-Havey quarry, **Poland** is rare. The mineral was found, along with a comprehensive phosphate suite from the locality, in 1911 by Charles Palache. While it is unclear if any additional landesite specimens were uncovered due to Havey's mining in 1913, virtually no additional specimens were found subsequently, including from the Szenics mining episode in 1975. Berman and Gonyer (1930) described the species: "The reddingite as stated above, has been altered to a brown mineral related to salmonsites. The crystals are rough, octahedral development suggesting in form the unit pyramid of reddingite. ... The crystals possess a good cleavage in the position of *b* (010) of reddingite and an inferior cleavage at right angles to the first." Landesite is found in the same matrix as reddingite, as an oxidation pseudomorph of reddingite replacing lithiophilite or rhodochrosite. Landesite is dark red-brown to reddish chocolate-brown and the crystals are generally 1-2 mm. Partially oxidized reddingite departs from its original pink to almost colorless color and grades imperceptibly into landesite through color changes, indicating oxidation, from orange to dark red to brown. The mineral is usually much intergrown and only the points of the pseudo-octahedral bipyramids might be visible on microscopic examination. In addition to the above mentioned species, dickinsonite, fairfieldite, and eosphorite are associated.

LAUEITE (Paravauxite Group)



Buckfield? - Bennett Q; **Greenwood** - Emmons Q; **Newry** - Bell Pit, Nevel Q, Dunton Q; **Paris** - Mount Mica Q; **Rumford** - Black Mountain Q?, Goddard Ledge Q; **Stoneham** - Cole Q

Laueite was reported from the Bennett quarry, **Buckfield** (Morrill et al., 1958), but the only known specimen (Bjareby collection) is actually an orange hureaulite.

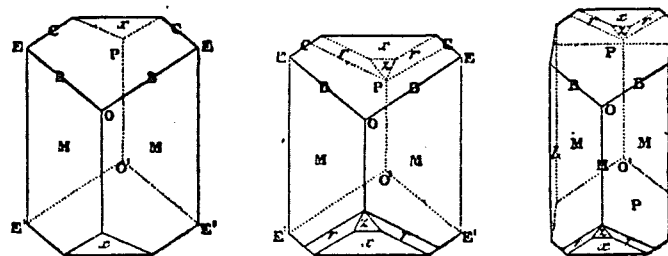
Laueite from the Emmons quarry, **Greenwood** is found in vugs in lithiophilite partially replaced by rhodochrosite/siderite. The crystals are yellow to amber obliquely terminated blades (to 1 mm) associated with earthy olive green mitridatite, golden orange-brown jahnsite-(MnMnMn), strengite, stewartite, fairfieldite, rhodochrosite, etc.

Pale tannish orange to just-barely tan to yellow colored laueite crystals (to less than 1 mm) are found at the Bell Pit, **Newry** in etched fairfieldite in the siderite assemblage. The obliquely terminated crystals are more or less individually grouped and can be associated with beraunite, diadochite, hydroxylapatite, jahnsite-(CaMnMn), fairfieldite, quartz, siderite, sphalerite, stewartite?, triphylite, vivianite, whitmoreite, etc.

Dunton quarry, Newry laueite is found in the siderite assemblage, frequently enclosed in blue tourmaline eyes in cleavelandite. The yellow to orange obliquely terminated crystals (to 2 mm) are found with beraunite, diadochite, fairfieldite, mitridatite, rockbridgeite, siderite, strunzite, etc. (Ushkovite (q.v.) also has been found at the Dunton quarry.)

Excellent orange laueite crystals (to 1 mm) are found in mitridatite-lined cellular cavities in quartz-cleavelandite-muscovite pegmatite from the Mount Mica quarry, **Paris**. Excellent pale yellow stewartite bladed crystals (to 1 mm) are also found along with orange-brown pitchy botryoids (less than 1 mm) of diadochite. A very pale, straw-yellow unknown mineral which visually somewhat resembles pseudolaueite (very much less than 1 mm) is associated.

A few specimens labeled laueite, from Black Mountain quarry, **Rumford** have proven to be eosphorite or other minerals. Laueite was reported from Black Mountain quarry (Seaman, 1975c), but no specimens are known from this location.



Laumontite, Phippsburg (from Goldschmidt, 1918)

LAUMONTITE (Zeolite Group)



Brooksville - Callahan M; **Calais** - U. S. Route #1 road cut; **Chisholm** - International Paper Company Power Project; **Machias**; **Machiasport** - Point of Maine A; **Newry?** - Plumbago M; **Phippsburg**; **Stonington** - Crotch Island Q

Laumontite is a snow-white to tan zeolite which dehydrates irreversibly to a brittle material called leonhardtite. Laumontite can be found as tiny (severall mm) individual crystals or radial sprays on a fracture surface.

Bouley and Hodder (1984) wrote of the Callahan mine, **Brooksville**: "The rhyolite dome, which is such a conspicuous topographic feature at the mine, is roughly egg-shaped in plan and 250 m by 500 m, about average dimensions for such domes on Cape Rosier. Flow banding is evident on weathered surfaces. Near the southwestern corner of the dome, nearly vertical, laumontite-lined open fractures transect the dome in east - west orientation."

Tiny (less than 1 mm) tan laumontite needle crystals are found on some of the terminations of prehnite crystals (4 - 5 mm) from the U. S. Route #1 road cut, **Calais**.

Laumontite has been found as radial flat opalescent white sprays on fracture surfaces in fine-grained gneiss from the excavation of the International Paper Company's power project, **Chisholm**.

Burr (1930) listed laumontite from **Machias** and **Machiasport** and Morrill and Hinckley (1959) further specified of the latter, **Point of Maine**. No specimens known.

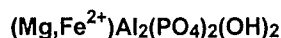
True (1869) reported laumontite? from **Newry**: "This mineral is found at the Plumbago mine, on Puzzle Mt., in Newry. It forms seams in the rock when the crystals are of an acicular form, and readily effloresces on exposure to the air." While the report

may be accurate, no one has specimens of this material and the location of the graphite mine is questionable and presumed lost.

Jackson (1837a) first reported Maine laumontite when he also reported on Phippsburg "axinite" (see ferroaxinite quote). Dufrenoy (1835) examined the crystallography of **Phippsburg** laumontite and compared it with material from the type locality, Huelgoet mine, Brittany, France, with which it compared favorably. Dufrenoy (1835) made a chemical analysis of 5 grams (!) of the Phippsburg material, but the size of the crystals was not reported or described except for idealized crystal drawings. The locality was not specified, but the specimens were found lining a fracture in gneiss and were associated with quartz and calcite: "La laumontite des Etats-Unis forme un petit filon dans du gneiss. Elle est accompagnée de cristaux de quartz et de chaux carbonatée grenue." No specimens known.

Laumontite occurs at the Crotch Island quarry, **Stonington** as rectangular prismatic milky white crystals (to 3 mm) with obliquely sloping terminations. The Crotch Island laumontite is frequently embedded in calcite and associated with stilbite (q.v.)

LAZULITE (Lazulite Group)



Newry? - Bell Pit, Nevel Q, Scotty Q; **Phippsburg**

Lazulite is an uncommon bright blue phosphate typically found in metamorphic rocks or quartz veins. Scorzalite (q.v.), its iron-bearing relative, has been found in granite pegmatites. Morrill et al. (1958) listed lazulite from the Scotty quarry, **Newry**, but without description. Deep blue, fine-grained masses (to 1 cm) of a mineral have been observed, but no specimens are currently available for study. Based on the iron-rich character of the pegmatite, the mineral was listed under scorzalite by King (1975b). Very tiny cobalt-blue dots (very much less than 1 mm) observed in granular tan siderite from the Bell Pit and Nevel quarry, **Newry** have been chemically analyzed (this study) and are scorzalite. The mineral can resemble indicolite. Gregory (1967) noted "lazulite" from the "left tunnel" of the Nevel quarry and also listed an occurrence at the Bell Pit.

Lazulite occurs as tiny (1 mm) dark blue patches with snow-white sillimanite at **Phippsburg** (Arthur Hussey, personal

communication, 1990). The mineral was, at first, presumed to be dumortierite, but the identification was based on X-ray diffraction by C. W. Burnham at Harvard University.

lead?

Cape Elizabeth? - *old rifle range area - a completely unreasonable occurrence*

Usually, the report of "lead" from a locality is informal in its intent and lead ore, usually galena, is the actual material. The same is usually true for copper, silver, and other reports of elements. The prefix *native* is used by people who want to unambiguously report the occurrence of a naturally uncombined element. The following report of *native* lead from **Cape Elizabeth** by McCarthy (1925) is highly questionable. The method of identification also seems inadequate to establish the species. Lead is so soluble both under the conditions of gneiss formation and when exposed to the erosional elements of nature that it is extremely doubtful if any *native* lead could have survived for long. The doubt hinted in the article should be heeded:

"In the summer of 1920 the writer obtained several specimens of metallic lead which occurred as a discontinuous sheet projecting from the joints of a gneissic cliff at Cape Elizabeth, near Portland, Maine. At the time the importance of a discovery of native lead was not realized, and little attention other than the prying out of several small specimens was paid to it. Since then no opportunity for a second visit has presented itself, but hoping that some one may find the time to look it up, the following facts are offered.

The lead was found in two or more vertical joints in a gneissic cliff, near the extremity, and on the shoreward side of a rock spit running northward a few hundred feet north of the Cape Elizabeth Casino. The metal, which seemed to be of natural origin, was in the form of thin sheets, about 4 or 5 mm. in thickness, and could be traced as a somewhat discontinuous streak for ten or fifteen feet along each of the joints in which it was found.

No chemical tests other than simple blowpiping were made, but the lead would seem to contain a little silver and perhaps some antimony. Its distribution along several vertical joints spaced rather far apart would seem to preclude the possibility of the overturning of a pot of molten metal on top of the low cliff, or of the lead being a relic of an abandoned rifle range, though a closer investigation might possibly indicate something of the kind. At any rate, the time spent in a more careful examination would be well worth while, should any mineral enthusiast chance to pass that way."

lead oxides?

Trescott - *Trescott M*

The interest in the verification of "lead oxides" (Morrill and Hinckley, 1959) lies in the fact that the most common lead oxide species are massicot, litharge, minium, and plattnerite. It is

unlikely that these species were meant, and the identification may have been made on cerussite and/or limonite replacements of galena. No specimens known.

leonhardtite (Zeolite Group) - dehydrated variety of laumontite

found wherever laumontite occurs in Maine

lepidochlore = clinochlore?

Mount Pisgah = Georgia!

The chlorite mineral lepidochlore was named by Shepard (1859) based on specimens from Mount Pisgah, Georgia. It was erroneously ascribed to Mount Pisgah, Maine by Frondel (1970).

LEPIDOCROCITE

FeO(OH)

Pembroke - *Big Hill M*

Lepidocrocite is a polymorph of goethite. It usually forms thin brown plates with vivid red internal color, but can be earthy. Lepidocrocite is undoubtedly a constituent of many "rusty" coatings.

Red lepidocrocite plates (1-2 mm) are found in and on black earthy masses in quartz matrix from the Big Hill mine, **Pembroke**.

LEPIDOLITE (Mica Group)

$K(Li_{0.5}Al_{0.5})_3(Si_3Al)O_{10}(F,OH)_2$

Albany - *Bumpus Q, "manway" excavation?*; **Auburn** - *Dionne Extension Q; Greenlaw Q, Groves Q, Hatch Farm Q, Maine Feldspar Q, Keith (Towne) Q, Maine Feldspar Q, Pulsifer Q, Wade Q, Western Avenue excavation*; **Brunswick**; **Buckfield** - *Bennett Q*; **Bucksport**; **Carrabassett Valley?** - *Sugarloaf Mountain A*; **Dixfield?** - *Route #2 excavation*; **Falmouth?** - *Falmouth High School excavation*; **Frye?** - *South Twin Mountain A*; **Georgetown** - *Tourmaline P*; **Greenwood** - *Emmons Q, Harvard Q, Gross P, Tamminen Q*; **Hebron** - *Hibbs Q, Mills Q (may actually be in Paris), Mount Rubellite Q*; **Lewiston**; **Limestone?** - *Limestone airbase excavation*; **Litchfield?**; **Minot** - *Charles Harries Farm A*; **Newry** - *Dunton Q*; **Norway** - *BB #7 Q, Longley House A?, Tubbs Ledge Q*; **Oxford**; **Paris** - *Mount Marie Q, Mount Mica Q, Stony Brook A, Whispering Pines Q*; **Peru** - *Eberhardt Farm A? (=Ferry Farm A), Lobikis Q, Lovejoy Pasteur A?*; **Poland** - *Berry-Havey Q*; **Raymond**; **Rumford** - *Black Mountain Q, town library excavation?*; *southern extension of pegmatite belt?* - **Durham**, **Freeport**, **Pownal**, **Yarmouth**; **South Portland?**; **Standish**; **Stoneham** - *Lord Hill Q*; **Topsham** - *Fisher Q*; **Warren** -

Starrett Q; Waterford? - Major Theodore Stone's Farm; **Weld?** - Tumbledown Mountain A; **West Paris** - Cobble Hill Q (= Pike Ledge Q, Ski Pike Q), Kittridge Hill A brook, A. C. Perham Q; **Winslow?** - Winslow Tin M; **Woodstock** - Koskala Q

Lepidolite is a lithium-rich and fluorine-rich mica found mostly in granite pegmatites. Its presence indicates the replacement of pre-existing pegmatite by late-stage fluids. Lepidolite has been used as an indicator of nearby gem pockets. Typically in Maine, lepidolite is found in lilac to mauve masses (to 30 cm) of randomly intergrown cleavages (about 3 mm), sometimes including green or pink tourmaline prisms, cassiterite, manganotantalite, quartz, cleavelandite, spodumene, etc. The color of lepidolite should be colorless, but it is usually pink, lilac, red-purple, blue-purple, blue-gray, etc. due to the common presence of manganese. Pale yellow lepidolite is suspected in several localities, but the yellow micas examined so far are members of the muscovite series. In particular, clusters of columnar, triangular yellow muscovite crystals from Auburn and Greenwood have been erroneously called lepidolite. Additionally, many Maine pegmatite muscovites are lithian and yield a red lithium flame when tested. Hess et al. (1943) reported on the cesium and rubidium content of Maine lepidolites. Hess et al. (1943) reported that 34.5 metric tons of lepidolite were recovered from the Mount Mica quarry, Paris as a source of cesium and rubidium despite previous analyses showing very low values (Clarke, 1887b). The gallium content of the various Maine minerals studied by Hess et al. (1943) appears to have been due to extraneous lines, of other elements coinciding with the monitored gallium spectrographic lines, giving false readings (Ernest Fairbanks, personal communication, 1969). Some gallium, but no cesium or rubidium, was found in Black Mountain quarry lepidolite by spectrographic analysis at the Merk company in 1961 (Neil Wintringham, personal communication, 1992). Ahrens (1948) reported lower rubidium values for Auburn and Norway samples than those of Hess et al. (1943). Gunnell (1928) noted that some Maine lepidolites are triboluminescent.

Brush (1862) first reported cesium and rubidium in Hebron and Paris lepidolite. Allen (1862) reported on rubidium and cesium in Hebron lepidolite and on the extraction procedure for these elements. Subsequent chemical studies on these elements, at Yale University, were based on refined chemicals derived from Maine pollucite and lepidolite. Berwerth (1877) chemically analyzed lepidolite from Paris and noted the presence of cesium and rubidium. Clarke (1887b, 1893, 1900b), Schaller (1905b), Heinrich et al. (1953), and Steiger (1900) studied and chemically analyzed Maine lepidolites. Clarke (1887b) noted: "Similarly, a southern extension of the belt is suggested in the region covered by the towns of Pownal, Durham, Yarmouth, and Freeport, a region from which a few specimens of lepidolite have been reported," but the reports were probably verbal and of such small quantities that no further information is known and no locality marks for these occurrences are on his index map. Santmyers (1930) briefly reviewed the occurrence of cesium and rubidium

in Maine lepidolite. Stevens (1938) and Berggren (1941) variously interpreted Maine lepidolite analyses in terms of their theoretical end-members. Berggren (1941) indicated that Black Mountain was located in Maryland. Heinrich et al. (1953) listed Mount Mica quarry, Paris and Black Mountain quarry, Rumford among the top 13 lepidolite-producing areas of the world. Baumhauer (1913) studied lepidolite and lepidolite rims on muscovite from Auburn and Paris. J. Perham (1965b) published a list of Maine lepidolite locations. Some pale pink or lilac Maine "lepidolite" could be rose muscovite.

Specimen Description

Some very fine horizontally color-zoned lepidolite crystals (to 3 cm) with "ragged" edges were found on microcline crystals (to 10 cm) and quartz crystals (to 10 cm), as well as occasional elbaite crystals (to 7 cm), at the Keith (Towne), Maine Feldspar, Pulsifer, Greenlaw, and Hatch Farm quarries, **Auburn**. Few of the lepidolite crystals are terminated, but have cleavages forming the "termination." Small (to 4 mm) yellow, slightly triangular and serrated, muscovite crystals are quite common, especially at the Pulsifer quarry, sometimes associated with milky quartz crystals and purple fluorapatite. This mica has been frequently misidentified as yellow lepidolite. Pale purple lepidolite "rims" (to 1 cm wide) are common on the muscovite crystals (to 10 x 10 cm) which projected into crystal pockets. (Pale yellow to silvery fine-grained mosaic overgrowths on muscovite crystals tend to be muscovite instead of lepidolite. Such overgrowths have been called "soda rims" by some collectors, but there is no evidence to suggest that such rims are, in fact, soda-rich.) Some Dionne Extension quarry muscovite crystals (to 10 cm) have intervening clear to cloudy mosaic selvages (to 5 mm wide) with abruptly overgrown parallel to subparallel lilac lepidolite, which also has mosaic texture but is coarser (to 1 cm). Reasonably sharp pseudo-hexagonal crystals (to 6 cm) have been found on and embedded in cleavelandite or emplaced on quartz crystals. The lepidolite crystals have exterior, vertical ribs as well as a superimposed "feathery" surface texture due to the vertical alternating stacking of slightly differing sized crystal layers. The far superior lepidolite crystals from the Xanda [shan-da] quarry, Virgem da Lapa, Minas Gerais, Brazil superficially resemble some of the Auburn lepidolite crystals. At one time, Auburn lepidolite was regarded among the best of species in the world. (Heinrich et al. (1953) apparently followed an old locality label that listed an Auburn lepidolite as coming from Minot, and they listed a colorless lepidolite from Auburn.)

Clarke (1886b) reported of Auburn: "In the western part of this town, near the Minot line, there are two localities, less than half a mile apart, yielding lepidolite with the associated minerals. The one longest known is small and apparently unimportant, while the other, lying about southeast of the first, upon the farm of Mr. G. C. Hatch, has been thoroughly opened. It has yielded a large number of gem tourmalines, mostly of the paler greenish,

lilac, or lavender colors, unusually fine crystallizations of apatite, and perhaps the best crystallizations of lepidolite so far known... Cookeite, orthoclase, albite, cassiterite, muscovite, biotite, beryl, garnet, quartz, and amblygonite are among the other species here found. The lepidolite occurs in the ordinary purple, coarsely granular form, and also in remarkable perfection as a border upon muscovite, the broad plates of the latter being practically encircled by aggregations of small crystals of the lithia mica. Some specimens of this type have also been found at Paris, but the Auburn examples are much finer than those from other localities." A chemical analysis by Clarke (1886b) showed interesting subtle differences between the late lepidolite borders on muscovite and the granular massive lepidolite. Kunz (1884b) wrote of the Hatch Farm quarry, Auburn: "*Lepidolite* was found in some abundance, in distinct isolated hexagonal crystals implanted in layers on masses of this mineral, or on crystals of quartz and feldspar. Although not sharply enough defined for good measurements, they are the finest crystals of this mineral that I have yet observed from any locality. In size they vary from 1^{mm} to 8^{mm} in width, and from 1^{mm} to 15^{mm} in length, and large masses of parts of crystals 30^{mm} to 40^{mm} in width have been observed."

Thin pale lilac coatings of lepidolite on blocky albite are found at the Groves quarry, Auburn as well as typical micaceous aggregates.

An "emerald green" lepidolite was reported from **Brunswick** by Dana (1837), but the mineral is probably fuchsite (q.v.) instead.

Landes (1925) wrote of the Bennett quarry, **Buckfield**:

"The lepidolite of Class II has the characteristic lilac color. It appears in books usually under a centimeter in diameter and up to three centimeters thick.

Hardly a specimen containing minerals of class II fails to show lepidolite. ...

The constant association of lepidolite with pocket tourmaline is well known to the gem hunter. ...

In Class IV lepidolite occurs exclusively in veins. This habit easily distinguishes it from the earlier hydrothermal and magmatic types. The veins are lilac in color, and cut minerals of Class II, especially spodumene. The separate individuals in the veins are very minute. They vary sufficiently in orientation so the vein has no well-defined cleavage.

In the majority of cases the veins have been isolated by the complete removal of surrounding minerals. The result is an irregular sheet of massive lepidolite ranging from paper thin up to one centimeter in thickness. These are found buried in kaolin in the bottom of the pockets. Very often minor veins of much smaller dimension extended out from the large veins into cleavage and other cracks in the surrounding minerals. In that case a great host of excessively thin shelves jut out from the side of thicker slabs..."

This variety of lepidolite has been locally called "shell lepidolite" due to the fragile nature of the sometimes curved thin plates (to 15 x 15 x 0.3 cm). Lepidolite rims on muscovite were occasionally found at the Bennett quarry.

A lepidolite is listed from Bucksport (AMNH), but the actual location is unknown and seems improbable.

Pale lilac-gray lepidolite borders (3-5 mm thick) on diamond-shaped muscovite crystals (to 4 x 7 cm) were found at the Tourmaline prospect, **Georgetown**.

The Gross prospect, **Greenwood**, between the Harvard quarry and West Hayes Ledge quarry, has produced ball lepidolite (to 3 cm) in cleavelandite, sometimes associated with bertrandite (to 2 mm) and blue apatite crystals (to 4 mm).

Hunt (1871) wrote of Mount Rubellite quarry, **Hebron**: "... a curious example of enclosure has been observed by Prof. Brush at Hebron, where crystals of muscovite are encased in lepidolite." At the time of this report there were very few Maine pegmatites which had been exposed and this is one of the earliest reports of lepidolite rims on muscovite. Clarke (1887b) reported: "Associated with the Hebron lepidolite there have been found specimens of red and green tourmaline, which, preserving their crystalline form, have undergone alteration into a softer mineral of an opaque, talcose appearance. Some of this material so derived from tourmaline has been supposed to be lepidolite; and, as it was possible that a study of it might be of interest, an analysis of a pink specimen, originally rubellite, was made by Mr. Riggs. ... These results show clearly that the alteration product is not lepidolite, but damourite, a fact which could hardly be altogether unexpected." Normal granular, pale purple lepidolite has been found at Mount Rubellite quarry, Hebron. Piutti (1910, 1913) reported on minor amounts of helium in Hebron lepidolite.

Excellent free-standing lepidolite crystals come from the Dunton quarry, **Newry**. Sharp, pseudohexagonal blue-lilac crystals to 3x3 cm were not uncommon at the Dunton quarry in the search for tourmaline in 1972 and later. Large groups of these crystals (to 20 x 20 cm) were found and hundreds of individual 2 x 2 x 1.5 cm crystals and small clusters were found. Fine-grained masses were also common as well as a few coarse cleavages (to 7 x 7 cm). A few pale purple lepidolite borders (3-5 mm thick) were seen on muscovite crystals (to 1 x 2 cm) from the Dunton quarry. In one rare case (HU 103199), lepidolite is found as a uniform rim (about 3 mm thick) of medium-grained cleavages (to 3 mm) around a blue beryl crystal (5 x 5 cm cross-section) in cleavelandite. (In many ways, the Dunton lepidolite crystals are identical to the best of those from the Stewart mine, Pala, California, but the best American, and perhaps world's best, lepidolite probably comes from the Little Three mine, Ramona, California (Larson, 1977; Shigley et al., 1986; Foord et al., 1989).)

The lepidolite at the Mount Mica quarry, **Paris** forms medium-grained (to 4 mm) intergrown masses of excellent deep purple-red color. Clarke (1887a,c) reported on a chemical analysis of the lepidolite. Kunz (1892a) noted "masses of 50 to 200 pounds." Toppa (1932) wrote of Mount Mica quarry: "Lepidolite or lithia mica is abundant in the gem zone and occurs as nearly pure masses some of which weighed nearly 10 tons." Tschermak (1879) reported a chemical analysis of Mount Mica quarry lepidolite. A newspaper report indicated (MMJ, Septem-

ber 23, 1881): "Several tons of *Lepidolite* have already been found here and as it is worth ten cents per pound or \$200 per ton, it is expected that quite a revenue may be derived from the mining and sale of it and other minerals."

Lepidolite is found in several different forms. At one time at Black Mountain quarry, **Rumford**, it occurred in continuous, though impure, exposures with a surface area of over 30 m². The grain size of the lepidolite varies from 1-2 mm to over 10 cm. Lepidolite which is probably of true replacement origin usually has the smallest grain size and also the darkest lilac to pink color. Lepidolite flakes over 5 x 5 mm are unusual from the Black Mountain quarry. At the Black Mountain quarry, a peculiar aplite is found which contains pale pink elbaite and pale pink lepidolite. Pink tourmaline sunbursts in fine-grained lepidolite have been found at the Black Mountain quarry which resemble the well known sunbursts in fine-grained lepidolite from the Stewart mine, Pala, California, but the number of good Black Mountain quarry specimens are few. Kunz (1886b) wrote of the Black Mountain quarry: "The lepidolite found here is finer grained than that from the other Maine localities. One form is in scales not over 1 mm. across, quite compact, and occurs in large masses of a beautiful lilac color, closely resembling the mineral from Altenberg, Saxony. A characteristic form is of a light lavender color, very compact, and has scales not more than 1 to 25 mm. in width, penetrated in every direction by crystals of rubellite, which are of a light or dark shade of red. This association is very similar to that from the well-known locality of Rozena, in Moravia...." Kunz (1892a) made an additional comparison: "... at Mount Black, Rumford, Me., ranging from rose-pink through a variety of shades of pink-lavender to heliotrope color. As this mineral is used abroad to some extent for ornaments, such as dishes, vases, paper-weights, etc., the similar utilization of the American variety is suggested. This variety, like the lepidolite of Rozena, Moravia, contains crystals of rubellite. At Rumford the association is almost identical and the mixture can be as easily polished or worked as the former." Clarke (1887b) remarked on an analysis: "In the ordinary analysis no caesium nor rubidium could be found; but a bare trace of the latter was shown spectroscopically..." (In 1942, "about 35 tons of lepidolite had been quarried and piled ready for shipment. Two or three tons more were quarried but were not yet picked over and piled" (Hess et al., 1943).)

Heinrich et al. (1953) noted lepidolite and lithian muscovite from **South Portland**, but as there is no reasonable locality in the area which could produce the species, the specimen(s) must be considered mislabeled.

The earliest report of lepidolite from the Winslow Tin mine, **Winslow** (MMJ, June 17, 1881) stated: "The recent developments have been exceptionally encouraging and the cross-cut on the 100 foot level exposed a good body of very superior tin ore and also considerable quantities of lepidolite, a rare and very valuable mineral." Graton (1905) reported on the Winslow Tin mine: "Tin occurs at Winslow in a number of narrow veins in mica-schist. The veins are composed largely of lepidolite and

fluorite, holding cassiterite, beryl, and mispickel." Holman (1921) listed both margarite and lepidolite from the Winslow Tin mine and cited a communication from Forrest Shepard indicating the find of "... rose-colored mica, or lepidolite..." In modern times, only muscovite has been found.

Burr (1939c) listed lepidolite from Oxford, Raymond, and Waterford without comment. No specimens known.

Ball Lepidolite

Hamlin (1826) reported the first ball lepidolite, in the world, from Mount Mica quarry, Paris: "*Lilac coloured Mica*. - This is found in small globular concretions, consisting of minute folia, placed one upon another so as to form short columns... These folia are easily separated from each other, and appear to be hexaedra tables." Schaller (1905b) added: "A large specimen of the pegmatite in front of Mr. Bowker's barn, at Mount Mica, shows a number of these spheres of lepidolite, several centimeters in diameter. At Auburn, Me., several specimens of globular lepidolite were found in the summer of 1904 by Mr. Wade, working on Pulcifer's [sic] ledge on Mount Apatite. Some of these were fairly large being 6 cm. in diameter and 2 1/2 cm. thick. Here, at Mount Apatite, this globular form of lepidolite is abundant and forms one of its characteristic phases. It often has a whitish border (a few millimeters thick) of some undetermined mineral (probably a mica) surrounding it."

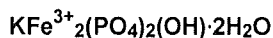
"Ball" lepidolites with a conical shape and red-purple color were found at the Greenlaw, Keith, Maine Feldspar, and Pulsifer quarries, Auburn as well as the Berry-Havey quarry, Poland. The curved crystals, with convex side toward the pegmatite-forming fluid, started from a small nucleus and grew progressively larger in one direction only. The result was a "cone." Large ball lepidolite (to 15 x 13 cm), which consists of pale pink cleavages sutured together, are also known. Many Maine lepidolite localities have at least some "ball" texture.

lepidomelane (Mica Group) - see discussion of annite under biotite series

Litchfield - *Dennis Hill A*; **West Gardiner** - float boulders

Black mica associated with cancrinite, nepheline, albite, zircon, etc. from **Litchfield** and **West Gardiner** is related to a ferrian annite, but has been given the varietal name, lepidomelane. Material was analyzed by Clarke (1889, 1900c). This material deserves modern study.

leucophosphite?



Greenwood - *Emmons Q*

Tiny (1 mm and less) platy purple-brown crystals in vugs in siderite-rhodochrosite have been visually identified as leucophosphite from the Emmons quarry, **Greenwood** (Gene Bearss, personal communication, 1989). Associated species include golden amber-brown jahnsite-(MnMnMn) (1 mm and less), yellow stewartite crystals (1 mm), straw-colored strunzite needles (to 2 mm), and tiny salmon-pink stained fairfieldite (1 mm and less) crystals as well as a bronzy red flaky unknown manganese phosphate which superficially resembles bermanite, but which has an unusual bladed aspect (much less than 1 mm) and a steeply sloping termination.

leucopyrite = löllingite or arsenopyrite

Hebron - *Mount Rubellite Q*

True (1869) announced this material: "*Leucopyrite*.- Mt. Rubellite, Hebron. This rare mineral has not been noticed elsewhere in this country."

leucoxene = fine-grained rutile, anatase, titanite, etc.

Andover; Berlin; Blaine; Blue Hill - *Parker Point A; Bridgewater; Byron; Cutler?*; *Dunn Brook Formation* - **TDR2 WELS, TER2 WELS, T8R3 WELS, T9R3 WELS**; *Flagstaff Lake pluton gabbro and troctolite* - **Coplin, Dallas, Davis, Eustis, Lang, Rangeley, Stetsontown, Tim Pond**; **Hanover; Jim Pond Formation** - **Alder Stream, Jim Pond, Seven Ponds; Littleton; Merrill; Mexico; Monticello** - *greenstone dikes; Moro; Newry; Penobscot* - *2 miles west of Toddy Pond; Rangeley Formation* - **Davis, Eustis, Lang, Stetsontown, Tim Pond; Rumford; Spider Lake quadrangle** - *Bluffer Pond Formation, Munsungun Lake Formation; Spruce Top Greenstone* - **TDR2 WELS, TER2 WELS; York** - *Cape Neddick granophyre*; **TCR2 WELS; T6R6 WELS; T7R4 WELS; T7R5 WELS; T7R6 WELS**

Leucoxene is an indefinite term used for fine-grained, golden brown minerals believed to be titanium-bearing which are found replacing titanium minerals such as ilmenite, rutile, titanite, etc.

Leucoxene was noted in the Flagstaff Lake pluton, **Coplin, Dallas, Davis, Eustis, Lang, and Rangeley**; mafic metavolcanics of Jim Pond Formation, **Alder Stream, Jim Pond, and Seven Ponds**; as well as the Rangeley Formation, **Davis, Eustis, Lang, Stetsontown, and Tim Pond** by Boudette (1991).

Smith et al. (1907) described leucoxene from **Penobscot**: "Under the microscope Ellsworth Schist from Parker Point in Blue Hill Harbor shows as its principal minerals quartz and chlorite. ... Muscovite in minute shreds is associated with the chlorite in a few places, as is also an opaque mineral, yellowish in reflected light, which may be leucoxene. ... The schist two miles west of Toddy Pond, in the extreme northern part of the quadrangle, weathers to a rusty surface. ... Ilmenite, largely altered to leucoxene is present in small grains, as is also some

micaceous hematite." Similar statements are made by Gates (1961), Pavlides et al. (1965), Ekren and Frischnecht (1967), and Moench and Hildreth (1976).

Hall (1970) indicated leucoxene in the Bluffer Pond and Munsungun Lake Formations, Spider Lake quadrangle, **TCR2 WELS, T6R6 WELS, T7R4 WELS, T7R5 WELS, T7R6 WELS** and other areas in Aroostook and Piscataquis Counties. Hall's (1970) leucoxene was consistently used as a fine-grained alteration of ilmenite which may have graded into identifiable titanite.

Pavlides et al. (1965) wrote of the Spruce Top Greenstone, **TDR2 WELS** and **TER2 WELS**: "...normally much of the ilmenite is slightly to considerably altered to leucoxene-coated sphene."

leverrierite? = montmorillonite or damourite

Auburn?; **Buckfield?** - *Bennett Q*

Leverrierite is a mica/clay mineral. A micromount in the Yedlin collection (NMNH) from **Auburn** is labeled: "Leverrierite after topaz."

Landes (1925) wrote of the Bennett quarry, **Buckfield**: "The optical data above nearly coincide with those given for leverrierite..." but he listed the material under montmorillonite.

limonite = impure earthy goethite (q.v.)

many bog iron locations; Abbot; Anson; Argyle; Arrowsic; Atkinson; Augusta; Aurora; Barnard; Bath; Blue Hill; Bridgton; Bristol; Brooksville - *Tapley #1 M; Brownville; Buckfield; Bucksport; Camden; Canton; China; Clinton; Dexter; Dixfield; Dover-Foxcroft; Farmington; The Forks; Gardiner; Greenbush; Greenwood; Harmony; Harpswell; Harrington; Hodgdon; Houlton; Howland; Jay; Katahdin Iron Works* - *Katahdin Iron Works M; Lebanon; Liberty; Linneus* - *Stewart M; Lisbon; Lubec* - *Lubec Lead M; Moxie Gore; Naples; Newfield; New Limerick; New Portland; Orland; Oxbow; Paris; Pembroke; Penobscot* - *Annear M; Phillips; Phippsburg; Pittston; Rangeley; Raymond; Rumford; Saco; Salem; Sebec; Shapleigh; Skowhegan; Somerville; Stonington* - *Parker-Ryan Q; Strong; Thomaston; Trescott* - *Trescott M; Troy; Turner; Union; Wade; Wales; Warren* - *Knox Q; Waterville* - *Route U. S. #1-95 road cut; Wells; West Forks; Whitefield; Williamsburg; Winslow; Winthrop; T3R7 WELS; T8R7 WELS*

Limonite is a generic name for brown earthy pseudo-morphs, irregular rusty masses, or thin orange, brown, or black stains presumed to be iron-rich and generally goethite-bearing. Bog iron is generally composed of limonite as are rusty outcrops of rock that contain pyrite, pyrrhotite, etc. There is hardly a gem pocket from a pegmatite which does not have at least a small amount of rusty, earthy stains and/or cement of limonite. (The

extent of limonite staining in Maine pegmatites is relatively slight when compared with many gem-pocket-bearing pegmatites in other regions.)

Notes on Removing Limonite Stains

Some limonite stains should not be removed as the staining is frequently indicative of a locality. Very desirable inconspicuous associated species might be present on a stained specimen, and the associated species might be more valuable than the obvious ones. Apatites and other phosphates are particularly soluble in acids. Always examine specimens carefully before altering them. A note of caution is in order. Many collectors use commercially available household cleaners, poisonous oxalic acid, or hydrochloric (muriatic) acid to clean limonite off from an attractive specimen. New yellow stains can form as the result of the "cleaning." Specimens should be soaked in ordinary water to fill up the pores in the rock so that concentrated acid doesn't work its action too deeply in the rock. Acid, dissolving rust deep inside crevices, can also precipitate iron oxalates or new complex chlorides, etc. due to chemical reactions. (Do not allow oxalic acid to come into contact with skin. This acid is highly poisonous and can be absorbed by the skin.)

Specimens which absolutely require cleaning should be done with relatively dilute solutions and by putting the specimen through several changes of solutions. The cleaning will take more time, but the cost of chemicals will be the same. Solutions which become yellow due to their having dissolved some of the rust should be discarded to prevent a new yellow unremovable stain from being formed. (Discarded acid solution should be first neutralized by putting calcite or limestone into them overnight or by putting sodium bicarbonate or ammonia solution into them. Note: septic tanks will not tolerate household cleaning solutions, much less harsher chemicals. Additionally, metal plumbing can be corroded to the point that pipes will require replacement. If you do not have training in the use of chemicals, do not use them.) The action of the iron-stain removing solution can be repeated without the formation of new stains as long as the cleaning solution is frequently renewed and is not allowed to get too concentrated with iron, manganese, etc. as indicated by the increasingly yellow to brown color of the solution. Finally, the specimen should be rinsed in ordinary water overnight to remove any chemical which would leave its "legacy" by dissolving old labels, discoloring wooden shelves, tarnishing nearby specimens, or causing the corrosion of nearby metals. Acid treated specimens can give off vapors, which will insidiously work their toll, for many years. A second soaking with slightly ammonia-bearing water will help to remove the problem. A final soaking in water should always be done. Some collectors recommend distilled water in the final rinse, but this expense is not necessary. (Don't expect cleaning solutions to do too much work. A large bucket of specimens to be cleaned should be avoided as too concentrated a residue solution can easily form. Also, rinse and neutralization solutions won't be effective over a large quantity

of specimens and these steps will have to be repeated many times, even if the specimens look clean.)

Of course, all cleaning should be done outdoors in plastic containers. Used solutions should never be dumped into drains where metal pipes can be corroded or septic tanks can be damaged. Before cleaning specimens, even with household cleaners such as those sold to keep flush tanks free of iron, an experienced collector should be asked about safety and disposal procedures. Don't Pollute! Warning: associated minerals with the limonite, particularly apatites and other phosphates, might be soluble in the cleaning solution used. Many specimens have been ruined in the attempt to clean them.

LINARITE



Brooksville - Cape Rosier M (= Callahan M); **Eastport** - Kendall Head A; **Garland** - Jones M (= Preble Hill M); **Lubec** - Lubec Lead M

Blue linarite has been found profusely coating fractures in talcose matrix at the Cape Rosier mine, **Brooksville**. The 1-2 mm square to rectangular platy crystals can be individually grouped. Carpenter and Foster (1960) described some small linarite crystals: "The relatively rare mineral is widely disseminated as deep blue prismatic crystals 0.2 mm in length throughout the oxidized ore and commonly associated with smithsonite. Linarite is also commonly found in talc-rich rock as radiating crystal groups somewhat similar in appearance to the tourmaline 'sunbursts' which are occasionally found in pegmatites. Linarite can be distinguished from azurite by its reaction to cold, dilute hydrochloric acid; azurite effervesces whereas linarite rapidly becomes white in color as a result of the formation of lead sulfate." Brochantite (q.v.) can be associated.

Medium sky-blue earthy masses (to 1 mm) of linarite are found with limonite in quartz vugs in galena-invested breccia at Kendall Head, **Eastport**. Some small (0.5 mm) dark green stains could be brochantite.

Linarite from the Preble Hill mine, formerly the Jones mine, **Garland** consists of dark blue masses (to 2 mm) on cerussite and with green brochantite masses (to 1 mm) in quartz on the margins of galena cleavages (to 1 cm).

linnaeite?



Katahdin Iron Works? - *Katahdin Iron Works M*

Houston (1956) reported of the Katahdin Iron Works mine, **Katahdin Iron Works**: "The only other mineral noted in the deposit was a small bright colored isometric euhedral mineral with a hardness of D [on a scale of microhardness; system

unspecified], roughly cubic in outline, and tentatively identified as linnaeite. It is negative to all standard reagents. It occurs most commonly near the center of the ore body, but is everywhere in only very small particles and nowhere makes up more than .1% of the sulphides." See discussion of the related species violarite.

litchfieldite - a nepheline- and cancrinite-bearing syenite rock

Gardiner, Litchfield - Dennis Hill

LITHIOPHILITE (Triphylite Group)



Auburn - Greenlaw Q, Groves Q, Keith Q, Pulsifer Q, Wade Q; **Buckfield** - Bennett Q, Dudley Ledge Q (= Westinghouse Q); **Greenwood** - Emmons Q, Tamminen Q; **Hebron** - Mount Rubellite Q; **Newry?** - Dunton Q; **Norway** - B. B. #7 Q, Tubbs Ledge Q; **Paris?** - Mount Mica Q; **Poland** - Berry-Havey Q; **Rumford?**; **Stoneham?**; **Warren?** - Starrett Q

Lithiophilite is a "primary" phosphate in Maine pegmatites and can be the parent of a host of "secondary" species. As manganese is more resistant to oxidation than the iron, lithiophilite is generally less oxidized and/or replaced than triphylite. Lithiophilite is generally found in cleavelandite or quartz matrix. A black stain is frequently seen on the outside of the masses. This stain might be partly the result of incipient alteration and partly the late deposition of manganese and iron oxides. Lithiophilite and triphylite were reported from the Bennett pegmatite (Landes, 1925), but the triphylite reported by Landes may have been made on a manganoan fluorapatite specimen preserved in Landes' suite (Francis, personal communication, 1990). The only locality where both lithiophilite and triphylite are certainly known to occur is the Tanco pegmatite, Manitoba, Canada (Crouse and Černý, 1972).

Some lithiophilite masses (to 7 x 7 cm) such as those from the Pulsifer quarry, **Auburn** are bright orange-tan indicating high manganese content. Chemical analysis (Vandall King, unpublished data, 1976; Moore, in press) also shows the Pulsifer material to be almost devoid of iron. The lithiophilite is found in cleavelandite and usually has a several millimeter wide black stain on the surface. Frequently, dark red-brown massive triplite is found on the edge of the lithiophilite nodule. Purpurite is a scarce alteration of lithiophilite at the Pulsifer quarry.

A crude rounded lithiophilite crystal (2.5 x 2 cm, HU collection) of tan to salmon color was found embedded in gray quartz with coarse muscovite (to 7 cm) and broken schorl at the Westinghouse quarry, **Buckfield**.

The Bennett quarry, Buckfield, has produced pinkish brown masses of lithiophilite (to 15 cm) in quartz and even in pollucite. Landes (1925) noted: "It is pale salmon pink in color

and for the most part very fresh." After giving optical data and a chemical analysis, Landes (1925) continued: "At Buckfield lithiophilite occurs frozen to the pocket walls, which generally consist of massive quartz. A change in the character of the solutions following the deposition of lithiophilite made this mineral unstable and it was extensively attacked and replaced by later minerals." Dark red-brown crystalline veinlets, of constant thickness (to 5 mm), of reddingite/landesite cut across some of the lithiophilite. Pink coarse cleavages of rhodochrosite also cut across the margins of lithiophilite nodules.

Orange-brown to brown lithiophilite masses (to 10 x 10 cm) have been found at the Tamminen quarry, **Greenwood** and slightly smaller masses are found at the Emmons quarry, also in Greenwood. The Emmons and Tamminen occurrences are found in cleavelandite and quartz. The dark brown to "black" border around Tamminen quarry lithiophilite has a high proportion of triplite which is easily identifiable using magnification. Emmons quarry lithiophilite can be brownish red interlaced with gemmy yellow lithiophilite as well as the familiar salmon color.

Muddy brown masses (to 5 cm) of lithiophilite in quartz and cleavelandite from the Mount Rubellite quarry, **Hebron** have been analyzed and are just barely over the species boundary line from triphylite (Paul Moore, personal communication, 1990).

The first listing of lithiophilite from the Dunton quarry, **Newry** was apparently made by Fairbanks (1928). Fraser (1930) briefly described triphylite from the Dunton quarry, but used a peculiar notation, "heterosite (purpurite)" to designate its alteration, suggesting that a manganese parent was actually present. Semi-quantitative analysis (this study) indicates the primary mineral and its oxidation product are manganoan triphylite and manganoan heterosite, respectively, and not lithiophilite and purpurite at the Dunton quarry. Further analyses (Moore, in press) substantiate the triphylite at Newry.

In 1883, Penfield reported on the chemical analysis of lithiophilite from "Tubbs Farms," **Norway**: "The specimens from Norway, Me., are associated with quartz, albite and tourmaline, and are broken fragments of considerable size, blackened on the exterior by oxidation, to which the mineral is peculiarly liable, but in the interior perfectly fresh and of a light salmon color."

Chemical analysis of "lithiophilite" from Mount mica quarry, **Paris** show the mineral is manganoan triphylite (q.v.).

Lithiophilite from the Berry-Havey quarry, **Poland** occurs in medium-sized pinkish brown to orange-brown to light brown masses (to 10 cm) which are significantly altered and replaced. Rhodochrosite frequently replaces the lithiophilite along with secondary phosphates such as reddingite, dickinsonite, fairfieldite, eosphorite, triplite, montebasite, etc. Berman and Gonyer (1930) reported on its optics and chemical analysis.

Hess et al. (1943) reported of the Starrett quarry, **Warren**: "Small lumps of lithiophilite, partly changed to purpurite, and flakes of white lepidolite occur here and there." Sundelius (1963) tested iron-rich specimens.

***lithian-muscovite?** (Mica Group)



Buckfield - *Bennett Q*; **Newry**; **Paris** - *Mount Mica Q*; **South Portland**; **Topsham**

Stevens (1938) proposed the component $\text{K}_4\text{Li}_6\text{Al}_6\text{Al}_4\text{Si}_{12}\text{O}_{40}(\text{OH},\text{F})_8$ called lithium-muscovite which was to serve as an end-member of the lepidolite series, but no analyses that he calculated arrived above 0.47 of this mineral component, the specimen being from Mesa Grande, California. Berggren (1940, 1941) proposed the species lithium-muscovite from several localities including **Paris**. The name was intended to replace lepidolite as a species name while lepidolite would be retained as a group name, but it was not generally adopted as lepidolite had clear priority. Stevens (1938) did not describe his specimens, while Berggren (1941) described only specimens from Varuträsk, Sweden. The specimens may have been visually identical to pale purple micas which would be called lepidolite.

Landes (1925), for example, was apparently describing lithian muscovite when he wrote of the Bennett quarry, Buckfield: "In the main pegmatite lepidolite has all the appearance of muscovite. It occurs in silvery white books, usually five to eight centimeters in diameter and under one centimeter in thickness. Optically lepidolite is almost identical with muscovite, so the flame test was used in distinguishing these two micas. The white mica of the first class gave as sharp and as definite a lithium flame as did the pink lepidolites of the later classes. The flame was secured all about the periphery, in the center, and in every quadrant of the book. Also the plates were microscopically homogeneous. Nowhere was there any evidence of lepidolite-muscovite zoning or intergrowths..."

Heinrich et al. (1953) wrote: "In the course of X-ray studies of so-called lepidolites a new variation of the muscovite polymorph has been discovered." After discussing theoretical aspects of the "new" variety and listing Newry, South Portland?, and Topsham as localities, Heinrich et al. (1953) wrote: "In a specimen of mica from Newry, Maine, labeled 'lepidolite,' the lithian muscovite structure grades into that of normal muscovite."

lithomarge?

Greenwood - *Harvard Q*

Lithomarge was a name applied to kaolinite, halloysite, and, probably, smectite [montmorillonite] (Dana, 1892). A specimen of lithomarge from the Harvard quarry, **Greenwood** consisted of concentric tan fine-grained to clayey masses (to 4 cm) associated with a patch of purple damourite in cleavelandite. The lithomarge has been shown to be cookeite, perhaps with montmorillonite with interlayer calcium based on chemical analysis

and X-ray diffraction (this study). The specimen has a concave surface where it could have been in contact with montebrasite.

Iodestone = magnetite which shows strong natural magnetism

Lubec - *Baileys Mistake Island A*

LÖLLINGITE



Auburn - *Keith (= Towne) Q*; *Maine Feldspar Q?*; **Bowdoin** - *Coombs Q*; **Buxton** - *Bar Mills road cut*; **Greenwood** - *Emmons Q*; **Hebron** - *Hibbs Q*, *Mount Rubellite Q*; **Hollis** - *Hollis Center road cut*; **Newry** - *Dunton Q*; **Paris** - *Mount Mica Q*; **Poland** - *Berry-Havey Q*; **Rumford** - *Brown-Thurston P*; **Standish** - *Breakheart Hill A*; **York County**

Löllingite and arsenopyrite are easily confounded. In general, löllingite has a bright silvery metallic luster while arsenopyrite has a medium to low brightness silvery to silvery gray metallic luster. Sometimes arsenopyrite shows some granulation of the mass while löllingite sometimes has a barely perceptible "fibrous" appearance on fracture surfaces, but this distinction is not always consistent.

Arsenopyrite is well-known (including this study) from the Maine Feldspar quarry, **Auburn**. Reports, such as Fisher and Bernard (1934) and Morrill et al. (1958), have suggested that löllingite occurs at the Keith and Maine Feldspar quarries respectively, but no löllingite is available for study from these areas.

Bright silvery masses (to 5 x 7 x 1 cm) of löllingite are found embedded in albite and quartz at the Coombs quarry, **Bowdoin**.

Dolloff (1930) noted löllingite in a pegmatite in a Bar Mills road cut, **Buxton** as well as at a Hollis Center, **Hollis** road cut.

Bright silvery metallic masses (to 10 cm) of löllingite have been found embedded in albite at the Emmons quarry, **Greenwood** (Gene Bearss, personal communication, 1991). Occasionally, an olive green powdery alteration is seen on the löllingite grain boundaries which has been called scorodite. Parallel growth löllingite crystals (1 x 6 mm) occur in tightly grouped, ribbon-like clusters (to 2 x 15 cm) in tan to brown stained, compact to undulating cleavelandite at the Emmons quarry. The ribbon-like löllingite clusters can have a thick rusty coating or be complete pseudomorphs (Ray Sprague, personal communication, 1992).

Löllingite from the Hibbs quarry, **Hebron** is found as elongated masses (to several centimeters) embedded in albite. Dark blue-gray tourmaline sometimes forms a thin (2-3 mm) selvage around the grains. In a few cases slender terminated crystals 8 x 2 mm are found embedded in albite. A coating of

muscovite is sometimes seen on löllingite. Though the crystals are sharp and exceptional for the species, the Parker Mountain quarry, Center Strafford, New Hampshire crystals are still far superior.

Löllingite is a scarce mineral at the Dunton quarry, **Newry**. It occurs as lightly tarnished, irregular, slightly corroded silvery metallic masses (to 8 mm) embedded in cleavelandite. A thin limonite coating might be indicative of its iron-bearing nature. Löllingite crystals are not known at Newry, but the equally scarce arsenopyrite is usually found there as elongated crystals (to 2 mm) with rhombic cross-section.

Bright silvery masses (3-5 cm) of löllingite embedded in albite from Mount Mica quarry, **Paris** were common at one time. Occasionally, the löllingite has a blue tourmaline corona developed around the grain or mass.

Löllingite (chemical analysis, this study) occurs as sub-metallic silvery gray crystals (to several mm) at the Berry-Havey quarry, **Poland**. The Berry-Havey quarry löllingite can be seen as fractured crystals embedded in orange-pink to pale pink granular triplite masses (to 1 cm) associated with rhodochrosite, cleavelandite, and muscovite. These löllingite crystals have a wedge-shaped habit which looks "pyramidal" and are almost always striated and sometimes have vicinal growths of triangular faces.

Large (to 10 cm) bright silvery masses of löllingite are found at the Brown-Thurston prospect, **Rumford** associated with large masses of purple purpurite and microcline.

Dolloff (1936) reported löllingite from **Standish**: "Löllingite was found in veins at Breakheart Hill with quartz, pyrite, a greenish mica, and later spalerite [sic]. At the Oak Hill road cut, a vein of that material was found in albite. In this occurrence, the löllingite has repeated twins on m(110) with the crystals penetrating the albite." Dolloff (1936) additionally wrote: "Material from a pegmatite in York County contained both arsenopyrite and löllingite in a single polished surface. The arsenopyrite replaced löllingite. ... The Standish material resembled the löllingite. It is found as irregular, elongated intergrowths in microcline."

LUDLAMITE



Greenwood - Emmons Q; **Newry** - Bell Pit, Dunton Q?, Scotty Q; **Paris** - Mount Mica Q; **Rumford** - Black Mountain Q, Red Hill Q; **Stoneham** - Cole Q

Ludlamite from the Emmons quarry, **Greenwood** is found in carbonate-bearing replacements of lithiophilite. The pale green, nearly parallel plates (to 2 mm) are found in a cellular network of fine-grained rhodochrosite/siderite which can be partially filled with tan to brown jahnsite-(MnMnMn) (much less than 1 mm), sprays of elongated pink to nearly colorless hureaulite (much less than 1 mm), gray fairfieldite clusters (to 2 mm), black rockbridgeite radial crystal sprays or clusters (to less than 1 mm), etc. Many of the ludlamite grains have fine-grained intergranular veinlets of medium blue vivianite.

Ludlamite from the Bell Pit, **Newry** consists of a pale lime green mineral embedded in granular tan siderite and granular white montebrasite. The mineral has a perfect cleavage and is translucent. Crystals (to 1 mm) are pseudo-hexagonal with "c" pinacoids sometimes giving the normally equant crystals a slight tabular habit. Souzalite and scorzalite can be associated.

Peacor (1960) reported of the Scotty quarry, **Newry**: "Ludlamite: Aggregates up to an inch in diameter were found with siderite as a hydrothermal triphylite alteration." No specimens known.

Seaman (1975a) reported ludlamite associated with beraunite (q.v.), etc. at the Dunton quarry, **Newry**. No specimens known.

Gray-green ludlamite crystals (to several mm) are found in siderite in blue tourmaline eyes from the Mount Mica quarry, **Paris** (Gene Bearss, personal communication, 1991).

Apple-green ludlamite crystals (to 3 mm) with a pseudo-hexagonal aspect have been found at the Red Hill quarry, **Rumford**. The ludlamite has a pearly luster on the basal cleavage and is found intergrown with siderite and vivianite with occasional strunzite.

M

MACKINAWITE

(Fe,Ni)₉S₈

Brooksville - Callahan M; **Union** - Harriman P; **Warren** - Warren Nickel P

Park and Bastille (1973) reported mackinawite without description or chemical analysis as a "subordinate" part of the ore at the Callahan mine, Harborside, **Brooksville**. Bouley and Hodder (1984) wrote: "Park and Bastille (1973) also describe occurrences of safflorite, marcasite, arsenopyrite, and mackinawite as small blebs in pyrite," yet Park and Bastille (1973) did not specify the matrix in writing.

Rainville and Park (1976) said of this mineral: "In the **Harriman** and **Warren** deposits, mackinawite is restricted to occurrences within chalcopyrite or at its borders. It occurs in spindle-like forms and wormlets and as irregular and subrounded grains. As there has been much confusion in the literature regarding the identification of mackinawite, we employed the electron microprobe to determine chemical composition, because the optical properties of mackinawite merge imperceptibly with those of valeriite with the substitution of trace elements."

macle = chialtolite, in the sense of Cleaveland (1816)

magnesiochromite?

Stoneham?

Magnesiochromite was listed for **Stoneham** by Morrill et al. (1958). No specimens or any other references known.

MAGNESIO-HORNBLENDE (Amphibole Group)

$\text{Ca}_2(\text{Mg,Fe}^{2+})_4\text{Al}(\text{Si}_7\text{Al})\text{O}_{22}(\text{OH})_2$

Ammonoosuc Volcanics - **Grafton**, **Upton**; **Hermon** - **Hermon Hill Q**; **Newry** - **Dunton Q**, **Nevel Q**

Most of the reports of "hornblende" (q.v.) in granites, schists, amphibolites, etc. probably refer to magnesio-hornblende, but they were identified before the IMA nomenclatural changes were introduced into amphibole (q.v.) nomenclature. There are relatively few amphibole chemical analyses from

Maine specimens, most specimens having been identified in thin section only.

Kimball (1981) chemically analyzed magnesio-hornblende from Ammonoosuc Volcanics, **Grafton** and **Upton**:

"The hornblende in the three amphibole assemblage gedrite-anthophyllite-hornblende occurs as small, discrete grains about 0.05 mm across. These grains are very dark green and faintly pleochroic. ... In the Ammonoosuc Volcanics hornblende occurs in three different assemblages. The first is the single amphibole assemblage hornblende-plagioclase-quartz-sphene-ilmenite... In this assemblage hornblende occurs as subhedral grains whose cross-sections are 2.0 to 3.0 mm across. The amphibole is green and pleochroic shades of green to pale greenish brown.

The second hornblende-bearing assemblage is hornblende-cummingtonite-plagioclase-quartz-biotite or chlorite-ilmenite. In this assemblage hornblende occurs as: 1) small grains (up to 0.1 mm) in contact with cummingtonite..., 2) small isolated grains..., or 3) fairly large isolated grains (0.5 to 2.0 mm ...). The small grains tend to be inclusion free, green and pleochroic in shades of pale green while the larger ones are brownish green and pleochroic in shades of green to tan. The large grains tend to have quartz and ilmenite inclusions. Cummingtonite occurs as distinct laths up to 1.0 mm long. The blades are colorless and contain few inclusions...

The third hornblende assemblage contains actinolitic hornblende co-existing with actinolite and is observed in two sections. One of these sections shows pale green amphibole fading into a colorless amphibole ... and the other has colorless amphibole surrounded by a relatively dark amphibole... In both cases the green amphibole is hornblende and the colorless one is actinolite."

Magnesio-hornblende crystals (to 1 cm) are found embedded in the altered hornblende diorite porphyry of the small Hermon Hill quarry, **Hermon**. The magnesio-hornblende crystals are wedge-shaped or rhombic, are dark green in color, and are frozen in matrix primarily by actinolite needles and calcite grains. The surface of the crystals has a parquet texture and the very edge of the crystals shows a clear fibrous selvage (less than 1 mm). Dale (1907) and Smith (1923) reported: "The rock consists, in descending order of abundance, of hornblende, calcite, a much altered feldspar (plagioclase), and magnetite, together with secondary actinolite, fibrous serpentine, and chlorite. It contains sufficient calcite (calcium carbonate) to make it effervesce with cold dilute hydrochloric acid. It takes a very fine polish and cuts very light, but the presence of the calcite exposes it to attack by the carbonic acid of the atmosphere. It is therefore

more suitable for indoor work. Ora W. Knight..., State assayer of Maine, reports that it contains a very small amount of platinum which is very irregularly and unevenly distributed."

The actinolite-clinocllore-dravite schist surrounding the Dunton pegmatite and Main pegmatite sheets at **Newry** is partly composed of the amphibole magnesio-hornblende. While actinolite is intermediate between tremolite and ferroactinolite when magnesium and iron are considered, there is also a transitional composition to magnesio-hornblende and ferrohornblende when aluminum and silicon variations are also considered. Henry and Dutrow (1990) showed the green "actinolite" needles which are part of the exo-contact action of the intrusion of the pegmatites on Halls Ridge vary from actinolite (high magnesium - low aluminum) to magnesio-hornblende (medium magnesium - high aluminum): $Mg/(Mg + Fe) = 0.77$ to 0.87 and $^{IV}Al = 0.238$ to 0.909 . It is not possible to visually distinguish the two amphiboles.

MAGNESITE (Calcite Group)

MgCO₃

Deer Isle - Little Deer Isle Traprock Q; **Greenwood**; **Jim Pond** - fuchsite L; **Portland?** - State Street; serpentinite units (unnamed) - **Alder Stream**, **Jim Pond**, **Seven Ponds**; **TDR2 WELS?** - *Maple Mountain P*, *Number Nine Stream A*, *Porcupine Hill A*; **T9R3 WELS?** - *Hovey Mountain P*

Magnesite is an uncommon member of the calcite group. Magnesite is less reactive to common acids than calcite and then the test can be confused with the reaction of dolomite.

Hitchcock (1862b) wrote of **Greenwood**: "... magnesite in a vein crossing the railroad." No specimens known.

True (1869) reported magnesite from **Portland**: "*Magnesite*. Crystals have been found in the Talcose Slate, near the foot of State Street in Portland." It is uncertain what material was actually found.

Despite the low MgO value obtained from their chemical analyses of manganese ore from the Maple Mountain prospect, **TDR2 WELS** and the Hovey Mountain prospect, **T9R3 WELS**, Skow et al. (1956) listed magnesite, without description, as a "major" mineral in the ore. Pavlides and Milton (1962) wrote: "The absence of detectable MgO both in the chlorite and the carbonate fractions is noteworthy." Pavlides and Milton (1962) did write of **TDR2 WELS**: "One small outcrop of magnesite rock is exposed on the top of Porcupine Mountain close to outcrops of serpentinite. Carbonate-talc schist crops out in the gully of the stream immediately east of Porcupine Mountain, and is probably genetically related to the serpentinite." Pavlides et al. (1965) added: "Magnesite rock is present along Number Nine Stream and at one place on Porcupine Hill."

Boudette (1991) reported magnesite in fuchsite-bearing carbonate rock from unnamed serpentinite units, **Alder Stream**, **Jim Pond**, and **Seven Ponds**.

magnetic iron = magnetite

magnetic pyrite = pyrrhotite

MAGNETITE (Spinel Group)

Fe²⁺Fe³⁺₂O₄

Addison - *Black Diamond Q*, *Pleasant River Black Granite Q*; **Alder Stream**; **Alfred** - *Bennett Q*; **Andover**; **Arrowsic**; **Auburn**; **Augusta**; *Aziscohos Formation* - **Adamstown**, **Lincoln Plantation**; **Baileyville** - *Hall Q*, *Tarbox Q*; **Bar Harbor**; **Bath**; **Berwick** - *Miniutti Q*, *Spence and Coombs Q*; **Bethel**; **Biddeford** - *Andrews Q*, *Emmons Q*, *Ricker Q*, *Wormwood Q*; **Big Squaw** - *Black Sand Island*; **Blue Hill** - *Chase M*, *Douglass M*, *Mammoth M*, *Stewart M*, *Twin Lead M*, *White Q*; **Bridgton** - *unnamed pegmatite L*; **Bristol** - *Round Pond Q*; **Brooksville** - *Bucks Harbor Q*, *Maine Lake Ice Granite Q*; **Brownfield** - *Partridge Mountain A*; **Brownville** - *Merrill Q*; **Brunswick** - *Hielie Q*; **Buckfield** - *Waterman's Farm A*; **Byron** - *heavy mineral Swift River A*; **Calais** - *Beaver Lake Q*, *Gardiners P*, *Mingo-Bailey and company Q*, *Maine Red Granite Q*, *Red Beach Q*, *Shattuck Mountain Q*; **Calais** - *Cookson Group*; **Camden**; *Cape Elizabeth Formation* - **Arrowsic**, **Georgetown**, **Phippsburg**; **Casco** - *Mount Quito M*; *Casco Bay islands*; **Castine** - *Emerson M*; **Castle Hill** - *volcanic rocks*; **Chapman** - *Edmunds Hill*; **Crawford** - *slate in Crawford village*; **Dedham** - *Brown Q*, *900 Foot Hill*; **Deer Isle** - *Deer Isle M*, *North Deer Isle A*, *Pine Hill A*; **Denmark**; **TDR2 WELS** - *Spruce Top Greenstone*; **Farmington** - *accessory in schists*; **The Forks** - *Pleasant Pond Q*; **Frankfort** - *Mosquito Mountain Q*, *Mount Waldo Q*; **Franklin** - *T. M. Blaisdell Q*, *W. B. Blaisdell Q*, *Crabtree and Havey Q*, *Robertson Q*; **Gardiner**; **Georgetown**; **Gouldsboro**; **Greenwood**; **Guilford** - *Brawn Q*, *Queen City Q*; **Hartland** - *Hartland Q*; **Hermon** - *Hermon Hill Q*; **Hodgdon** - *Westford Hill A*; **Houlton**; **Isle au Haut**; **Jay** - *Maine and New Hampshire Granite Q*; **Jefferson**; **Jonesboro** - *Bodwell-Jonesboro Q*, *Booth Brothers Jonesboro Q*, *Fish Q*; **Jonesport** - *Minerva Cove Q*; **Katahdin Iron Works** - *Katahdin Iron Works M*; **Lakeville** - *Getchell Mountain P*; **Leeds**; **Lincolnville** - *Heal Q*; **Linneus** - *Stewart M*; **Litchfield** - *Dennis Hill A*; **Long Island** - *Black Island Granite Q*; **Lubec** - *Baileys Mistake Q*; **Lyman** - *Lyman pluton*; **Marshfield** - *Marshfield Q*; **Milbridge** - *Milbridge Q*; **Monhegan** - *White Head Q*; **Monson** - *Mathews Q*, *Monson Pond Q*; **Mount Desert** - *Campbell and Macomber Q*, *Graves Brothers Q*, *Marshalls Island A*, *Snowflake Q*; **Mount Katahdin Township** - *Mount Katahdin A*; **Muscle Ridge** - *Dix Island Q*, *High Isle Granite Q*; **Newfield** - *"game reserve"*, *Straw Hill A*; **New Limerick** - *Drew Lake dam A*; **Newry** - *Bell Pit*, *Plumbago Mountain pluton*, *Scotty Q*; **Norridge-wock** - *Dodlin Q*, *Lawton Q*, *Taylor Q*; **Northeast Harbor** - *Graves Brothers Q*; **Palermo** - *Cushing Formation*; **Patten**; **Penobscot** - *Lymburner P*; **Perry** - *Loring Cove A*; **Phillips** - *Sandy River*; **Phippsburg** - *Parker Head A*; **Pownal** - *Pownal Q*; **Rangeley** - *metasedimentary rocks in Oquossoc*; **Rangeley Plantation** - *Bog*

Brook A; Raymond - Great Rattle Snake Pond A; Rumford - Plumbago Mountain pluton; Saint George - Herring Gut Island Q, Long Cove Q, McConchie Q; Salem; Sanford; Searsport - Bog Hill Q; serpentine units (unnamed) - Alder Stream, Jim Pond, Seven Ponds; Smithfield; South Pond porphyry - Cushing, Friendship, Waldoboro, Warren; South Thomaston - Sprucehead Q, Weskeag Q; Steuben; Stoneham; Stonington - Benvenue Q, Crotch Island Q, Goss Q, Latty Q, Moose Island Q, Ryan-Parker Q, Saint Helena Q, Settlement Q, Sherwood Q; Sullivan - Crabtree and Havey Q, Dunbar Q, Hooper-Havey Q, Petee Q, Sinclair Q, Stimson Q, Sullivan Village Q; Swans Island - Baird Q, Swans Island Q, Toothaker Cove A; Thomaston - Williams Q; Topsham - Mount Ararat Q, Russell Brothers Q, South Standpipe Hill Q, Spragues Q, Standpipe Hill Q, Swamp #1 Q; Tremont - Bass Harbor Head Q, Carrol Q, McKinley Q, Seal Cove Qs; Union - Harriman P; unnamed volcanic rocks - Danforth, Prentiss, T8R3 NBPP, T8R4 NBPP; Vinalhaven - Armbrust Q, Black Q, Bodwell Q, Hurricane Island Q, Palmer Q, Pequoit Q, Sands Granite Q; Warren - Warren Nickel P; Waterford; Wayne; Wells - Lord Q; West Gardiner; Whitefield - Jewett Q; Winslow; Woolwich; T3R5 BKP WKR; T5R7 BKP WKR; T10SD - Catherine Hill Q

Small (1-2 mm) grains of magnetite are commonly found as an accessory mineral in many of the granites, "black granites," basalts, gabbros, etc. of Maine (Dickerman and Wadsworth, 1884; Lord, 1898, 1900; Smith, 1923; additional references by Jackson, 1837a, 1838a, 1839). Merrill (1883) described "black nodules" within granites from **Biddeford, Blue Hill, Frankfort, Jonesboro, Mount Desert, Sullivan, and Vinalhaven** and noted that they contained magnetite, biotite, etc. Dale et al. (1906, 1914) listed accessory magnetite in Maine slates.

Guidotti (1977) wrote of **Adamstown and Lincoln Plantation**: "A particularly common feature of the phyllites of the upper member of the Aziscohos Formation is the presence on weathered surfaces of 1-2 mm magnetite euhedra and in a few cases pyrite cubes also."

Smith (1923) said of the Hall quarry, **Baileyville** occurrence: "The content of magnetite is so great that large blocks of the rock deflect the magnetic needle." Forsyth (1955a) made a similar remark of poorly bedded slates of **Crawford**. Abbott (1986) wrote of the Cookson Group exposed in **Calais**: "The amount and distribution of magnetite in the sedimentary and volcanic rocks adjacent to the hornblende granophyre and Charlotte granite suggest that the magnetite was formed by contact metamorphism. ... The unusually high proportion of magnetite can be detected easily with a magnet and affects compass readings."

Hodge (1838) wrote of Black Sand Island, **Big Squaw**: "On a small, low island N.W. from Moose Island, I found the beach almost covered with fine black ferruginous sand. It is the common black sand used in writing. It lies upon, and in strata with the yellow beach sand, and may be collected in great abundance. Such sand is commonly sold when put up in pound papers, at six

cents each. To obtain large quantities it might be scooped up with shovels, and afterwards separated from the yellow sand by powerful magnets."

Smooth-faced octahedral magnetite crystals (1-2 mm) are found in lenses (to 2+ cm) of fine-grained hematite at an unspecified locality in **Brooksville**.

Black octahedral (to 1 mm) to rounded magnetite crystals constitute the majority of the heavy minerals in the black sand residue of gold panning not only along the East and West Branches of the Swift River, **Byron**, but in virtually all of the gold panning residues in Maine. The sources of the magnetite in the Swift River gravels are probably the magnetite-bearing Albee and Aziscohos Formations (Charles Guidotti, personal communication, 1990).

"Magnetite in Arrowsic, Phippsburg, and Georgetown occurs in reddish brown cotecule within the Cape Elizabeth Formation (Hussey, 1985, and in preparation). The magnetite occurs disseminated in the cotecule as grains ranging from $1/2$ mm to 1 cm. During the course of field mapping, six prospect pits were located on Arrowsic Island. One of these located near the Arrowsic town hall is the one referred to by Morrill et al. (1958) as the 'Arrowsic Iron Mine' (mislocated on his map by about 3 km). This particular prospect has a sloping adit in the side of a short ridge in addition to the pit on top of the ridge. Any one or all of these pits could have been the 'Emery' locality mentioned by Morrill et al. (1958)" (Arthur Hussey, personal communication, 1992).

Mining for magnetic iron was announced in **Casco** (MMJ, December 23, 1881) and this may have been referring to the Mount Quito mine.

Ludman (1990b) wrote of magnetite in unnamed volcanic rocks (Ovf₂) **Danforth, Prentiss, T8R3 NBPP, and T8R4 NBPP**: "The diagnostic lithology is a massive, fine-grained, dark gray to black rock with abundant euhedral magnetite octahedra. It is associated with beautifully banded iron-formation consisting of alternating red, hematite-rich layers in which there are few magnetite crystals, and black, magnetite-rich layers rich in manganese oxides and hydroxides."

Magnetite from **Litchfield** is found in albite, lepidomelane, zircon, and nepheline matrix. The mineral is wrought-iron black and usually granulated (to 3 x 5 cm) with traces of dull parting surfaces, but can be iridescent on the external grain surface.

Boone (1955) listed magnetite as a common accessory mineral in schists of the **Farmington** area.

Hussey (1962) wrote of the Lyman pluton, **Lyman**: "Near the southern end of Lyman Township, accessory magnetite grains up to $1/4$ inch in diameter are conspicuously scattered through the granite."

Magnetite crystals (to 2 mm) with triangular striations are found in vugs lined with quartz crystals (to 3 mm) and albite crystals (to 3 mm) in granite at the Hall Quarry village area, **Mount Desert**.

Jackson (1837a) wrote of Marshalls Island, Mount Desert: "On the western side of the island is found a vein of very rich

magnetic iron ore, contained in granite rocks. ... This iron ore is of the purest variety, and being possessed of polarity, is admirably suited for magnets of great power. ... This is the most powerful magnetic iron ore that I have ever seen."

Newberg (1985) noted of the Cushing Formation, **Palermo** that patches of magnetite were "scattered" in the rocks.

Cameron et al. (1954) wrote of the Parker Head area, **Phippsburg**: "Magnetite and ilmenite occur with fine-grained quartz and plagioclase as small irregular, kidney-shaped pods in the outer parts of the wall zones of many pegmatites, particularly those in the southern half of the area. Similar pods occur in the fine-grained biotite granite."

Magnetite octahedra (to 2 mm) are found in metasedimentary rocks in Oquossoc, **Rangeley** (Charles Guidotti, personal communication, 1990).

Schrader et al. (1917) reported magnetite from **Raymond**: "in thin sheets in epidotic gneiss."

Newberg (1979) noted an unusual occurrence in the South Pond porphyry, **Cushing**, **Friendship**, **Waldoboro**, and **Warren**: "Small quartz-tourmaline-magnetite veins just east of the South Pond porphyry contact cut two generations of folds..."

Granite from the Crotch Island quarry, **Stonington** has striated magnetite crystals (1-2 mm) clumped with biotite and titanite crystals (to 3 mm) and occasional epidote and amphibole grains.

"Octahedral Magnetic Iron" of **Topsham** (Cleaveland, 1816, 1822) undoubtedly came from the Standpipe Hill area. The Standpipe Hill quarry proper, as well as the East and South Standpipe Hill quarries, has produced magnetite octahedra (to 4 cm) frozen in fine-grained granitic matrix. The octahedra show exaggerated trigonal "pagoda" growth steps which are frequently impregnated with muscovite cleavages. Smooth octahedral "faces" on the Topsham magnetite are usually parting surfaces, and not true crystal faces. The magnetite is widespread and is found in pegmatite outcrops along the railroad tracks as well as outcrops near the Androscoggin River falls. A specimen from an unspecified Topsham occurrence (CC collection) consists of large (to 5 cm) closely grouped (to 20 cm) magnetite crystals in brown-stained quartz. Parting, possibly related to oriented ilmenite (q.v.) inclusions, is abundantly developed in Topsham magnetite. Excellent magnetite specimens also come from the Mount Ararat quarry, Topsham. Schrader et al. (1917) reported that magnetite occurs at Spragues quarry, Topsham "as tris octahedral crystals in pegmatite."

Bastin (1908a) reported that as much as 10% by weight of the pyrrhotite-bearing peridotite, **Union**, was composed of magnetite.

Boudette (1991) noted some large magnetite crystals from unnamed serpentine units, **Alder Stream**, and **Seven Ponds**: "Gray fine- to medium-grained, waxy soapstone contains scaly to radiating, interleaved aggregates of nearly pure talc, conspicuous crystals of magnetite as much as 15 mm across, and some carbonate."

MALACHITE

$\text{Cu}_2(\text{CO}_3)(\text{OH})$

Alder Stream; **Blue Hill** - *Douglass M*, *Lady Elgin M*, *Revere M*; **Brooksville** - *Callahan M* (= *Cape Rosier M*); **Brunswick** - *Bagley Ledge Q*; **Castine**; **Eastport**; **Garland** - *Preble Hill M*; **Georgetown** - *Consolidated Q*; **Gouldsboro** - *Kerona P*; **Guilford** - *Guilford M*; **Hancock** - *Copperopolis M*, *Emmet M*, *Petit Manan M*; **Harpwell** - *road cut*; **Jim Pond**; **Lamoine**; **Litchfield**; **Lubec** - *Lubec Lead M*; **Milton** - *Mount Glines M*; **Newry** - *Nevel Q?*, *Scotty Q*; **Paris** - *Mount Marie Q*; **Pembroke** - *Big Hill M*, *Barrett P* (= *Dolsan Pit*); **Perry** - *Loring Cove A*; **Phippsburg**; **Steuben**; **Surry** - *Sunburst M*; **Topsham** - *Square Pit*; **Union** - *Union Q*; **Warren** - *Knox Q*; **Wiscasset** - *U.S. Route #1 road cuts*; **Woolwich** - *U. S. Route #1 road cut*; **T8R10 WELS** - *Ordovician slate*

Carpenter and Foster (1960) reported for **Brooksville**, "Malachite is apparently the rarest of the secondary minerals at the Cape Rosier deposit. It can be recognized by its occurrence as botryoidal aggregates of fibrous crystals and effervescence in acid." Malachite crystals (to 1 mm) and botryoidal coatings line cellular smithsonite-rich gossan at the Callahan mine, Brooksville. Fibrous sprays (to 2 mm) of malachite are found in vugs in talc matrix stained by black earthy tenorite at the Callahan mine.

Seaman (1975c) listed malachite from Bagley Ledge quarry, **Brunswick** and the Scotty quarry, **Newry**. At both locations the mineral was associated with chalcopyrite in pegmatite. Malachite, copper, and cuprite from the Nevel quarry, Newry were reported by King (1967), but the identifications were in error, being oxidized pyrite and iridescence only.

Malachite from the Guilford mine, **Guilford** consists of green films and patches (to 1 cm) on milky quartz fractures.

Emerald-green malachite crystals (to 2 mm) are found in quartz crystal-lined vugs (to 5 mm) in milky quartz at the Lubec Lead mine, **Lubec**.

Fibrous to almost prismatic malachite crystals (to 3 mm) are found in poorly crystallized quartz veins lined with brown limonite, pitchy to earthy black tenorite, chalcopyrite grains, and pyrite grains at the Barrett prospect, **Pembroke**. Some of the malachite crystals show triangular points of light reflecting from the terminations. The malachite forms stellate acicular radial aggregates. Azurite is occasionally associated.

Thin green films of malachite are found in fracture surfaces of iron-stained albite near pyrite and chalcopyrite masses (to 1+ cm) from the Square Pit, **Topsham**.

Malachite coatings were found abundantly on fractures in granite in road cuts along U. S. Route #1, **Wiscasset** and **Woolwich**, but acidic rain dissolved most of the exposed malachite quite quickly.

Hall (1966) noted in **T8R10 WELS**: "Locality B is about 800 feet upstream from Chandler Pond on the brook flowing

from Mathews Pond. Minor amounts of malachite are present in a thin bed of gray tuff interbedded with red Ordovician siliceous slate and chert." The locality is not far from the Pinkham Road.

manganapatite = manganoan fluorapatite (q.v.), usually fluorescent

Albany - Bumpus Q; **Auburn** - Greenlaw Q, Groves Q, Keith Q, Maine Feldspar Q; **Buckfield** - Bennett Q; **Greenwood** - Harvard Q, Nubble Q; **Newry** - Nevel Q; **Norway** - B.B. #7; **Paris** - Lower Hoopers Ledge P, Mount Marie Q, Mount Mica Q; **Rumford** - Black Mountain Q; **Stoneham** - Lord Hill Q

mangandolomite = manganoan dolomite

"manganese and/or iron" mineral

Hallowell - Longfellow Q

Smith (1923) reported of **Hallowell**: "Large areas of some of the joint planes in the Longfellow quarry are covered with frost-like crystallization of oxides of iron and probably of manganese." This mineral has never been studied and no specimens are known.

manganese ores

Ashland - Frenchville P; **Castle Hill** - Castle Hill Grange Hall P, Dudley P, Richardson P, Smith P; **TDR2 WELS** - Maple Mountain P, Nine Mountain/Bootfood Road A; **Hodgdon** - Benn P, Daggett Hill P, Haskell P, Henderson Hill P, Nickerson P, Westford Hill P; **Houlton** - Hovet Hill A; **Linneus** - Adams Mountain P, Stewart P; **Littleton** - Littleton Ridge P; **Mapleton** - Higgins P; **New Sweden** - Capitol Hill P, Gelot Hill P; **Oakfield** - Meduxnekeag Lake outlet A; **Perham** - Bugbee-Bragdon P, Fox-McIntyre P, Perham Church P, Spaulding School P; **Wade** - Aroostook River P, Bugbee-Bragdon P, Haines P, Silver P; **Woodland** - Anderson P, Grant P, Henderson School P, Lundgren School P; **T9R3 WELS** - Hovey Mountain P

The locations of the various manganese silicate ore deposits are described by Miller (1947) and Pavlides (1962). Many studies (White, 1943; Eilertsen, 1952; Skow et al., 1956; MacMillan and Turner, 1956) have been published concerning these deposits and their minerals. Castle Hill, TDR2 WELS, and T9R3 WELS areas have received the only detailed studies.

Miller (1947) said: "The Aroostook manganese ores are mineralogically complex. The manganese-bearing minerals are so finely disseminated that it is almost impossible to recognize them with the naked eye, and not easy to identify them even in the laboratory. Microscopic and x-ray studies have established, however, that the most abundant manganese mineral in both types of ores is braunite ... and that a pink form of bementite ...

is also common. Manganiferous carbonate is visible in some of the ore and is especially abundant in specimens from the Dudley deposit. The pinkest carbonate, which is also richest in manganese, approaches mangandolomite in composition. Manganiferous carbonate is probably also disseminated through much of the rock in which individual carbonate crystals are submicroscopic."

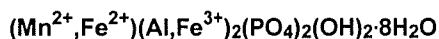
Of the Hovey Mountain prospect, **T9R3 WELS** and Maple Mountain prospects, **TDR2 WELS** ores, Miller (1947) reported: "Manganese minerals are so finely disseminated in the ore as not to be separately visible. They are presumed to be predominantly braunite and bementite, for the central district ores appear to be geologically and genetically similar to the ores of the northern district. The principal difference visible in the field is an apparent decrease in the amount of carbonate and increase in the amount of hematite."

manganesian garnet?

Patricktown? - David Patrick Farm A; **Phippsburg?** - The Basin L

Several reports of manganesian garnet by Jackson (1837a, 1839) have been supposed to be spessartine, but these reports may have been intended to indicate a faint qualitative chemical reaction for manganese. Although no obvious source of contamination is available to discredit the report, the Phippsburg locality is known to produce red to orange-red grossular. Alternatively, the color of the Phippsburg garnet may have been taken as an indicator of manganese content.

*MANGANGORDONITE (Paravauxite Group)



Newry - Dunton Q

The Dunton quarry, **Newry** is a co-type locality for mangangordonite along with the Foote quarry, Kings Mountain, North Carolina (Leavens et al., 1991). Mangangordonite is colorless and forms steeply terminated bladed crystals (to 1 mm) in vugs in blue tourmaline eyes. The mangangordonite can form on drusy quartz linings in blue tourmaline associated with yellow sphalerite (to 2 mm), lepidolite (to 3 mm), granular siderite (to 1 mm), and occasional foliated to massive snow-white fairfieldite (to 1 mm). Additionally, "toothy," less bladed mangangordonite can be cloudy gray and form in platy siderite crystal-lined vugs in blue tourmaline along with tapered carbonatian fluor-hydroxylapatite crystals (to 1 mm).

manganite?

Buckfield? - Bennett Q; **Newry?** - Dunton Q; **Rumford?** - Black Mountain Q

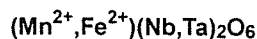
Many black minerals and stains have been presumed to be manganite, but the identifications have only been opinions. No data known.

Landes (1925) reported of the Bennett quarry, **Buckfield**: "Manganite is one of the commonest of the secondary minerals. It is widespread in the surface zone, even forming a fine film on quartz and cleavelandite. Thicker deposits are found on the minerals actually undergoing alteration, such as rhodochrosite and lithiophilite. In a very few specimens manganite coated psilomelane, preserving the botryoidal character of that mineral. In this case it was quite evidently derived from psilomelane, but it is very doubtful that all the manganite passed through a psilomelane stage. In one instance the alteration about the edges of dahllite into manganite was observed." The correct identification of these black minerals is uncertain. Lewis (1933) obtained a positive test for manganese on a specimen "believed to be manganite". No specimens known.

Fraser (1930) informally listed manganite from the Dunton quarry, **Newry**: "Later percolating waters developed heterosite, manganite or other manganese oxides..." Manganite was listed by Holman (1935) apparently as a continuation of Fraser's (1930) listing. The ubiquitous black stains from the Dunton quarry, principally found as bands marking the junction of one cleavelandite unit cutting another, have been investigated (George Rossman, personal communication, 1987) by infrared analysis and were found to consist of amorphous materials and, therefore, are not true minerals.

Burr (1930), Bailey (1930), and Morrill et al. (1958) listed manganite from the Black Mountain quarry, **Rumford** without description. No specimens known.

MANGANOCOLUMBITE (Columbite Group)



Andover? (= Black Mountain Q, Rumford?); **Auburn** - *Maine Feldspar Q*; **Buckfield** - *Bennett Q*; **Greenwood** - *Emmons Q*, *Harvard Q*, *Tamminen Q*; **Newry** - *Dunton Q*; **Norway** - *B. B. #7 Q*; **Paris** - *Mount Mica Q*; **Poland** - *Berry-Havey Q*; **Rumford** - *Black Mountain Q*; **Topsham**

Manganocolumbite is a member of the columbite (q.v.) group with a chemical composition of manganese greater than iron. Many specimens of supposed columbite are actually manganocolumbite, especially from known manganese-rich localities or assemblages (chemical analyses, this study). The composition of the particular member of the group is dependent on the paragenesis of the mineral. Specimens formed early in the crystallization of a pegmatite might be iron-rich, while those formed during replacement events, after enrichment of manganese occurred (or depletion of iron), might be manganese-rich. Manganocolumbite crystals frequently have a thin-bladed habit, but the habit is probably an expression of growth conditions

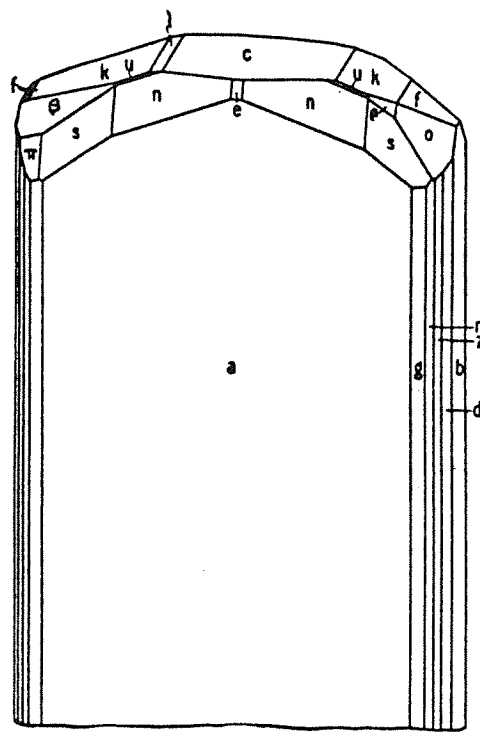
rather than the chemistry of the mineral. Manganocolumbites, especially those high in manganese, can have a few red internal reflections evident and the streak of the mineral can be brownish black rather than the black characteristic of columbite.

Manganocolumbite from the Maine Feldspar Quarry, **Auburn** is found in large thin plates (to 3 x 7 x 0.3 cm) embedded in tan-stained cleavelandite. The manganocolumbite blades are grouped in "house-of-cards" fashion when the cleavelandite is not considered. Numerous small brown zircon crystals (to 3 mm) are sometimes found studding the manganocolumbite crystal surface.

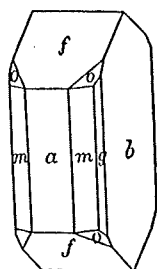
Black rectangular manganocolumbite crystals (to 5 x 1.5 x 0.3 cm) are found embedded in cream-colored cleavelandite at the Harvard quarry, **Greenwood**.

Thin black blades (to 2 x 0.8 x 0.2 cm) of manganocolumbite are found in albite at the Emmons quarry and the Tamminen quarry, **Greenwood**. Some specimens are almost intermediate between manganocolumbite and manganotantalite.

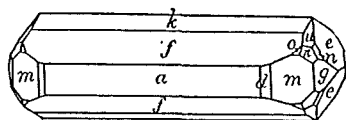
Manganocolumbite is found at the Dunton quarry, **Newry** embedded in cleavelandite and interlaminated with it. Plates to 10 x 10 cm have been found. Simple rectangular terminated and bladed crystals to 3 x 4 cm and larger are known. The crystals are interlaminated with cleavelandite and are wrought-iron-black without red internal reflections. Shainin and Dellwig (1955) reported specific gravity data of similar material and indicated that the mineral was nearly 50-50% manganocolumbite and manganotantalite. Chemical analyses (this study) have verified the mineral is tantalian manganocolumbite. The man-



Manganocolumbite, Dunton Q, Newry (from Fraser, 1930)



Manganocolumbite, Black Mountain Q, Rumford (from Foote, 1896)



ganocolumbite identification was first listed by Holman (1935). Manganotantalite (q.v.) of a different nature has been found at the Dunton quarry.

Manganocolumbite forms platy (to 4 x 4 x 0.2 cm) crystals frozen in cleavelandite sometimes associated with columnar to fibrous green tourmaline replacements (to 5 x 1 cm) of coarse muscovite (to 7 x 10 cm) at the Mount Mica quarry, **Paris**. Blue tourmaline eyes filled with carbonate and phosphate minerals can also be associated.

Black simple rectangular manganocolumbite crystals with slight red internal reflections embedded in or interlaminated with cleavelandite from the Black Mountain quarry, **Rumford** can be up to 10 cm in maximum length, but only 3 mm in thickness. Verrow (1941) reported: "*Manganocolumbite* - Is found in thin laminae in microcline and represents a replacement of microcline. Some of the plates are 4 to 5 inches square and quite thin. The plates are often iridescent." The identification has been confirmed by chemical analysis. Foote (1896) reported on the basis of specific gravity measurements that the crystals he figured were manganocolumbite, but the graph of Foote and Langley (1910) indicated that the mineral should be classed as a manganotantalite (q.v.). The physical description and habits illustrated by Foote (1896) agree with known manganotantalite specimens. Manganocolumbite occurs as thin black plates intergrown in cleavelandite and forms open stellate patterns.

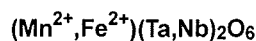
Lustrous flat, black laths (to 7 cm) of manganocolumbite (some of which approach manganotantalite), without matrix, have been found at unspecified localities in **Topsham** (Carl Francis, personal communication, 1991).

manganophyllite? (Mica Group)

Auburn? - "Mount Apatite"

Manganophyllite in the Thomas Lamb collection (MSB) from **Auburn** appears to be brown-stained lepidolite. Morrill et al. (1958) listed manganophyllite from Mount Apatite. The specimen observed does not appear to be zinnwaldite.

MANGANOTANTALITE (Columbite Group)



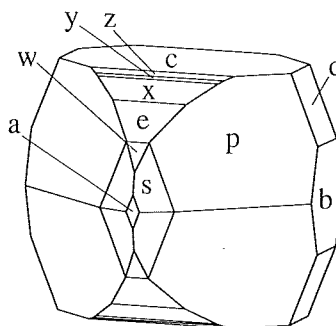
Auburn - Groves Q, Maine Feldspar Q?, Pulsifer Q; **Buckfield** - Bennett Q; **Greenwood** - Tamminen Q; **Newry** - Dunton Q, Rose Quartz Crystal L; **Rumford** - Black Mountain Q

Manganotantalite is a member of the columbite group (q.v.) and is closely related to manganocolumbite (q.v.). Although manganotantalite has the reputation of being a reddish orange to dark red mineral, intermediate composition crystals can be black. Manganotantalite is a species whose components become enriched in late stage pegmatite-forming processes and are, therefore, particularly found in "late stage" assemblages, especially cleavelandite matrix. The degree of enrichment varies from locality to locality, and manganocolumbite (q.v.) might be the actual species.

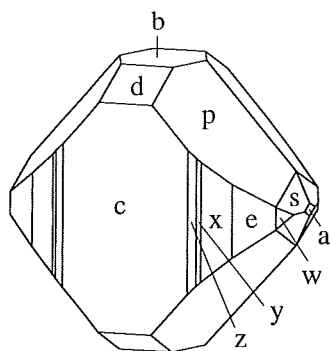
Schaller (1907, 1911) measured some small crystals of manganotantalite from an unspecified locality on Mount Apatite, **Auburn**, but if they were from a working quarry, they probably came from the Pulsifer quarry. The crystals were quantitatively analyzed without separate determination of niobium and tantalum. The mineral contained almost no iron and had a specific gravity of 7.14, which suggested a high tantalum content. Albite and lepidolite were the dominant associated species. The bladed crystals ("several millimeters in length") were measured crystallographically and were found to consist of eleven forms, one of which {320} was new to the species. The color of Schaller's (1907, 1911) crystals was probably dark red to red-brown. An unspecified Auburn specimen similar to Schaller's (1907, 1911) descriptions is preserved in the Harvard University collection.

Landes (1925) wrote of the manganotantalite from the Bennett quarry, **Buckfield**:

"A few small masses of manganotantalite appear, encroached upon and surrounded by quartz, cookeite, and apatite... They are all under one centimeter in diameter, and in most instances have lost their crystal boundaries, due to extensive attack of the solutions depositing the later minerals. ...



Manganotantalite, Pulsifer Q, Auburn (reoriented from Schaller, 1907)



Manganotantalite, Pulsifer Q, Auburn
(data from Schaller, 1907)

The Buckfield manganotantalite is dark brown and slightly translucent. Its [specific] gravity is 7.29."

Blocky, blackish-red manganotantalite crystals (to 5 cm), sometimes with a slight iridescence, were found in small cleavelandite-lined pockets during mining in the early 1980's (Ernest Schlichter, personal communication, 1990). During the 1992 mining season, some exceptional black manganotantalite crystals (to 4 x 4 cm) were found on cleavelandite with tan cookeite. Most of the larger specimens consisted of corrugated to "accordion-like" clusters with a matte luster, but one specimen consisted of a single crystal (3 x 3.5 cm) (Ronald E. Holden, personal communication, 1992; King, 1993a). The new Bennett quarry manganotantalite crystals rank among the largest of their kind in the U.S.A. The black manganotantalite has inclusions of wodginitite (q.v.) (Michael Wise, personal communication, 1992).

Starbird (1934) reported of the Dunton quarry, Newry: "*Manganotantalite* in *cleavelandite* and *Manganocolumbite* sparingly with *spodumene*." Shainin and Dellwig (1955) reported: "Both end members of the isomorphous columbite-tantalite series occur in the Newry Hill pegmatites. Tantalite has been found in the Dunton and Crooker pegmatites, and columbite has been identified in the Main pegmatite. Table 8 lists the results of determinations on these minerals. ... Fraser (1930, p. 358) published a drawing of tantalite [sic] from the Dunton pegmatite. Verrow (1940, p. 51) and Fraser (1930, p. 357) report 'manganocolumbite' from the Dunton pegmatite, but neither provides evidence in support of this variety." Fraser (1930) did not report *tantalite* from the Dunton quarry. It is clear that Shainin and Dellwig (1955) did not believe that the parallel manganese-rich series of minerals to the columbite/tantalite series, manganocolumbite/manganotantalite, was a truly separate series of species, but instead constituted "varieties" of columbite/tantalite. Shainin and Dellwig (1955) based their identifications in this group on their specific gravity. The large (to several cm) black plates in cleavelandite are generally niobium-rich and therefore manganocolumbite (q.v.). Shainin and Dellwig (1955) reported "tantalite" from the Dunton quarry based on specific gravity. Chemical

analyses of black tabular specimens from the Dunton quarry (this study) are variable in composition, but are manganese dominant, in every case. Manganotantalite from the Dunton quarry occurs as orange to orange-red irregular grains (to 2 mm) in fine to medium-grained lepidolite.

Red to orange doubly terminated manganotantalite crystals (to 7 mm) from Black Mountain quarries, **Rumford** are generally embedded in fine-grained "cleavelandite" which has a tan discoloration. Maine "manganocolumbite" was first announced from Black Mountain quarry (Foote, 1896), but the identification was made by specific gravity measurement (6.44) which indicated manganotantalite (Foote and Langley, 1910). The reddish brown color and crystal shape are also suggestive that the material was actually manganotantalite and this has been verified by chemical analysis (this study). Manganocolumbite (q.v.) does occur at the Black Mountain quarry, but has a different appearance.

MARCASITE

FeS₂

Blue Hill; Brooksville - Callahan M; Calais; Concord; East Moxie - Black Narrows A; The Forks - Black Narrows A; Georgetown - Consolidated Q; Katahdin Iron Works - Katahdin Iron Works M; Linneus - Drew Hill sulfide deposits; Monson?; New Portland; Paris; Portland? - Jewell Island A; Skowhegan - Central Maine Power dam excavation; Topsham? - Fisher Q; Union - Harriman P; Warren - Warren Nickel P; West Paris? - Perham Q; Winslow; T7R11 WELS - Cambrian slate

Marcasite is a scarce polymorph of pyrite. Due to its reputation as a mineral which will easily rust and decompose, many pyrrhotite specimens which exhibit this behavior have been erroneously called marcasite. Marcasite is not particularly magnetic and is distinguished from pyrrhotite which is usually magnetic.

Li (1942) listed of unspecified mines in **Blue Hill**: "Secondary minerals include marcasite (after pyrrhotite), covellite (after chalcopyrite), and hydrous iron oxide."

Park and Bastille (1973) reported marcasite from the Callahan mine, Harborside, **Brooksville** without description of the mineral. Bouley and Hodder (1984) wrote: "Park and Bastille (1973) also describe occurrences of safflorite, marcasite, arsenopyrite, and mackinawite as small blebs in pyrite," yet Park and Bastille (1973) did not specify the matrix in writing.

Houston (1954, 1956) said of the marcasite from Black Narrows, **East Moxie** and **The Forks**, and Katahdin Iron Works mine, **Katahdin Iron Works**: "Marcasite is particularly common at ... Black Narrows, and Katahdin [Iron Works mine] where it replaces pyrrhotite. The manner of occurrence of marcasite is very similar to that of the violarite except that it replaces pyrrhotite instead of pentlandite. Marcasite is much more abundant

in the weathered samples of the ore than in relatively fresh samples. For this reason it is thought to be a supergene mineral. There is an interesting contrast between the texture of the primary sulphides and this secondary mineral. In most of the deposits ... the sulphides characteristically occur as intergranular veinlets and do not as a rule cut across crystal grains. The marcasite, on the other hand, may occur between pyrrhotite grains, cut across grains, or almost entirely replace grains pseudomorphically. The veinlets are not smooth-walled like those of the primary sulphides; instead they have extremely jagged edges, leaving no doubt about a replacement origin (Plate 4, D)." Of the Katahdin Iron Works mine, particularly the marcasite from this locality, Houston (1956) commented: "Marcasite and hematite occur as alteration products of pyrrhotite. The marcasite alteration is confined almost entirely to the pyrrhotite, but hematite veinlets traverse the entire rock. Marcasite replaced the pyrrhotite along minute fractures which cut the oxidized pyrrhotite in all directions. The mass of replacing marcasite moved outward perpendicular to the fractures and developed irregular jagged contacts with the pyrrhotite. In some cases hematite developed in the center of the marcasite veinlets, but most of the hematite occurs as walled veinlets without the jagged edges typical of marcasite along contacts between sulphides and silicates. Many of the hematite veinlets have altered inclusions of both pyrrhotite and silicates."

Marcasite was reported from the Consolidated quarry, **Georgetown** (Morong, 1990): "small (5-mm) specimen found in late 1989 found here, in matrix typical of this quarry, with typical off-brass color and morphology of marcasite. Slightly altered." No specimens known.

Houston (1956) briefly reported on the sulfide veins in the Sam Drew Mountain marble quarry, **Linneus**: "Marcasite replaces the pyrrhotite along minute fractures in the mineral. The veinlets are small and replacement did not advance very far in the specimens examined."

Herbert Haven wrote in his diary (May 18, 1930)[Morrill, 1966] concerning **Portland**: "We went to Jewell's Island where in a pyritiferous slate, we found copperas, pockets of quartz crystals, pyrites, marcasite, kaolin and small black crystals not yet determined."

The renovation excavation (1958) for the Central Maine Power company dam on the Kennebec river yielded excellent silvery to brassy rhombic platy crystals and twins (to 7 mm) of marcasite in quartz impregnated brecciated phyllite, **Skowhegan**. The debris from the excavation was dumped on the shore near Mill street, but subsequent spring floods have removed most of the rock.

"Marcasite is not common in these [Harriman prospect, **Union** and Warren Nickel prospect, **Warren**] deposits. It is found only in those few polished sections containing pyrite, in which it comprises small irregular grains within the pyrite veins. The lack of alteration of pyrrhotite to marcasite and an intermediate product is unusual in view of the common occurrence of these minerals in pyrrhotite deposits. As previously noted, the paucity

of marcasite, as well as that of pyrite, indicates a relatively low sulfur fugacity" (Rainville and Park, 1976).

Wintringham (1962) wrote of **West Paris**: "Marcasite has been reported from the Perham Mine (West Paris), probably as the result of a mistake in identification of partially-decomposed pyrrhotite."

Hall (1966) noted in **T7R11 WELS**: "Pyrite and marcasite are common in the rusty-weathering Cambrian (€) dark gray slate. In this rock the sulfide is commonly concentrated as knots or crystalline rosettes in the hinges of minor folds."

MARGARITE (Brittle Mica Group)



Camden - Camden Hills A; **TE** - Smalls Falls A; **Rangeley**; **Stoneham?** - Harndon Hill A; **Winslow?** - Winslow Tin M

Berry (1987) wrote of the Camden Hills area, **Camden**: "The third metamorphic event was responsible for replacement of andalusite and sillimanite by sericitic muscovite and margarite, and replacement of biotite by chlorite. These replacements are complete in the southern and eastern parts of the area and affect the central part less intensely."

Margarite pseudomorphs after chialstolite crystals (1-3 cm) occur in phyllite from the Smalls Falls area, **TE** (Guidotti and Cheney, 1976): "The most interesting mineralogical feature of the pelites in the vicinity of Small's Falls is the development of chialstolite megacrysts with dimensions up to 3 cm in width and 15 cm in length. These megacrysts tend to lie within the foliation planes. In the specimens studied thus far the aluminum silicate has been completely converted to margarite. The margarite occurs as coarse sheaves which make up virtually all of the pseudomorph. Only minor quartz and the graphite of the original chialstolite are present as additional minerals in the pseudomorphs..." Guidotti and Cheney (1976) further noted that margarite was found only in pseudomorphs and that the groundmass of the rock contained muscovite.

Perkins (1924b) noted margarite from "Harndon Hill," **Stoneham**, but this may have been a confusion with the margarodite variety of muscovite which is well known from the Lord Hill quarry in that town.

Coarse-grained silvery "margarite" cleavages (1-2 cm) resembling muscovite were found lining ore veins in phyllite at the Winslow Tin mine, **Winslow**. The center of the veins contained cassiterite, white beryl, purple fluorite, etc. One specimen (Colby College) consists of a vug section (3 x 5 cm) with white "margarite" rosette crystals (to 5 mm) with milky white beryl crystals (to 1 cm) and cassiterite crystals. Some of the "margarite" rosettes show a coarse fan-shaped spray.

The first report of Winslow Tin mine margarite only listed the material (MMJ, May 28, 1880): "It [cassiterite] is associated with quartz, fluor spar, carb. of lime and margarite, running parallel with the slates." Similar reports were made in the *Maine*

Mining Journal on September 10 and November 26, 1880. Smith (1882) listed Winslow margarite, while Holman (1921) listed margarite and lepidolite.

Chemical analyses of several typical Winslow "margarite" specimens show them to be ordinary muscovite.

margarites = a kind of microlites (not the species microlite!)

Smith (1901) wrote of **Vinalhaven** acid volcanic rocks: "The darker lines are seen to owe their color to masses of black cumulitic grains, margarites, and trichites, minute crystallites, all of which, doubtless, have the composition of magnetite, being often connected with grains of that mineral." In this sense, margarites is a generic term used by petrologists for tentatively identified, or even unidentified, microcrystals (in this case-skeletal magnetite) within the groundmass of a volcanic rock.

margarodite (Mica Group) = variety of oily-lustered, yellow to nearly yellow-green muscovite

Rumford - *Black Mountain Q*; **Stoneham** - *Lord Hill Q*

Bailey (1929) noted "margarolite" from Black Mountain quarry, **Rumford**. Listed as margarodite by Bailey (1930), Morrill et al. (1958), and Gregory (1968a).

Coarse silvery to pale yellow muscovite with an oily luster from Lord Hill quarry, **Stoneham** has been called margarodite by Kunz (1884a₁): "*Margarodite* occurs here in abundance of a light yellowish oil-green color. The form of this mineral is nearly radiated."

MARIALITE (Scapolite Group)

$(\text{NaAlSi}_3\text{O}_8)_3(\text{NaCl})$

Raymond - *Camp Hinds P*; **Rumford?**

Marialite is an uncommon member of the scapolite group. Coarse white to tan scapolite prisms (to 2 x 2 x 4 cm) from an unspecified locality, **Raymond**: "... near the boundary between the towns of Raymond and Gray, and is perhaps in the latter" (Melville, 1893) have been called marialite, but no data are available. Herbert Haven noted finding marialite at the Camp Hinds prospect, Raymond in his diary entry for February 10, 1935 (Morrill, 1966). The Raymond marialite fluoresces moderate cream yellow in long wave ultraviolet light and only faintly the same color in short wave ultraviolet light.

marmatite = black ferroan sphalerite

Standish - *Route #25 road cut*

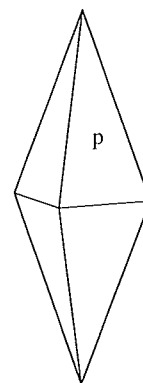
Marmatite is a black, iron-rich variety of sphalerite (q.v.). Much of the sphalerite found in Maine would qualify for this varietal name, but Dolloff (1936), reporting fine-grained black sphalerite from the Route #25 road cut, **Standish**, is one of the few authors actually to use this name in Maine.

***MCCRILLISITE** (Gainesite Group)

$\text{NaCs}(\text{Be,Li})\text{Zr}_2(\text{PO}_4)_4 \cdot 1-2\text{H}_2\text{O}$

Paris - *Mount Mica Q*; **Rumford?** - *Black Mountain Q*

The Mount Mica quarry, **Paris** is the type locality for mccrillisite (Foord et al., in press). Mccrillisite occurs very rarely as individual steeply pyramidal milky white crystals (to 1 mm) whose surface can have a crackled appearance. The mineral was found in a single boulder in blue elbaite eyes associated with albite, quartz, manganoan almandine, muscovite, siderite, rhodochrosite, fluorapatite, lepidolite, beryl, montebasite, cassiterite, manganocolumbite, uraninite, löllingite, zircon, eosphorite, moraesite, iron-rich roscherite, and kosnarite. Virtually no specimens exist outside of the type specimens. Francis et al. (1993) erroneously listed mccrillisite as coming from the Black Mountain quarry, Rumford previous to publication of the species.



Mccrillisite, Mount Mica Q, Paris

MEIONITE (Scapolite Group)

$(\text{CaAl}_2\text{Si}_2\text{O}_8)_3(\text{CaCO}_3)$

Casco - *Chute P*; **Cornish** - *Berry Ledge L, Day Hill L*; **Farmington** - *U. S. Route #2 road cut in Farmington Falls*; **Greenwood** - *Harvard Q, Tamminen Q*; **Lewiston** - *Robinson Mountain L*; **Lisbon** - *Tom Marquis P*; **Minot** - *Pitts-Tenney Q*; **New Limerick**; **Parsonsfield** - *Dr. Swett's fields, Stackpole's Tavern A*; **Phippsburg** - *The Basin L, The Basin Limestone Q*; **Sanford** - *Webster P, 200 m L, 600 m L*; *scapolite isograd* - **China, Vassalboro, Windsor**

Meionite is the common scapolite. It is found in varying amounts at virtually all of the calc-silicate collecting areas in Maine. Terminated crystals are scarce.

Fairbanks (1964) wrote of a locality in **Cornish**: "At the well-known haunt of the collector, the Berry Ledge, five miles north of Limerick, my son and I by considerable sweaty effort with an oversize crow-bar, opened up a sizable cavity or pocket. It was measurable in feet rather than inches. Attached to the cavity wall we found a completely unaltered pink scapolite crystal about six inches in length. It may have been the first gem quality scapolite ever to be reported in the United States. The other abundant scapolite at the deposit had been altered to an opaque-appearing white [sic] by circulating hot waters." Chalky white crystal sections with simple rectangular prisms (to 1 cm) are better known from this road cut.

Fisher (1948) described the Robinson Mountain vesuvianite locality, **Lewiston** and reported: "Scapolite is sparingly present and the variety meionite (figure 4) was determined by immersion oils." The figure showed irregular white patches (to several cm) of meionite projecting into calcite-filled vugs.

Jackson (1838a) noted scapolite with egeran, pargasite, etc. in Dr. Swett's fields and near Stackpole's Tavern, **Parsonsfield**. The localities are lost.

The so-called 200 meter and 600 meter prospects, and the Webster prospect in the Goodall Farm A, **Sanford** have yielded good white, square cross-sectioned crystals embedded in calcite associated with diopside crystals (to 5 mm), tan to light brown titanite crystal groups (to 2 cm), occasional molybdenite crystals (to 1 cm), actinolite needles (to 2 x 0.2 cm) and red grossular crystals (to 1 cm). Vesuvianite is only occasionally directly associated. Large subparallel groups (to 10 x 10 cm) of crystals (3-4 cm by 0.5 x 0.5 cm) are known. The Sanford meionite sometimes has an earthy white surface with a glassy interior. In short wave ultraviolet light, the meionite from Sanford has a dull pink response, but under long wave ultraviolet light the response is slightly more evident and is a paler pink, closer to white. The fluorescence of meionite is not diagnostic as the andesine and calcite at the locality also fluoresce dull pale pink, with variations which may be systematic, but vague. Fluorite (q.v.), scheelite (q.v.), and powellite (q.v.) also occur as fluorescent minerals at the Sanford localities, but they fluoresce in different colors than meionite.

Ferry (1976) mapped a scapolite isograd in **Vassalboro**, **China**, and **Windsor** and gave an analysis of a meionite.

melanterite? - apparently a post-mine growth

Acton?; **Bowdoin?** - *Coombs Q*; **Brooksville?**; **Concord?**; **Dixfield?**; **Greenwood?**; **Katahdin Iron Works?** - *Katahdin Iron Works M*; **Saco?**; **Stoneham?** - *Lord Hill Q*; **Wales?**; **Winthrop?**; **York (Ogunquit?)** - *gravel pit*;

Burr (1930), Morrill et al. (1958), and Morrill and Hinckley (1959) listed several "melanterite" occurrences probably on the

principle that most presumed sulfates or copperas occurring as efflorescences contain melanterite. The identification and natural origin have not been demonstrated and most specimens probably are post-mine in deposition or formation.

Acord (1976) listed melanterite without description from the Coombs quarry, **Bowdoin**.

Zodac (1961) reported of two rocks found in an old gravel pit in Ogunquit, **York**: "They consist of dark smoky quartz xls coated by drusy milky quartz on massive smoky quartz and all coated by yellow melanterite."

Anonymous (1948) noted of Lord Hill quarry, **Stoneham**: "melanterite (coating pieces of pyrite)."

menaccanite = ilmenite

Nile Brook - **Dallas, Rangeley**

Bartlett (August 6, 1880) reported of Nile Brook, **Rangeley** and **Dallas**: "Mr. King has quite a quantity of gold that he and his assistants have washed out of the black sand in that country and he is strongly of the opinion that a profitable business might be commenced with a small outlay of capital. ... The black sand proved to be menaccanite or titaniferous iron, containing over 25 per cent of titanium."

MESSELITE (Fairfieldite Group)

$\text{Ca}_2(\text{Fe}^{2+}, \text{Mn})(\text{PO}_4)_2 \cdot 2\text{H}_2\text{O}$

Newry - *Bell Pit*

Messelite is the ferrous iron-rich member of the fairfieldite (q.v.) group. Some of the sheaves of waxy, tan to light golden brown crystals (to 3 mm) of messelite are found implanted on the drusy lilac fluorapatite which lines fractures in the Bell pit, **Newry**. A survey of the chemistry of specimens of the group (this study) indicates that both fairfieldite and messelite are present at the Bell Pit, but they occur in different associations (environments) - they are otherwise visually indistinguishable and cannot be distinguished by X-ray diffraction.

metasericite (Mica Group) = sericite

Topsham

Greenish yellow fine-grained muscovite coatings on microcline from **Topsham** have been called metasericite for no apparent reason (CC unnumbered).

metastibnite

Linneus - *Drew Hill sulfide veins*

Metastibnite is an amorphous, naturally occurring antimony sulfide which is variously ranked with the minerals or not regarded as a separate species due to its amorphous nature. The material has been observed as a component of red earthy coatings admixed with schafarzinkite (q.v.) associated with valentinite and sulfur on fractures in fine-grained stibnite and quartz from the Drew Hill sulfide veins, **Linneus** (Robinson and King, 1991a,b; King, 1991b).

mica group - see annite, biotite, damourite, lepidolite, margarite, metasericite, muscovite, paragonite, phlogopite, sericite, zinnwaldite

The micas actually constitute a "super group" of minerals. Some authors include all phyllosilicates (including stilpnomelanes) in the micas while some authors recognize the "true micas", "brittle micas", chlorites, talc/pyrophyllite group, serpentines and kaolinites, etc.

The physical distinctions between the true micas, brittle micas, and the chlorites are that the true micas are flexible and elastic (to a point). A cleavage flake of true mica "slightly" bent will return to its original shape. Chlorite flakes (flexible but inelastic) will bend without breaking, while brittle micas will break when similarly bent (inflexible). Individual specimens might appear to violate the physical properties assigned to their group and so are not good characteristics to use for field identifications.

MICROCLINE (Feldspar Group)

(K,Na)AlSi₃O₈

Albany - Bumpus Q, Coe Q, Donahue Q, French Mountain P, Johnson Q, Lowe P (= Harriman Brook P), Pingree Ledge Q, Scribner Q, Songo Pond Q, Sterns P, Wardwell Q; **Appleton** - Lincoln Sill A; **Auburn** - Greenlaw Q, Keith (= Towne) Q, Maine Feldspar Q, Pulsifer Q, Wade Q; **Batchelders Grant** - Peabody Mountain Q; **Blue Hill** - Black Hawk M (var. amazonite); **Boothbay Harbor** - Lincoln Sill A; **Bowdoin** - Bracket Q, Coombs Q, Gustin Q, Higgins Q, McIver Q, Ordway Q, Powers Mountain Q; **Bowdoinham** - Booker Q, Brosso Q, Consolidated Q, Jack P, Purington Q, Rogers Q, Umberhind Q; **Bridgton** - Route #117 road cut; **Brunswick** - Dwelly Q, Garland Q, LaChance Q, Larrabee Q, Morse Q; **Buckfield** - Bennett Q, Bessey Q, General Electric Q, Irish Q, Wemco Q, Westinghouse Q (=Dudley Ledge Q); **Canton** - Pleasant Pond A (moonstone); **Casco** - road cut; **Cornish?**; **Deer Isle** - rapakivi granite; **Edgecomb** - Edgecomb Q; **Ellsworth**; **Frankfort** - Mount Waldo; **Franklin** - Bradbury and Sons Q; **Freeport** - Taylor Q; **Friendship** - Jameson Point; **Fryeburg** - Eagle Gray Q; **Georgetown** - Consolidated Q, Cummings Q, Golding Q, Moffat Q, Oliver Q, Todds Bay Q; **Gilead** - Peaked Hill Q, Wheeler Q; **Greenville** - Route #15 road cut; **Greenwood** - Emmons Q, Harvard Q, Heikkinen Q, Mustonen Ledge Q, Nubble Q, Ohtonen Q, Tamminen Q, Tamminen Senior

P, Tiger Bill Q; **Hebron** - Harlow Q, Hibbs Q, Mills Q (probably located in Paris), Mount Rubellite Q, Sanitarium Q; **Litchfield** - Dennis Hill A; **Livermore** - Route #4 road cut; **Lovell** - Durgin Mountain A, Maxim Q, Oak Hill Q; **Marshfield** - Marshfield Granite Q; **Mount Desert** - Halls Quarry village A; **Mechanic Falls** - Conroy Q; **Minot** - Giddings Q, LaFlamme Q, Phillips Q, Pitts-Tenney Pegmatite L, Stinchfield Q, Sturtevant Q; **Newry** - Bell Pit, Dunton Q, Nevel Q; **Norway** - BB #7 Q, Dunn Q, Horse Hill L, Ordway Q; **Orland** - Orland Q; **Oxford** - Jordan Q; **Paris** - Colby Q, Ellingwood Q, Elm Hill Q, Glover Q, Hoopers Ledge Q, Little Singepole Q, Lower Hoopers Ledge P, Mount Marie Q, Mount Mica Q, Ryerson Hill Q, Slattery Q, Stony Brook Q, Twitchell Q, Whispering Pines Q; **Phippsburg** - McKay Farm Q, Parker Head Feldspar Q, Thomas Q; **Poland** - Berry-Havey Q; **Pownal** - Hinkley P, Little Bradbury Mountain L, Lower Tryon Mountain Q, Upper Tryon Mountain Q; **Rumford** - Black Mountain Q, Goddard Ledge Q, Red Hill Q; **Southport** - Yacht club A; **Southwest Harbor** - Allan Q, Sea Wall A; **Standish** - Oak Hill L; **Stoneham** - Aldrich Q, Andrews Q, Barbour Q, Cole Q, Lord Hill Q, Warren Q; **Stonington** - Crotch Island Q; **Stow** - Upper Colton Hill P; **Sullivan** - Hopewell Granite Q; **Sumner** - Heikkinen Q, Mount Tom Q; **Topsham** - Consolidated #1 Q, Consolidated #2 Q, Fisher Q, Mallet Q, Mount Ararat Eastern Slope Q, Mount Ararat Northern Slope Q, Railroad Q, U.S. Route #1-95 road cut, Russell Brothers Q, Square Pit, Standpipe Hill Q, Trenton Q, William Willes #1 Q; **Vienna** - Nurse Q; **Vinalhaven** - Hurricane Island Granite Q; **Waterboro** - Brenner Farm A; **Waterford** - Saunders Q, Willis True Q; **West Bath** - Davis Q; **West Paris** - Perham Q; **Woolwich** - Trott Cove Q

Microcline, also called potash feldspar and K(potassium)-feldspar, is one of the important industrial minerals from granite pegmatites and was mined for its ceramic properties and other uses. It is a major component of granites, granite pegmatites, granodiorites, gneisses, etc. Most of the microcline granite pegmatite localities were interesting for the tonnage of ore that could be produced and will generally have no interest for collectors. Few really good microcline crystal localities have been found in the state. Several pegmatites have yielded small microcline crystals near their core zones, however. Seaman (1975c) noted that microcline crystals to "six feet" were found at French Mountain, **Albany** and to "eight feet" at Black Mountain quarry, **Rumford**. Bastin (1907) noted of microcline: "In others single crystals of nearly pure feldspar may be 20 feet across..." but no specific locality was given. Palache (1932) credited the entry to Maine as an example of the world's largest microcline crystals. Hanley et al. (1950) reported of the Devil's Hole pegmatite, Fremont County, Colorado: "The mass of microcline exposed in the north face of the main open-cut is about 75 feet wide and 40 feet thick at the maximum and has an area of 2,337 square feet, yet individual cleavage planes extend unbroken across the entire mass, which is probably a single crystal." Rickwood (1981) regarded this Colorado crystal to represent the largest reliable report of the species. Microcline frequently has sub-parallel

threads, bands, or elongated patches of albite which are generally only several mm wide but which can extend across the entire cleavage of the specimen. Such intergrowths are called perthite (q.v.).

Many early references to Maine pegmatites (e.g. Bastin, 1911) refer to microcline by the name orthoclase (q.v.) apparently based on a lower degree of twinning observed in thin section examination. While the distinction between microcline and orthoclase is somewhat transitional, depending on the specific ordering of its chemical components, Maine granite pegmatite microclines tend to be near "maximum microcline" in structural state, while orthoclase tends to be present in hotter, eruptive igneous rocks. Maine pegmatitic microcline is generally white to cream white to tan in general color. Pink to salmon pink microcline is uncommon in Maine pegmatites, but fairly characteristic of some "granites" and feldspathic gneisses.

Hess et al. (1943) analyzed a large number of Maine pegmatitic microcline specimens and found that microcline from the Dunton quarry, **Newry** had Rb_2O about 3.0 weight percent. They compared the specimen with microcline from the Ilmen Mountains, Russia (3.12 %) and Varutrask, Sweden (3.3 %), but Hess et al. (1943) used an estimated value from spectroscopic analysis rather than having determined the amount directly. Clarke (1892, 1900c) analyzed **Litchfield** microcline. Bastin (1907, 1910, 1911) summarized feldspar mining in Maine.

The Wardwell quarry, **Albany** has produced numerous white to creamy white, sharp, blocky microcline crystals (to 1 m) frozen in quartz. Additional pegmatite quarries in Albany contain euhedral microcline crystals in quartz. The microcline crystals (to several cm) from the Wentworth prospect, Albany are so-called salmon colored, while the microcline crystals (to 5-10 cm) from the Scribner quarry, Albany are creamy white to tannish pink. One creamy white microcline crystal from French Mountain, Albany (HU collection) is about 50 x 50 x 30 cm.

Trefethen (1937) described the Lincoln Sill: "*Coarse-grained, massive, porphyritic type.* - In its typical and most readily recognizable form the rock of this sill is a coarse-grained porphyritic syenite with large phenocrysts of dark-colored feldspar and a groundmass of biotite and hornblende with subordinate feldspar. The phenocrysts reach an observed maximum of $3\frac{1}{4}$ inches in length. They are typically euhedral to subhedral and generally twinned on the Carlsbad law. They frequently contain cracks filled with groundmass material. Orthoclase dominates with, however, much microcline, or perthite, in combinations. Characteristically, these phenocrysts are crowded with minute inclusions, many of which are brownish globules of indeterminate composition, possibly rutile." Large Carlsbad twins of pinkish gray microcline have been found in northwestern **Appleton**, near the Burkettville village gravel pit where a portion of the Lincoln Sill is well exposed. Perkins (1922c) called microcline crystals from the Lincoln Sill in **Boothbay Harbor** incorrectly by the name labradorite.

The feldspar from The Maine Feldspar quarry, **Auburn** and nearby quarries was noted for the high quality of the mineral, and

users were willing to pay a premium for this feldspar. Bastin (1910) gave a chemical analysis indicating a high soda content which would fuse at a low temperature. By comparison, the Consolidated (Golding) quarry, **Georgetown**, was shown to have half the soda content (Bastin, 1907, 1910).

Peculiar gray microcline crystals and fragments (to many cm) have been found with isolated globular cookeite overgrowths in gem tourmaline pockets at the Bennett quarry, **Buckfield**.

Blocky tan microcline crystals (to 3 x 5 cm) have been found in quartz from the Dwelly quarry, **Brunswick**.

Stewart (1956, 1959) wrote of the microcline mantled by albite (rapakivi texture) in granite on **Deer Isle**. Rapakivi granite is exposed in Stonington and is quarried at the Crotch Island quarry. The rapakivi texture is seen as white collars (to several cm) on pink to red microcline cores (to several cm). The maximum sizes are not additive and feldspar grains vary from completely microcline to completely resorbed by albite.

Carlsbad-twinned tan microcline crystals (4 x 6 cm) were occasionally found at the Tamminen quarry, **Greenwood**. Blocky microcline crystals (to 13 x 9 cm) in quartz have been found at the Nubble quarry, Greenwood.

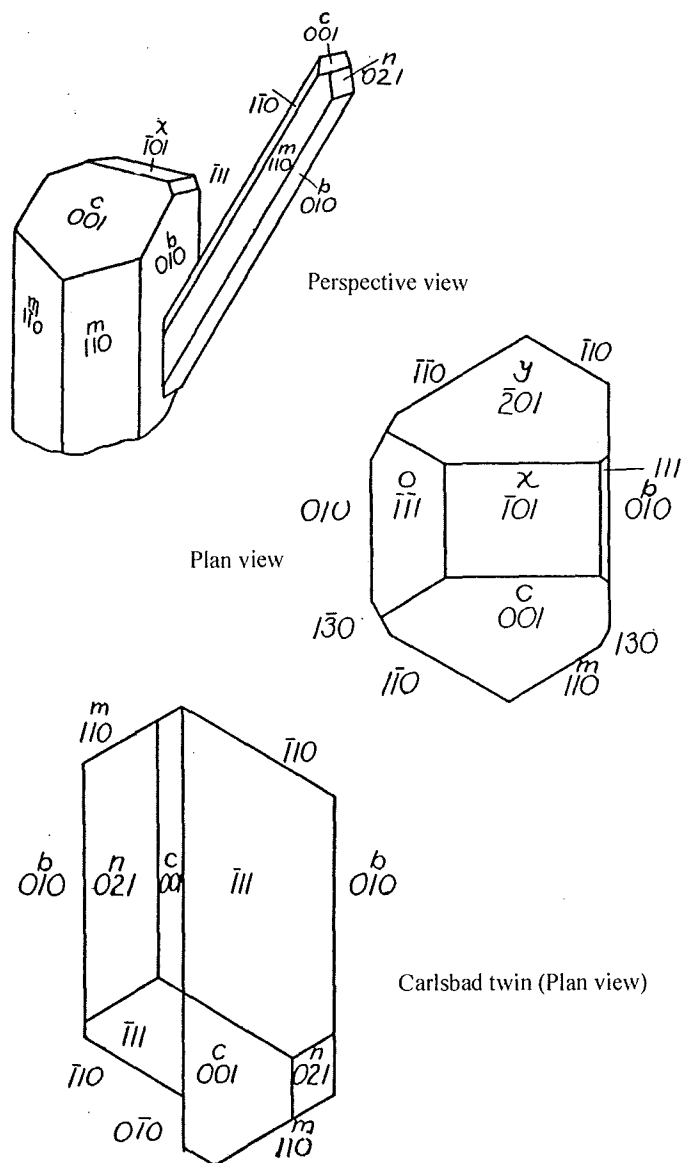
Sharp microcline crystals (30-60 cm) frozen in quartz are found on the Ernest Bartlett property on eastern Durgin Mountain, "6 km N 30° W" of North Lovell, **Lovell**.

The "Lower Tunnel" of the Nevel quarry, **Newry** produced a tan to orange stained microcline crystal (21 x 12 cm) (HU 97581) which was originally frozen in quartz, but is now isolated.

One of the most famous "lost" microcline localities in Maine is the group of narrow pegmatites (generally 15-30 cm) on Horse Hill, **Norway**. MacKenzie (1923) figured the crystallographic relationships of coexisting microcline and oligoclase (q.v.) crystals which were apparently collected from a small prospect, perhaps only worked by hand tools or a single blast of dynamite. The crystals of microcline were frequently Carlsbad twinned and were up to 110 x 50 x 83 mm. (Horse Hill extends into the town of Oxford, but the report specified "Norway." Manchester and Bather (1918) indicated the locality was on the Ordway farm.)

Amazonite, a blue-green variety of microcline, has been reported from the Mount Mica quarry, **Paris**, but the mineral appears to be a light grass-green cleavelandite. The amazonite color appears to fade due to evaporation of intergranular moisture and/or exposure to sunlight. Kunz (1892a) noticed the Mount Mica quarry, Paris and the Mount Desert Island "amazonite" and, perhaps exaggeratingly indicated that some specimens "... would cut into fair gems..." Several Maine pegmatites have produced green plagioclase which looks like amazonite.

Medium-sized (10 x 8 cm) tan microcline crystals were found embedded in smoky quartz at the Upper Tryon Mountain quarry, **Pownal**. An outstanding Baveno-twinned microcline crystal (14 x 3.5 x 3.5 cm) has been found on Little Bradbury Mountain, Pownal (Herbert Haven collection, now at Colby College).



which pervade it; vivianite ... and siderite ... xls have been found recently in some of these veinlets."

MICROLITE (Pyrochlore Group)



Albany? - Bumpus Q; **Auburn** - Greenlaw Q, Pulsifer Q; **Brunswick** - LaChance quarry; **TD** - Bemis Stream P; **Georgetown** - Tourmaline P; **Gorham?** - Dundee Falls A; **Greenwood?** - Harvard Q; **Newry** - Dunton Q, Rose Quartz Crystal L; **Paris** - Mount Mica Q; **Poland** - Berry-Havey Q; **Rumford** - Black Mountain Q; **Stoneham?** - Lord Hill Q; **Topsham** - Fisher Q

Microlite is a member of the pyrochlore group. Microlite is by far the most common member of the group found in granite pegmatites. Some reports of pyrochlore were made when considerable uncertainty existed on the status of microlite (King and Teixeira, 1993).

Supposed microlite from the Bumpus quarry, **Albany** has been observed to be actually rusty almandine crystals.

The Pulsifer quarry, **Auburn** has produced dark amber to yellow-brown microlite octahedra (to 8 mm), sometimes showing multiple growth faces. The microlite is found intergrown with cleavelandite or in interstitial voids between the cleavelandite lamellae.

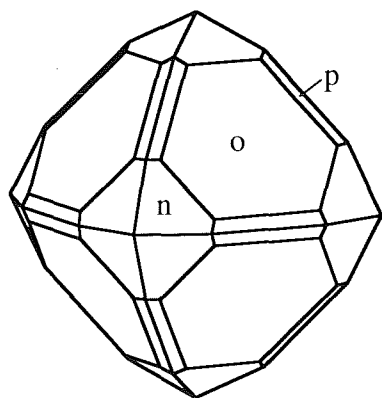
Greenlaw quarry, Auburn microlite can consist of gemmy yellow-green to yellow octahedra (to 4 mm) modified by dodeca-

hedral faces and embedded in a fine-grained (1-3 mm) matrix of lepidolite overgrowths on rhombic muscovite crystals in fine-grained albite, all intergrown with small (1-2 mm) patches of fine-grained white cookeite. The Greenlaw microlites can have these mica crystals as ophitic inclusions and can have a slight orange stain along their contact with the matrix. Also from the Greenlaw quarry, some very unusual butterscotch-colored microlite crystals (to 2 mm) have been found in interlocking clusters (to 1 cm) in cleavelandite. The unusual feature of the microlite is the presence of rare faces. The usual octahedral habit is combined with nearly equally developed etched trapezohedral faces and prominent trisoctahedral etched faces. Lepidolite "stacks" (to 5 mm) with serrated muscovite fringes can also be associated along with a scaly muscovite coating.

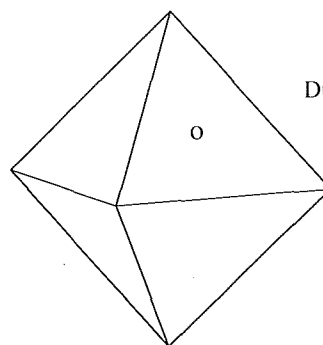
Rounded complex octahedral crystals of brown microlite (to 2 mm) are found in vugs in albite at the LaChance quarry, **Brunswick**. Broken pieces show a resinous, but not metamict appearance. Sometimes the microlite occurs as brick-red grains (to 1 mm) with columbite crystals.

Bright lemon-yellow octahedra of microlite (to 4 mm) have been found embedded in cleavelandite along with spessartine crystals (to 2 mm) at the Bemis Stream prospect, **Township D**.

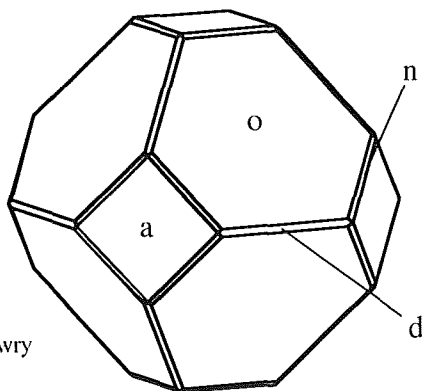
Fairbanks (1954) reported microlite from a bizarre assemblage in Gorham: "Dundee Dam ... Large crystals of orange microlite. Had previously found poor crystals brown in color but this new find was much better. Also a 200 lb. mass of spodumene containing unaltered blue bladed kyanite. A small mass was green in color but definitely not of gem quality." Morrill et al.



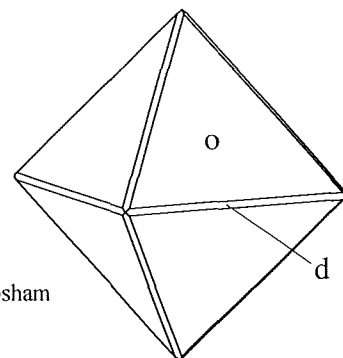
Greenlaw Q, Auburn



Dunton Q, Newry



Dunton Q, Newry



Fisher Q, Topsham

Microlite

(1958) listed "Orange Microlite Xls" from the Dundee Falls area, **Gorham**. The mineral microlite is ordinarily restricted to granite pegmatites and usually to their replacement units. While the specific entry for the locality appears confidence inspiring, the lack of subsequent specimens or "suitable" host rocks suggest that some other "orange" mineral was encountered such as low-iron rutile, etc. Additionally, kyanite and spodumene in the same rock is an unbelievable assemblage. No specimens known.

Irregular and rounded stained garnet crystals (to 3 mm) embedded in fine scaly cleavelandite on smoky quartz from the Harvard quarry, **Greenwood** have been sometimes misidentified as microlite.

Yellow to brown microlite crystals (to 1 cm) are known from the Dunton quarry, **Newry**. The crystals are simple octahedra and are frozen in lepidolite, quartz, cleavelandite, green elbaite, rarely blue or pink elbaite, and, occasionally, montebrazite or pollucite. Most crystals are cloudy to translucent. Gregory (1973) illustrated a microlite from the Rose Quartz Crystal locality, Newry.

Golden yellow to brownish green microlite grains (to 1 cm) are found embedded in lepidolite-bearing aplite at the Berry-Havey quarry, **Poland**. The microlite grains, or scarce golden yellow octahedra, can have an orange-stained halo around them in the aplite. Small (1 mm) manganocolumbite crystals can be associated.

Microlite from Black Mountain quarry, **Rumford** is very interesting. It was first announced, "Very beautiful crystals of microlite averaging 2^{mm} in diameter of a honey-yellow color and high luster are found sparingly at the locality. The prevailing form is the octahedron, modified by the dodecahedron and sometimes by the icositetrahedron, 113. The habit is then very much like that of the pyrochlore figured on page 762 of the sixth edition of Dana's Mineralogy" (Foote, 1896). The usually transparent microlite is generally embedded in cleavelandite along with manganotantalite (to 25 mm) and lepidolite (to 7+ mm). Bjareby (1965a) wrote: "Microlite has been found here as brilliant tan colored octahedra but also in xls showing very complex twinning [sic; twinning is probably misidentified here]."

Yellow-green octahedral fluorite crystals (to 2 mm) embedded in clear topaz from Lord Hill quarry, **Stoneham** have been misidentified as microlite.

Bright emerald-green to pale yellow-green microlite crystals (to 8 mm) were found in cleavelandite in the Fisher pocket, Fisher quarry, **Topsham**. The microlite was originally thought to be gahnite (Palache, 1934), but it was later shown to be misidentified (Palache and Gonyer, 1940). The microlite is unique for its color. Microlite is found in crevices in cleavelandite as well as between cleavelandite lamellae. The microlite frequently shows a flattened and interrupted habit when in cleavelandite. The microlite is sometimes found on lepidolite and not uncommonly embedded in fine-grained muscovite along with indicolite tourmaline crystals (to 8 mm). Most crystals are translucent, but transparent crystals are not rare. Frequently the microlite is seen in a flat zone in the cleavelandite, but it also can occur with

indicolite on the surface of cleavelandite rosettes, which in turn have a thick coating (to 5 mm) of tan to brown sericite. Palache and Gonyer (1940) wrote: "With few exceptions the Topsham microlite is green, a color not before recorded for this mineral. ... The dominant form of the crystal is octahedral with an occasional narrow face of the dodecahedron. There are, however, numerous extreme distortions which give the appearance of a hemimorphic hexagonal crystal. ... The largest crystal is one half of an octahedron an inch on an edge; it is implanted on sericite with an irregular bounding surface." Palache and Gonyer (1940) noted the association of microlite embedded in topaz, enclosed in lepidolite, implanted on tourmaline, and encrusted with stibiotantalite. The chemical analysis of Palache and Gonyer (1940) indicates that the Fisher quarry microlite is devoid of chromophores except for minor amounts of uranium and rare-earths and these elements, along with the non-metamict character of this microlite, probably account for the unusual color. Brown octahedral microlite (to 4 mm) crystals (chemical analysis this study) on cleavelandite crystals are also known from the Fisher quarry.

microlites = a generic term always used in the plural sense; unidentified, microscopic structures or crystals, usually found in glassy volcanic rocks

Merrill (1883) wrote of **Sullivan** granite: "Magnetite, in the form of small rounded grains, is usually very plentiful, together with very many colorless microlites such as were noticed in the Jonesboro rock."

millerite?

Casco?

Folklore has suggested that millerite was found in **Casco**. No references or specimens known.

MIMETITE (Apatite Group)

Pb₅(AsO₄)₃Cl

Garland - Preble Hill M

Mimetite from the Preble Hill mine, **Garland** is found in several habits. Pale green simple hexagonal prisms with "c" pinacoids individually placed on matrix characterize the Preble mine mimetite. The crystals (to 1 mm) show the slightly tapering effect seen on mimetite from many worldwide locations. Alternatively, the mimetite can be transparent colorless hexagonal crystals (to 1 mm) with pyramidal terminations arranged in clusters with a flat radial pattern. The main sulfides at the mine are galena and arsenopyrite, but the matrix consists of limonite-stained vugs in milky quartz sometimes with red-brown siderite crystals (to 1 mm). Semi-quantitative chemical analysis (this

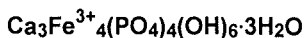
study) of the clear mimetite indicates that it is very nearly of end-member composition.

mineral C = wölsendorfite (q.v.)

Newry - Dunton Q

mispickel = obsolete name for arsenopyrite

MITRIDATITE (Mitridatite Group)



Greenwood - Emmons Q; **Newry** - Bell Pit, Dunton Q; **Paris** - Mount Mica Q; **Poland** - Berry-Havey Q; **Rumford** - Black Mountain Q; **Stoneham** - Lord Hill Q

Mitridatite is a very late-formed mineral in phosphate-bearing pegmatites. It is usually found as a coating in small vugs (less than 1 cm) and frequently has additional late phosphates associated.

Mitridatite is found in vugs (1-5 mm) of altered lithiophilite at the Emmons quarry, **Greenwood** in association with rhodochrosite/siderite. The avocado-green earthy mineral coats vugs in the carbonate, and secondary phosphates such as stewartite, strunzite, and hydroxylapatite can be associated.

Bell Pit, **Newry** mitridatite is a slightly gleaming, but mostly earthy avocado-green coating on siderite. The coating usually lines the entire vug (1-4 mm) and faithfully reflects the shape of the underlying minerals. Diadochite is frequently associated as well as other late phosphates such as rockbridgeite, laueite, occasional eosphorite, etc.

Botryoidal dark avocado-green mitridatite is found with siderite/rhodochrosite from the Dunton quarry, **Newry**. A black highly lustrous botryoidal mineral is frequently associated. Rarely, dark grass-green pseudohexagonal mitridatite crystals (less than 1 mm) are found in cavities in fractures in heterosite which are lined by massive tan hydroxylapatite.

Small altered phosphate blebs (1-10 mm) in black-stained quartz/cleavelandite/muscovite pegmatite at Mount Mica quarry, **Paris** can have a cellular internal structure and be composed mostly of muddy brown to greenish brown earthy mitridatite. Stewartite, siderite, strunzite, and laueite can be associated.

A thin light avocado-green dusting of mitridatite is sometimes found in the siderite/rhodochrosite assemblage at the Berry-Havey quarry, **Poland**. Rockbridgeite, stewartite, and other secondary phosphates can be found on the mitridatite. When associated with pink rhodochrosite, the mitridatite can be found coating fairfieldite crystals and/or rhodochrosite crystals.

Mitridatite is a rare mineral at the Black Mountain quarry, **Rumford**. It is found as a thin earthy to waxy brown to avocado-green coating on siderite/rhodochrosite. Other phosphates are not usually associated.

MOLYBDENITE

MoS₂

Alder Stream; **Argyle**; **Auburn**; **Augusta**; **Belfast**; **Blue Hill** - Blue Hill Bay A, Blue Hill Falls, Camdage Farm M, Long Island A, Trio M; **Bowdoinham**; **Bradstreet** - Catheart Mountain A; **Brunswick** - Androscoggin River falls A, sewer excavation; **Buckfield?** - Flagg Farm P; **Calais**; **Caratunk**; **Carmel**; **Charlotte** - Charlotte road cut; **Cooper** - American Molybdenum Company M, Calais Mining Company M; **Damariscotta**; **Eustis**; **Franklin** - Bragdon Q; **Frenchport** - Mosquito Mountain Q; **Greenwood** - 6 miles north of Norway village; **Hebron**; **Jackman?** (= **Bradstreet?**); **Jim Pond**; **Litchfield** - Roths Pasture A on Dennis Hill; **Littleton** - Henderson Farm P; **Marshfield** - Marshfield Q; **Minot** - Pitts-Tenney Q; **Mount Desert** - Pretty Marsh Harbor A, Pretty Marsh mills A; **Newfield** - Bergendahl Farm A, Symmes Pond stock; **New Limerick** - Nickerson Lake pluton; **Norridgewock** - Dodding Hill Q; **Norway**; **Paris** - Crocker Hill M, Mount Mica Q; **Pownal** - Hinkley P; **Sanford** - Webster P; **Surry** - outcrop Surry-Blue Hill line; **Topsham** - Androscoggin River falls A, Square Pit, Power Plant Dam A; **Tremont** - McKinley M; **Union** - Harriman P; **Vinalhaven** - Reubens Corner Pond Farm P, Sands Q; **Warren** - Warren Nickel P; **Whiting** - Cooper M; **York** - Mount Agamenticus fractures, Pine Hill Q; **T10SD** - Catherine Hill Q; **T10R8 WELS** - Priestly Lake L

Molybdenite is frequently confused with graphite. Molybdenite is subtly "gunmetal blue" while graphite is silvery gray. Molybdenite frequently lines the surfaces of fractures in granitic rocks and graphite usually doesn't. Well developed molybdenite crystals show corrugated prism zones while graphite is ordinarily so thin as to show no prism. Both are flexible, but inelastic. Graphite crystals sometimes have triangular surface markings.

Molybdenite has been found as 1 cm plates in quartz, occasionally with beryl, from Long Island, **Blue Hill**. Jackson (1838a) described some specimens from Long Island: "Sulphuret of molybdena is also very abundant; occurring in large and brilliant tabular prisms, of 6 sides; also in large intersecting and radiating plates."

Large plates (to 7 cm) are found, sometimes coated by ferrimolybdate or with intergranular fillings of ferrimolybdate, in quartz from the Catheart Mountain prospect, **Bradstreet**. Nowlan (1989) gave an account of the Catheart Mountain deposit.

Molybdenite has long been known from the Androscoggin River Falls of **Brunswick** and **Topsham**. Cleaveland (1816) noted: "In *Maine*, at Brunswick, on the banks of the Androscoggin, Sulphuret of molybdena is abundantly disseminated in granite and gneiss. It is sometimes finely crystallized in short hexahedral prisms, or rather in tables or thin plates. The tables are sometimes equilateral, and sometimes elongated, being more than an inch in length; sometimes also they are very small. In some instances, hexahedral laminae are superimposed on each

other, with a decreasing extent, so as to form a solid somewhat pyramidal. Frequently also it occurs in small foliated masses, varying from one tenth of an inch to two inches or more in diameter. It is sometimes associated with a yellowish or greenish yellow substance in the form of a crust of efflorescence, which has the external characters of oxide of uranium." Cleaveland (1822) repeated the entry, but amended the last sentence: "It is sometimes associated with a yellowish or greenish yellow oxide of molybdena in the form of a crust or efflorescence. - Also at Mount Desert, near Pretty Marsh mills, forming narrow veins." The excavation for the Power Plant dam in the Androscoggin Falls area of Topsham, in the 1980's, yielded reasonably sharp crystals 1 cm thick and 2 x 6 cm across, which were found in tan-stained microcline matrix. Molybdenite in pegmatite from the Square Pit, Topsham formed around rusty microcline grains (to 3 cm) with almandine crystals (to over 1 cm) frozen in microcline. The crudely hexagonal molybdenite from the Square Pit can be 1.5 cm across and part of 3 x 5 x 1 cm masses.

Hess (1908) reported of the Horatio N. Flagg farm, **Buckfield**: "On the Flagg farm both gneiss and pegmatite have been crushed until the pegmatite shows merely as mashed lenses in the gneiss. The gneiss carries more or less graphite at each of these places, reaching a maximum at Crocker Mountain. The graphite is flaky and much resembles molybdenite, but specimens collected at each place and submitted to Waldemar T. Schaller, of the Geological Survey laboratory, showed no traces of molybdenum. Others report having specimens tested which showed its presence, and it would seem entirely possible that molybdenite should occur in these gneisses, considering their possible origin from a granite and later intrusion by pegmatites." Jackson (1838a) earlier reported Buckfield molybdenite.

Ludman and Hill (1990) found one molybdenite flake in the Charlotte road cut, **Charlotte**.

Smith (1905a) wrote of the American Molybdenum Company mine, **Cooper**: "The molybdenite occurs both in pegmatite dikes and in the granite cut by these dikes. A number of distinct pegmatite dikes were seen on this property, varying in width from a few inches to several feet. In these the molybdenite occurs in lead-gray hexagonal crystals of short prismatic habit, or as less regular foliated masses, often with radiate structure. These crystals and bunches of molybdenite range from 1 to 2 inches in diameter and are intimately mixed with the quartz and feldspar of the pegmatite. ... The molybdenite occurs also in small flakes or larger nests of flakes disseminated throughout the granite mass. ... It is comparatively poor in the darker minerals, but in places near the pegmatite dikes the flakes of molybdenite are sufficiently abundant to give the rock the appearance of a granite rich in biotite." Hess (1908) added: "Many of the joints of this third set have been filled with thin dikes of rather quartzose pegmatite from one-half inch to 3 inches thick. Ordinarily the most quartzose phases occur where the dike has narrowed to its smallest proportions, and at many such places molybdenite forms crusts in which the flakes lie in radial groups of considerable beauty. ... It is said that segregations occur weighing 10 or

12 pounds." Associated minerals which have been noted include pyrite, ferrimolybdate, bismuth, and fluorite. Hess (1908) did not observe any molybdenite at the nearby Calais Molybdenum Mining Company mine. Emmons (1910) reported on a visit to the American Molybdenum Company mine.

Gray-black molybdenite plates (2-4 mm) with blue tarnish in quartz, tan microcline, and clinocllore were found at an unspecified location in **Eustis**.

Hess (1908) noted that he visited a molybdenite occurrence in **Greenwood**: "6 miles north of Norway village..."

Gilman (1978) wrote of the Symmes Pond syenite stock, **Newfield**: "The rock contains small amounts of molybdenite and has been the site of minor prospecting in past years." Carpenter and Zodac (1955) noted molybdenite and powellite from the contact of a basalt dike and pegmatite on the Hans Bergendahl farm area, Newfield. A Newfield micromount in the Yedlin collection (NMNH) is labeled: "S.W. slope of Wilson Mountain, 100 feet [33 m] north of Hall road" (Pete Modreski, personal communication, 1992).

Hess (1908) reported of **Paris**: "Molybdenite is occasionally found in the pegmatite at Mount Mica." Burr (1917) may have been trying to correct this statement: "Small amounts have been found, near the Mt. Mica gem mine, in Paris, in a dark colored mica schist." The Burr (1917) reference could concern the nearby Crocker Hill locality. Crocker Hill mine, Paris was extensively worked early in the twentieth century (Burr, 1917), and a processing plant was erected to separate molybdenite from graphite (q.v.) and its host rock. Hess (1908) wrote of Greenwood, Buckfield, and Paris: "The graphite is flaky and much resembles molybdenite, but specimens collected at each place and submitted to Waldemar T. Schaller, of the Geological Survey laboratory, showed no traces of molybdenum." At any rate, very little molybdenite was ever found and the Crocker Hill mine may have been a fraud, at least personal if not public.

Webster (1848) noted molybdenite in vesuvianite from his locality, the Webster prospect, **Sanford**. Numerous foil-like individual platy crystals (to 1 cm) as well as tabular molybdenite crystals (to 5 mm) have been found in calcite-filled vugs (acid leached) in diopside-rich matrix. All three of the Sanford prospects have produced good molybdenite crystals. Some molybdenite is altered on the surface to powellite (q.v.).

Molybdenite in thin, sharp hexagonal crystals (to 1 x 1 cm) in a gahnite and andalusite-bearing rock was exposed in a wooded low ledge area along the north side of a woods road, **Surry** near the Blue Hill line.

In the Harriman prospect, **Union** and the Warren Nickel prospect, **Warren**: "Molybdenite is minor but widespread throughout the deposits. It occurs as laths and irregular grains and is in close association with graphite and pyrrhotite. The paragenetic position of this mineral is uncertain, but most of the molybdenite appears to have formed early - contemporaneously with pyrrhotite. Some is well developed in pegmatites within the ore body, so that two generations may be likely" (Rainville and Park, 1976).

Molybdenite can be found in joint surfaces of rock at various points along Route #182, **T10SD**. The Catherine Mountain prospects, also called Catherine Hill prospects, T10SD produce molybdenite flakes (to 3 x 4 cm) in coarse to pegmatitic granite. Hess (1908) indicated several additional small molybdenite prospects "west of Sand Cove" and on the "south side and elsewhere around the lake" [T7SD?]. Catherine Hill prospects were briefly described by Emmons (1910), Burr (1917), and Wing (1953). Trefethen and Miller (1947) mapped the various prospects on Catherine Mountain.

Ayuso and Shank (1983) wrote of the Priestly Lake quartz-molybdenite veins, **T10R8 WELS**:

"Quartz-molybdenite veins occur along the east-facing flank of Priestly Mountain, between the fire tower and Priestly Lake... In an area of 150 m by 150 m, quartz veins range in width from millimeters to about 15 cm and invariably contain molybdenite. ...

The mineral assemblage in the veins consists of quartz + molybdenite ± pyrite and epidote (?). Leafy aggregates of coarse molybdenite grains about 4 mm in diameter form clusters (up to 3 cm) and thin selvages filling internal fractures in the quartz veins and in the granodiorite."

molybdite = name formerly given to ferrimolybdite, but now assigned to another mineral not yet found in Maine.

Burr (1930) listed molybdite from **Cooper** and **Franklin** (=T10SD?). Trefethen et al. (1955) listed molybdite from the Webster prospect, **Sanford**. No specimens known.

MONAZITE-(Ce)

Ce(PO₄)

Blue Hill - East Blue Hill; **Brunswick** - Androscoggin River falls A; **Eustis** - Flagstaff Lake igneous complex; **Jim Pond Formation** - Alder Stream, Jim Pond, Seven Ponds, Stetsontown, Tim Pond; **Newry** - heavy mineral concentrate; **Pownal** - Hinkley P; **Rumford** - Black Mountain Q; **Stow** - Colton Hill Q; **Topsham** - Androscoggin River falls A, Consolidated #1 Q, East Standpipe Hill P, Havey #2 Q; **Mount Ararat Q**, **Russell Brothers Q**, **Square Pit** (= Consolidated #4 Q), **Standpipe Hill Q**, **Swamp #1 Q**, **Yedlin locality**

Monazite-(Ce) is sometimes a fine-grained component (less than 1 mm) of granite and acts as a repository of rare earth elements. According to the Levinson rule (Levinson, 1966), rare earth element (REE) minerals are suffixed by the dominant REE present (note hyphen and parentheses). Monazites which have not been found in particularly unusual environments are usually very near the cerium end-member, so the names have been converted here without chemical data, but analyses are pending (William Simmons, personal communication, 1994).

Nielsen et al. (1989) wrote of monazite-(Ce) occurring in the Flagstaff Lake igneous complex, near Stratton, **Eustis**: "Biotite schlieren fall into two mineralogic [sic] groups. ... These schlieren are finer grained (~200 microns) and biotite frequently contains abundant inclusions of monazite[-(Ce)] and zircon."

Boudette (1991) noted monazite-(Ce) as a "clastic accessory mineral" in a metaquartzite of the Jim Pond Formation, **Alder Stream**, **Jim Pond**, **Stetsontown**, and **Tim Pond**.

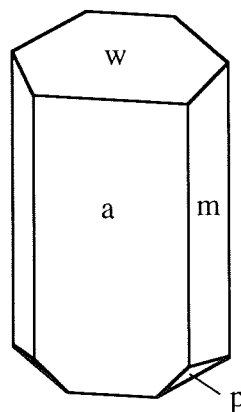
Monazite-(Ce) was recovered in **Newry** as part of a heavy minerals survey of sandy stream sediments by the Vitro Company. Exact sample locations are unavailable. Samples consist of light brown gemmy rounded grains (1 mm and less) which have been separated from other species by heavy liquids (Bob Hinkley, personal communication, 1992).

The Hinkley prospect, **Pownal** has yielded a small lens, within the general pegmatite, rich in smoky quartz, zircon, and microcline where monazite-(Ce) crystals (to 3 cm) were found frozen in microcline along the borders of biotite cleavages.

Gemmy emerald-green square platy monazite-(Ce) crystals (to 2x2 mm) are found at the Black Mountain quarry, **Rumford** in cleavelandite with cassiterite.

Square-tabular brown monazite-(Ce) crystals (to 4 mm) were found frozen between smoky quartz and microcline grains (5-10 mm range) in excavated rock during the 1980's from the hydroelectric dam in the Androscoggin River falls area, **Topsham**. Beautiful orange, square-tabular monazite-(Ce) crystals (to 4 mm) are found embedded in smoky quartz from the Consolidated #1 quarry, Topsham. Typical elongated to prismatic dark orange-brown monazite-(Ce) crystals (to 7 mm) are found frozen in microcline along the border with biotite at the Square Pit (Consolidated #4 quarry), Topsham.

Outstanding monazite-(Ce) crystals are found in the various rocks at the Standpipe Hill radioactive area, Topsham. Sharp dark orange to red-brown monazite-(Ce) crystals (to almost 2 cm) are found embedded in red to brown-stained microcline along the borders of biotite cleavages at the Yedlin locality - a small prospect written about by Neal Yedlin (1942), who men-



Monazite-(Ce), Yedlin L, Topsham

tioned that twins of monazite-(Ce) (to 3.5 x 2.5 cm) were found there. The twins are scarce and have short fish-tail habit. Monazite-(Ce) is only rarely found completely embedded in smoky quartz at the Yedlin locality. Monazite-(Ce) and samarskite-(Y) crystals are frequently found in mutual contact. Similar monazite-(Ce) is found at the Standpipe Hill quarry proper. Hecht et al. (1937) analyzed ferrian thorian monazite-(Ce): "The exact locality is near the standpipe on top of the hill, and about a quarter-mile away from the samarskite locality." The largest Maine monazite-(Ce) crystals seem to come from the East Standpipe Hill prospect. These two small (several meters) adjacent pits located about 100 meters east of the Standpipe (a water tower) have produced monazite-(Ce) crystals frozen in microcline along the borders of biotite and rarely frozen in smoky quartz. Monazite-(Ce) crystals (to 4 cm) have been found at this locality along with exceptional samarskite-(Y) crystals (to 5 cm).

Gemmy bladed (to 1 x 0.3 cm) to rod-like butterscotch-brown monazite-(Ce) crystals have been found in peristeritic (q.v.) oligoclase associated with annite, uraninite, and almandine at the Swamp #1 quarry, Topsham.

MONTEBRASITE (Amblygonite Group)

$\text{LiAl}(\text{PO}_4)(\text{OH},\text{F})$

Auburn - Hatch Farm Q, Keith Q, Pulsifer Q; **Buckfield** - Bennett Q, General Electric Q, Westinghouse Q?; **TD** - Bemis Stream P; **Georgetown** - Tourmaline P; **Greenwood** - Emmons Q, Harvard Q, Tamminen Q; **Hebron** - Mount Rubellite Q; **Newry** - Bell Pit, Dunton Q, Kinglet Q, Nevel Q, Rose Quartz Crystal L; **Paris** - Mount Marie Q, Mount Mica Q; **Peru**; **Poland** - Berry-Havey Q; **Rumford** - Black Mountain Q, Goddard Ledge Q, Red Hill Q, "Rumford Point" A; **Topsham** - Fisher Q; **Warren** - Starrett P

Montebrasite is the most common member of the amblygonite group. Due to extensive misidentifications and nomenclatural inconsistencies, an historical summary is provided here for insight into the problem. Amblygonite was named in 1817 by Auguste Breithaupt. Its name was firmly established in all of the later systematic mineralogy books. The nomenclature of the amblygonite/montebrasite series depends on the fluorine:hydroxyl ratio. In the nineteenth century, the relationship of fluorine/hydroxyl substitution was slow in being recognized and a substantial controversy developed. An example of the development of chemistry's and mineralogy's understanding of the role of fluorine, versus water (i.e. hydroxyl), in chemical substitution is given by a different phosphate group, triplite. Brush and Dana (1878) discussed at length the significance of the chemical and crystallographic similarity of triplite and wagnerite, but were compelled to erect a new species, triploidite (from Branchville, Connecticut), because the material they were studying contained almost no fluorine, but hydroxyl instead. The critical statement in their paper read: "The conclusion to which we are led is this - that in the compound triploidite the radical hydroxyl (OH) plays

the same part as the element fluorine, the molecule $\text{R}(\text{OH})_2$ taking the place of RF_2 ." Samuel Penfield was the analyst. One would have expected that a host of fluorine and hydroxyl mineral series would have been recognized, but several factors undoubtedly prevented this nomenclature change from occurring: some of the reasons have been alluded to under hydroxyl-herderite (q.v.) discussions as well as eosphorite (q.v.). The various Yale mineralogists were reluctant to name species only because of a small variation of a chemical component. Additionally, the montebrasite and hebronite controversy in Europe undoubtedly contributed to the recognition by Brush, Dana, and Penfield that isomorphous substitution of fluorine and "water" was a concept to be reckoned with. (Note: The early reports cited will use the word amblygonite. Modern information suggests that they were dealing with montebrasite, but only "20-20" hindsight allows us to solve nomenclatural puzzles. As quotations are *verbatim*, amblygonite will be seen wherever it originally appeared in the quote.)

The Amblygonite/Montebrasite Controversy

Montebrasite (Montebras, France) was named by Des Cloizeaux and hebronite (Hebron, Maine) was named, a few months later, by von Kobell, both in the year 1872, after they had published preliminary notices and analyses of the mineral. In 1879, Penfield made a chemical survey of worldwide amblygonite samples. He discussed the recent report of Brush and Dana (1878) that hydroxyl could replace fluorine: "In this paper I wish to show that in amblygonite the hydroxyl group is also isomorphous with fluorine, and that in chemical composition the original amblygonite does not differ from the American and Montebras varieties which have been called hebronite." Later, the confounding philosophy is revealed: "Des Cloizeaux, from a difference in optical characters made out by him, has divided the mineral into two species: the original amblygonite ... and a second species for which he proposed the name *montebrasite*. ... Owing to the close identity in chemical composition it seems that a slight variation in optical properties is hardly sufficient ground for dividing the mineral into two species, but on the contrary, I think that the old name amblygonite should be retained, and that all varieties should be included by it." Penfield went on to discuss his reasons for the unification of the name amblygonite. The results of the chemical analyses, however, gave OH:F of 1.17:1 (Auburn); 1.78:1 and 2:1 (Hebron); and 2.13:1 (Paris) and, therefore, the species we would now call montebrasite. The materials discussed were intermediate in composition, but mineral nomenclature is generally based on the 50-50 rule. The boundary of montebrasite with amblygonite is placed at OH:F = 1:1. Therefore, Des Cloizeaux had a fluorian montebrasite and von Kobell had sodian hydroxylamblygonite, while Penfield's analyses from Maine were intermediate to definite montebrasite.

Winchell (1926) summarized optical data on the montebrasite-amblygonite series, as had Backlund (1918). Palache et

al. (1943), who cited Penfield's (1879) analysis on Hebron material with OH:F = ~2:1, wrote concerning Newry material without chemical analysis, calling the minerals both amblygonite. The nomenclature of the material was so firmly entrenched that montebrasite has had little chance to be publicized. Additionally, data given by Backlund (1918) and Winchell (1926) would make members of the series more fluorine-rich due to poor controls of the old chemical analyses used to calibrate the optical constants (Černá et al., 1973). (The optic sign of montebrasite changes between (+) and (-) within its half of the montebrasite/amblygonite series.) Fransolet and Tarte (1977) and Greiner and Bloss (1987) studied nearly end-member montebrasite from (Nevel Q?) Newry, and Greiner and Bloss (1987) also studied an intermediate amblygonite from Hebron. Quantitative water determinations (this study) confirm the presence of montebrasite: Dunton quarry, Newry (5.17 weight %) and Black Mountain quarry, Rumford (5.11 weight %).

Description of Specimens

Massive montebrasite is ordinarily snow-white, has a noticeably high specific gravity, and a cleavage with variable low to high oily luster. The outside edge of the masses is frequently chalky in texture and varies through white, gray, and pink. The pink color is frequently ascribed to pink montmorillonite staining.

Montebrasite from the Hatch Farm, **Auburn** was found embedded in compactly intergrown lilac lepidolite cleavages (to 2-3 mm) with very minor cloudy quartz grains (to 3-4 mm). The blocky, white, oily lustered, montebrasite "crystals" (to 3 cm) superficially resemble feldspar, including the presence of a perfect cleavage. However, the second cleavage (~ 110° from the perfect one) is quite interrupted and much lower in quality than the second cleavage in feldspar. Montebrasite from the Pulsifer quarry, Auburn is snow-white with similar "oily" cleavages (7 x 1 x 3 cm) embedded in fine-grained albite and yellow lepidolite with pink, gray, and green elbaite.

Landes (1925) reported amblygonite and montebrasite from the Bennett quarry, **Buckfield**, but the data given indicate both samples were montebrasite - one intermediate in composition and one nearer end-member montebrasite. Landes (1925) wrote:

"Amblygonite is very rare in the main pegmatite, appearing in but one hand specimen studied. Here it is a small cream colored fragment intimately associated with manganese apatite, tourmaline, and white lepidolite. ... A grayish white rim surrounds the pocket minerals of Class III. The border is about 4 centimeters wide, and usually consists of material microscopic in dimension. The rim is always bounded on the outside by massive microcline of the main pegmatite. It is evidently caused by a replacement of the microcline.

Optical study and chemical tests proved the replacing mineral to be amblygonite. Residual fragments of microcline surrounded on three

sides by amblygonite may be seen along the outer margin of this zone in the thin section. Cleavage cracks in the feldspar are filled with amblygonite."

Fraser (1930) wrote of Newry without providing data: "*Amblygonite and Montebrasite*. These two minerals are developed rather locally, although they may occur in very large masses. Commonly they show good crystal form. They often enclose cleavelandite and other earlier minerals and sharp crystals of amblygonite are found in massive lepidolite. The distinction between amblygonite and montebrasite is based chiefly on the difference in their optical properties." Given the lack of data, previous identifications in the same laboratory by Landes (1925), and the recent findings of montebrasite, but no amblygonite (Vandall King, unpublished data, 1978, and this study), the amblygonite identification has not been believed.

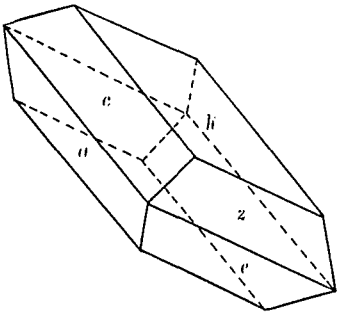
Montebrasite is well-known from the Emmons quarry, **Greenwood** in crude, blocky crystals (to 15 cm) which are snow-white and usually have a chalky gray exterior. Nodules (to 10 cm) of snow-white montebrasite coated by lamellar masses of clayey montmorillonite have been found at the Harvard quarry, Greenwood.

Tamminen (1952) reported a montebrasite crystal from the Tamminen quarry, Greenwood: "Last summer, there was a lovely crystal ... [of] amblygonite about 16 inches across, in the pit wall. The face had been blown off, affording an excellent view of both the inside and outside. The outer coat was red, which is characteristic of the amblygonite in this pit. Surrounding the crystal was cleavelandite, montmorillonite, and a large mass of altered spodumene." Additionally, cream-colored, relatively sharply developed wedge-shaped crystals of montebrasite (to 2 mm) rarely occur on clear jackstraw quartz crystals (to 8 mm).

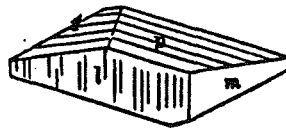
Montebrasite from the Harvard quarry, Greenwood occurs as white, fine-grained nodules (to 10 cm) surrounded by an indurated pinkish tan rim of montmorillonite frozen in albite and quartz. Landes (1925) wrote:

"Amblygonite occurs in very striking forms. One crystal found by Mr. Noyes ... is a complete individual 15 cm. long, 8 wide and 5 thick. It is flattened parallel to the dome $h(101)$ and shows the forms $c(001)$, $a(100)$, $z(120)$, $h(101)$, and $e(021)$. Most of the amblygonite however occupies the centers of nodules composed of alteration products in concentric arrangement. ...

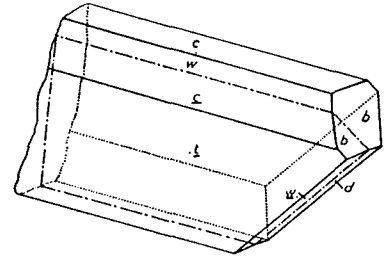
The nodules of amblygonite appear to have been converted into kaolin by concentric zones working inward. In the nodules pictured... the outer crusts are kaolin and sericite, but the core has not yet succumbed to this alteration. In other instances the center of the nodule is white and compact, with a conchoidal fracture. Here kaolinization has been more complete. A green crust also surrounds the kaolin core. ... Calculations on the constituents of the core indicate a mixture of mica 52 per cent (muscovite 40 per cent, lepidolite 12 per cent), kaolin 48 per cent and amblygonite 0.1 per cent. Calculated in the same way the green outer crust appears to consist of about 41 per cent kaolin, 31 per cent lepidolite, 0.3 per cent amblygonite and 28 per cent bauxite."



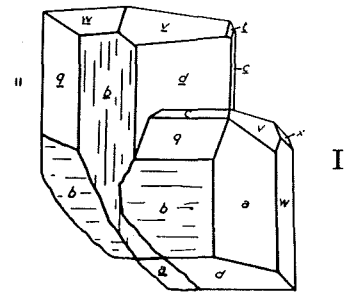
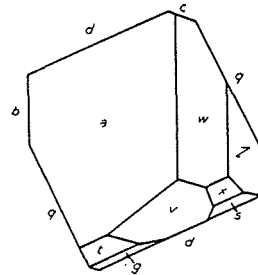
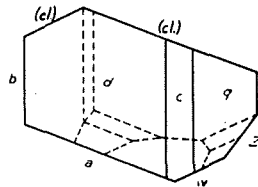
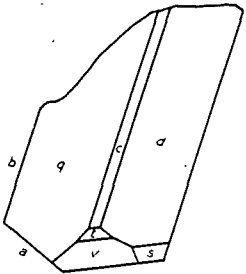
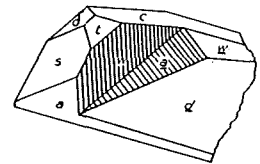
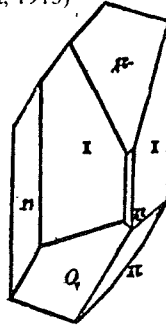
Harvard Q, Greenwood
(from Landes, 1925)



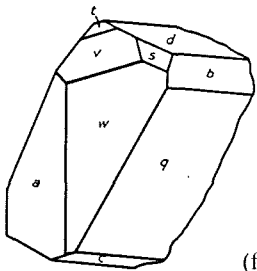
Mount Rubellite Q, Hebron
(from Goldschmidt, 1913)



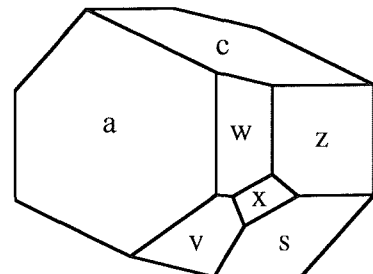
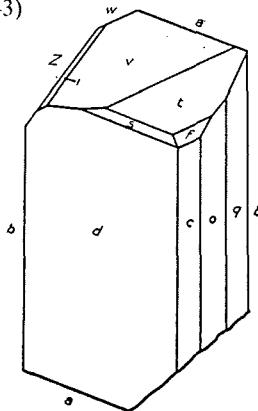
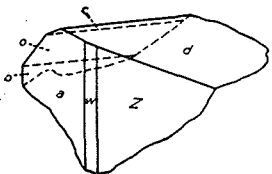
Mount Rubellite Q, Hebron
(from Palache et al., 1943)



Nevel Q, Newry
(from Palache et al., 1943)



Nevel Q, Newry
(from Palache et al., 1943)



Bell Pit, Newry (this study)

Montebrasite

Palache et al. (1943) described a new find of montebrasite crystals from Mount Rubellite, **Hebron**, complete with new crystallographic data and a chemical analysis which indicated that the new material was actually montebrasite: "The crystals of amblygonite [sic] are white, translucent to transparent, and vary in size from one-half to three millimeters in the direction of elongation [010]. They are generally attached to the matrix by one end of this *b* - axis and are of two types, although all prove to be twin crystals. ... In one they are thin-tabular parallel to the plane of composition of the twins {111}, and the individuals are either exactly symmetrical to this plane or approximately so. In the other type the flattening is parallel to the prism {110} and the two individuals are of very unequal size. The two types are intermingled on the surfaces where they occur with no apparent difference in age. The faces of these tiny crystals are for the most part brilliant and plane, giving excellent reflections on the goniometer. But there are delicate striations in the prism zone [001], and one form is characteristically curved..." The plates of montebrasite crystals described by Palache et al. (1943) are thin and appear to have "peeled off" from smooth surfaces of quartz, etc. The transparent bladed crystals were from a late paragenetic stage, having formed in open cavities, rather than from a slightly earlier paragenetic stage where replacement and rapid co-crystallization was occurring. Early-formed masses of the series, from the Mount Rubellite quarry, have been shown to be amblygonite (q.v.).

Bell Pit, **Newry** material has been determined by optical properties and by the method of Černá et al. (1973) to be montebrasite. The crystals from this location are outstanding for bladed habit montebrasite crystals, despite the larger (to 8 x 2 cm) bladed crystals from near Linopolis, Galileia County, Minas Gerais, Brazil. The Bell Pit montebrasite consists of transparent, twinned crystals (to 0.5 x 1 cm) in siderite-lined vugs in quartz. The bladed crystals are usually individually placed, but some specimens are thickly intergrown in "disheveled house-of-cards" fashion. Sometimes the transparent montebrasite crystals are interspersed in jackstraw-intergrown quartz crystals. Additionally associated species with montebrasite include goyazite, moraesite, beryllonite, and minerals typical of the siderite assemblage, in general. The siderite can vary from golden yellow needle-scalenohedral shapes to brownish black etched rhombohedra. Montebrasite is also found at the Bell Pit as fine-grained white to gray masses (to several centimeters) with siderite and quartz.

Palache et al. (1943) illustrated the crystallography of Nevel quarry, Newry montebrasite and reported: "Crystals of amblygonite of really spectacular quality were found during 1940 and 1941 in a new pit opened for feldspar on Newry Mountain about two hundred yards east of the old Nevel pollucite quarry. The crystals are found in pockets in the pegmatite up to about two feet square and are attached to the feldspar walls. With them, besides quartz and beryl, have been found small amounts of triphylite [sic], apatite of violet color, small amounts of eosphorite, cassiterite, and rhodochrosite." The yellow to tan,

transparent to translucent montebrasite crystals were almost vitreous in luster. Many were developed in parallel growth clusters. The largest cluster reported by Palache et al. (1943) was 11 x 8.5 x 4 cm. A single well-developed crystal is also known of this size. The Nevel quarry crystals were formerly regarded as the best-of-species worldwide and in some respects surpass the Linopolis crystals.

Fraser (1930) enigmatically reported of the Dunton quarry, Newry: "*Amblygonite and Montebrasite*. These two minerals are developed rather locally, although they may occur in very large masses. Commonly they show good crystal form. They often enclose cleavelandite and other earlier minerals and sharp crystals of amblygonite are found in massive lepidolite. The distinction between amblygonite and montebrasite is based chiefly on the difference in their optical properties." W. D. Nevel reported to Hess et al. (1943): "A little amblygonite was found in flat crystals 1 to 2 inches thick and 3 to 4 inches broad with a clear-white porcelainous [sic] fracture, but one mass was estimated to weigh 800 pounds." Černá et al. (1973) published optical and specific gravity data from samples of unspecified provenance in Newry (USNM 5906 and 5841; HU unnumbered) which show the material is near end-member montebrasite. The association of USNM 5906 with lepidolite suggests a Dunton quarry origin. Dunton quarry montebrasite can have a slight tan color and blocky masses in cleavelandite can resemble microcline.

Montebrasite was first reported (as amblygonite) from the Mount Mica quarry, **Paris** by Brush (1862). Recently collected specimens frozen in quartz- and lepidolite-bearing matrix have a white rim (to 3 mm) with a cloudy white interior. The cleavage is perfect and has a high luster, but usually is interrupted. Masses over 10 cm have been found, some with crudely formed crystal faces.

Berry-Havey quarry, **Poland** montebrasite is opaque snow-white and forms large masses (over 10 cm) with an interrupted, medium luster cleavage. Berry-Havey quarry montebrasite nodules frequently have lepidolite or an orange staining on their surface.

The Black Mountain quarry, **Rumford** has produced a great deal of montebrasite. The opaque snow-white montebrasite forms blocky masses (to 10 cm) frozen in gray quartz. The montebrasite cleavage has a low luster and is very interrupted. Tan blocky montebrasite masses can be frozen in lepidolite, rubellite, spodumene, and cleavelandite matrix. Bjareby (1965a) wrote: "The surfaces of amblygonite crystals and masses are often altered somewhat and may be gray, olive, brown or pinkish." The pink coating on the opaque crystals and masses of montebrasite has been generally supposed to be due to pink montmorillonite. Tiny transparent montebrasite crystals (1-3 mm) of typical bladed development, frequently fish-tail twinned, are found in vugs in albite along with eosphorite and gray clay coating. Blocky montebrasite crystals (to 2 mm) also occur with albite and eosphorite. At least one blue-gray mass of amblygonite (q.v.) was found at the Black Mountain quarry, Rumford using

the analytical method of Černá et al. (1973) (Michael Wise, personal communication, 1993).

The Red Hill quarry group, Rumford produced transparent bladed (3-4 mm) montebasite crystals with siderite and eosphorite on cleavelandite. The Goddard Ledge (= Ford Hill) quarry, Rumford has also produced transparent bladed montebasite crystals (to 2 mm) with siderite in replacements of triphylite, as well as massive nodular montebasite (Woodrow Thompson, personal communication, 1994).

MONTMORILLONITE (Smectite Group)



Auburn - Keith (= Towne) Q, Pulsifer Q; **Buckfield** - Bennett Q; **Castle Hill** - Dudley P; **Georgetown** - Consolidated Q?, Tourmaline P; **Greenwood** - Harvard Q, Tamminen Q; **Hebron** - Mount Rubellite Q; **Newry** - Dunton Q, Nevel Q; **Norway** - BB #7 Q, Tubbs Ledge Q; **Paris** - Mount Mica Q; **Rumford** - Black Mountain Q; **Stoneham** - Lord Hill Q

Montmorillonite is a clay mineral of the smectite group. Although thought of as a lithium mineral by mineral collectors, frequently impregnating lithium mineral assemblages, the exchangeable nature of the inter-layer alkalies, etc. means that montmorillonite can be completely lithium deficient. Montmorillonite can accommodate manganese substituting for its octahedral cations. The resulting pink clay is found abundantly impregnating cleavelandite-rich matrix along with quartz-lined cellular cavities in montebasite, etc. Pink stains of montmorillonite on the margins of montebasite masses are also common.

Pink clayey montmorillonite impregnating cleavelandite, sometimes associated with lepidolite, is found at the Keith (Towne) and Pulsifer quarries, **Auburn**.

Pink to pinkish orange montmorillonite is found at the Bennett quarry, **Buckfield** as films and masses in microcline, cleavelandite, quartz, etc. and is a late-stage coating on many minerals. Landes (1925) wrote of the Bennett quarry: "Cleavelandite in the zone of oxidation is sometimes found partially altered to a pink, clay-like substance. This is one of the clay minerals, known as montmorillonite. The bright pink color of the fresh material pales upon exposure, probably due to partial dehydration." In some specimens, montmorillonite completely infills vugs in cleavelandite and forms "polyhedroids." Pale pink to rose-colored montmorillonite is found as inclusions in pollucite at the Bennett quarry as well as coating fractures in pollucite. This montmorillonite is calcium-bearing with minor magnesium and manganese (chemical analysis, this study).

White (1943) wrote of montmorillonite from the Dudley farm prospect, **Castle Hill**: "A layer of volcanic ash 1 to 2 inches thick was noted at the Dudley farm in one drill core and in two trenches on the surface. Should this ash prove to belong to a single continuous layer in the deposit, it would serve as an excellent reference plane for detailed stratigraphic and structural

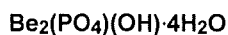
studies. It consists, according to Charles Milton [personal communication], mainly of crystals of sodic plagioclase in a matrix of what is probably montmorillonite, derived from fragments of glass."

Montmorillonite is found in interstices in cleavelandite as clayey masses at the Consolidated quarry, **Georgetown**. Morong (1990) noted: "found in cleavelandite vugs as a white to gray (with an occasional greenish cast) clay mineral. Unctuous when first found, but soon dries and hardens." The mineral might be intermediate between montmorillonite and nontronite. No specimens tested.

Montmorillonite is particularly common at the Tamminen quarry, **Greenwood**. The Tamminen quarry montmorillonite can be faintly pink through all shades to pinkish brick-red color. It occurs as mottled, very friable earthy masses, usually in cleavelandite, but can be a stain on elbaite, montebasite, petalite, spodumene, etc. A chemical analysis of montmorillonite from Greenwood, found as an alteration product of pollucite, was reported by Wells (1937). Ross and Hendricks (1945) and Sherman and Vergo (1988) studied a pink montmorillonite, from Greenwood, presumably from the Tamminen quarry, and showed the mineral was a montmorillonite with interlayer calcium and very minor magnesium. The latter authors demonstrated that the color was due to a small amount of Mn^{3+} in distorted octahedral coordination.

Pink montmorillonite is found staining matrix at the Lord Hill quarry, **Stoneham**. It can sometimes be found as polyhedroids which completely fill voids in cleavelandite. Kunz (1884a₁) reported that the mineral from Stoneham was the second American locality for the species: "*Montmorillonite*. - Occurs in masses that vary in color from a very delicate pink to a dark pink closely approximately red, filling the cavities and interstices in the cleavelandite. When the latter is broken, it falls out, and it so far retains the impression of the spaces it has occupied as to lead one to infer that it has a crystalline form. It also occurs in botryoidal masses resembling rhodochrosite on crystals of cleavelandite. This mineral is evidently identical with that described by Professors Brush and Dana from the Branchville, Conn., locality."

MORAESITE



Greenwood - Emmons Q; **Newry** - Bell Pit, Dunton Q, Rose Quartz Crystal L; **Paris** - Mount Mica Q

Emmons quarry, **Greenwood** moraesite forms snow-white silky fibrous sprays (to 2 mm) on earthy olive-green to olive-brown mitridatite coating vugs in rhodochrosite/siderite matrix (Gene Bearss, personal communication, 1991). Stewartite can be associated.

Moraesite from the Bell Pit, **Newry** consists of snow-white tangled fibrous to straight radiating needles in botryoidal clusters

(to 2 mm). Individual needles are generally much less than 1 mm. The moraesite can be found in small siderite and quartz vugs, sometimes with quartz crystals (to 1 mm) and occasional eosphorite crystals (to 1 mm). Some coarse to splintery radially fibrous moraesite botryoids (to 2 mm) have been found on blocky gray fluorapatite crystals (to 3 mm) along with blobs and irregular masses of black manganese minerals and orange diadochite. Occasionally, moraesite forms sprays of straight acicular crystals and can be indistinguishable from white fluorapatite.

Moraesite occurs as snow-white, silky, tangled fibrous needles as well as radially fibrous rosettes in beryllonite and beryllonite-bearing matrix at the Dunton quarry, Newry. The moraesite is non-fluorescent. The botryoids resemble "organized" cotton-balls and are virtually always later and implanted on botryoidal hydroxyl-herderite. The matrix beryllonite is almost always fibrous to etched. When "roscherite" is present it generally forms reddish brown botryoids (to 3 mm) and the "roscherite" is distinctly later than both hydroxyl-herderite and moraesite. Fibrous bundles, individual needles, and matted crystals of gray-white hydroxylapatite can be present, but are not as silky as moraesite. Some snow-white moraesite forms flat-lying mats in botryoidal hydroxyl-herderite. Small (0.5 mm) torbernite crystals can be found on moraesite. (Note: Some snow-white hydroxylapatite in mitridatite can mimic moraesite. The hydroxylapatite does not have silky luster and the crystals are less distinct than moraesite's.) Brown-stained moraesite botryoids (to 3 mm) can occasionally be found in siderite in blue tourmaline eyes.

Moraesite has been rarely observed at the Rose Quartz Crystal locality, Newry. The snow-white moraesite forms flat-lying sprays of tangled fibrous needles (to 1 mm) on black earthy stain in albite crystal vugs.

Silky snow-white moraesite needles (less than 1 mm) are found in botryoidal to cotton-ball clusters (to 4 mm) in siderite in blue tourmaline eyes in microcline at the Mount Mica quarry, Paris. Golden brown eosphorite crystals (1-2 mm), yellow-green "roscherite" crystals (1 mm), and massive quartz are associated. In one case, glucine was found with this association. Occasional snow-white to brown-stained masses to 1 cm were found in the gem pockets.

morganite = a gemmy, pink beryl (q.v.)

mountain leather?

Thomaston - Lawrence Q

"Mountain leather" is a generic term for matted fibrous light-colored minerals which frequently consist of amphibole, palygorskite, etc. Herbert Haven noted in his diary (August 29, 1937) that he had collected mountain leather and calcite at the Lawrence Portland Cement quarry, **Thomaston** (Morrill, 1966). No specimens known.

mundic = general mining term for fine-grained pyrite

Mundic was reported from the Stover Hill mine, **Blue Hill** (MMJ, May 7, 1880): "... the shaft excavation shows this expansive channel to be simply an unfaulted, homogeneous zone of copper-tinted Mundic!"

murchisonite = microcline

Burnt Meadow Mountain A

A specimen of orange-stained microcline labeled Burnt Meadow Mountain, Maine is called murchisonite (HU collection).

MUSCOVITE (Mica Group)

$(K,Na)Al_2[Si_3Al]O_{10}(OH,F)_2$

Albany - Bumpus Q, Donahue P (=Bennett Q), Johnson Q, Pingree Ledge Q, Scribner Ledge Q, Songo Pond Q, Wardwell Q, Wentworth P, Wiley-Pechnik P; **Andover** - Puzzle Mountain A; **Auburn** - Greenlaw Q, Hatch Farm Q, Keith Q, Maine Feldspar Q, Pulsifer Q, Wade Q; **Blanchard** - Blanchard Q, Moosehead Q, North Blanchard A; **Bowdoin** - Coombs Q; **Bowdoinham** - Brosso Q, Consolidated Q, Jack P, Purington Q, Roger Q, Trufant P, Uberhind Q; **Brownville** - Bonded Q, Brown Q, Brownville Q, Crocker Q, Highland Q, Hughes Q, Merrill Q, Stanchfield Q, Thomas Q, Wilbur Q, Williams Q; **Brunswick** - Bagley Ledge Q, Dwelley Q, Garland Q, LaChance Q; **Buckfield** - Bennett Q, Bessey Q, General Electric Q, Westinghouse Q (=Dudley Ledge Q); **Canton** - Reynolds Q; **Cushing** - Benner Hill sequence; **TD** - Bemis Stream P; **Edgecomb** - Edgecomb Q, Williams Ledge Q; **The Forks** - Pleasant Pond Q; **Freeport** - Taylor Q, Wolf Neck L; **Fryeburg** - Eagle Gray Q; **Gardiner**; **Georgetown** - Consolidated Q, Golding Q, Staples Point A; **Gilead** - Peaked Hill Q (= Maine Mica Q), Wheeler Q; **Grafton** - Morse Brook L; **Greenwood** - Emmons Q, Harvard Q, Heath Q, Heikkinen Q, Nubble Q, Tamminen Q, Tiger Bill Q, Waisanen Q, West Noyes Mountain L; **Hebron** - Hibbs Q, Mills Q (probably located in Paris), Mount Rubellite Q; **Leeds**; **Lewiston**; **Limington**; **Lovell** - Maxim P; **Mexico** - Gogan P; **Minot** - LaFlamme Q; **Monson** - Big Kineo Q, Boston and Maine Q, Burma Q, Cement Pit Q, Cora Q, Cove Q, Dirigo Q, Eighteen Pond Q, Eureka Q, Farm #1 Q, Farm #2, Farm #3, Farm #4 Q, Forest Q, General Electric Q, General Slate Q, Hillside Q, Mathews Q, Monson Hebron Q, Monson Pond Q, Monson Village Q, Oakland Q, Pine Tree Q, West Monson Q, Wilkens Q; **Newry** - Bell Pit, Dunton Q, Kinglet Q, Nevel Q, Rose Quartz Crystal L, Puzzle Mountain A, Scotty Q, Smith Ledges Q; **Norway** - BB #7 Q, Tubbs Ledge Q; **Oxford** - Jordan Q; **Paris** - Hoopers Ledge Q, Lower Hoopers Ledge P, Mount Mica Q, Ryerson Hill Q, Slattery Q, Snow Falls road cut, Whispering Pines Q; **Peru** - Hedgehog Hill Q, Lobikis Q, Perry Q; **Phippsburg** - Basin quarry, Small Point A, Thomas Q; **Poland** - Berry-Havey

Q; **Pownal** - Upper Tryon Mountain Q; **Raymond**; **Rumford** - Black Mountain Q, Elliot Q, Red Hill Q, Brown-Thurston P, Whitecap Mountain A; **Salem**; **Sandy River** - Rangeley Formation; sillimanite zone - **Byron, TD, TE**; **Southport**; **South Portland?**; **Stoneham** - Aldrich Q, Lord Hill Q; **Stow** - Colton Hill Q; **Sumner** - Silva Biron Q; **Topsham** - Fisher Q, Mount Ararat Eastern Slope Q, Porcupine Hill Q, Railroad Q, Russell Brothers Q, Staples Q, Trenton Q, William Willes #1 Q; **Unity** - James Neal Farm A; **Waldoboro** - Dutch Neck; **Waterboro** - Beacon Light Q; **Waterford** - Beech Hill Q, Blackguard Q, Saunders Q, South Waterford Q; Waterville Formation - **Litchfield**, **West Gardiner**; **Wayne**; **West Bath** - Davis Q; **West Paris** - Perham Q; **Wilton** - Thompson Mountain Formation; **Woodstock**; **Woolwich** - Trott Cove Q

Muscovite is such a ubiquitous mineral that only selected localities are mentioned. Muscovite is the common "white mica." Many of the pegmatites which have been mined in Maine were mined for their mica content, either as the primary ore mineral or as a by-product. Several grades were recovered, from scrap mica (the lowest quality) through rum and ruby mica (the highest grades). Ruby muscovite, also called rum muscovite, is found in a number of Maine pegmatites. When thick (2-3+ cm) books of muscovite are viewed with a strong backlight, the otherwise dark mica shows a red to red-brown color. The sheets in ruby muscovite are particularly flat and free of imperfections such as ruling and "A"-structure. Trefethen (1943) and Miller and Wing (1945) [see also Bastin, 1911] provided a summary of mica operations in Maine. Heinrich et al. (1953) chemically analyzed, optically studied, and/or X-rayed muscovite samples from Hebron, Newry (lithian muscovite), and South Portland? (lithian muscovite). A great many Maine pegmatite muscovite specimens are lithian and will give a red lithium flame test (Neil Wintringham, personal communication, 1992). Additionally, many pocket clays are principally muscovite (XRD, EDAX, this study) such as at the Intergalactic Pit, Stow.

Evans (1969) and Evans and Guidotti (1966) reported on trace element substitutions in muscovite from pelitic schists of western Maine. Zimányi (1894) reported an optical study of Buckfield muscovite. Fuchsite (pronounced "fooksite") (q.v.) is a variety of muscovite with chromium which gives the mica a bright emerald-green coloration. Many muscovites can have a slight greenish cast without actually being fuchsite.

The Wardwell quarry, **Albany**, Wheeler quarry, **Gilead**, and the Nubble quarry, **Greenwood** are particularly noted for their ruby muscovite, though almost any mica-rich pegmatite might produce a few good specimens. The Johnson quarry, **Albany** was noted for its rum muscovite. Burr (1939c) listed many towns where muscovite has been mined either as a primary ore or as a by-product. Dale et al. (1906, 1914) described the mica slates and their accessory minerals from **Blanchard**, **Brownville**, **The Forks**, and **Monson**.

Muscovite crystals, free-growing into vugs and cavities are scarce in Maine. A few excellent 5 x 5 cm triangular muscovite

crystals were found with quartz crystals (to 10 cm) and elbaite crystals (to 4 cm) at the Pulsifer quarry, **Auburn**. Yellow to yellow-green triangular to pseudo-hexagonal muscovite crystals (to 3-4 cm) were found in cleavelandite at the Keith quarry, Auburn. (Muscovite from both Auburn localities has been misidentified as yellow lepidolite.) Clarke and Schneider (1891) described an interesting muscovite: "... a pale yellowish-green mica collected by Mr. G[eorge]. P. Merrill at a granite quarry in Auburn, Me., near where the Maine Central railroad crosses the Androscoggin river. It occurs in direct contact with ordinary, broadly foliated muscovite, sometimes forming marginal growths about the plates of the later mineral, like lepidolite. Analysis gave ... the composition of muscovite, which the mica undoubtedly is. The case is interesting, however, as showing a secondary growth of muscovite on muscovite, with a marked difference in outward appearance between the two formations." Plumose muscovite was abundantly found at several unspecified pegmatites on Mount Apatite, Auburn. Plumose muscovite forms silvery-white feathery aggregates frozen in microcline. The pattern can resemble the fronds of palm branches. One early specimen of plumose muscovite has been observed from the Hatch Farm quarry, Auburn.

Excellent stacks of silvery to pale yellow crystals (to 5 x 5 cm) were found in a crystal pocket (to 1 x 1 x 2 m) at the Maine Feldspar quarry, Auburn (Ben Ashley, personal communication, 1992). Several types of muscovite were found. One type consisted of pseudo-hexagonal crystals with incomplete suturing of parallel growth stacks yielding a skeletal termination. A less abundant type consisted of slightly divergent stacks, which also were slightly skeletal and which resembled "ball mica."

The fuchsite variety of muscovite is found as emerald-green to light green flakes (to 3 mm) in pyrite-bearing pegmatitic gneiss at the intertidal locality on Wolf Neck, **Freeport**.

Outstanding rhombic-shaped ("diamond") ruby muscovite crystals (to 8 cm) embedded in smoky quartz and albite have been found at the Wheeler quarry, **Gilead** (near West Bethel). The crystals are frequently free of all imperfections and show flat cleavages free of ruling, "A"-structure, tangle sheet effects, or other flaws. Internally, the crystals show uniform flawless "facettable" areas. The color seen through the cleavage plane is deep ruby to cranberry red. Looking across the cleavage through the prism zone of the crystals, the color is a deep golden yellow.

Plumose silvery gray muscovite is found in pegmatitic ledges along Morse Brook, **Grafton**.

Large miarolitic cavities (to 20 cm) at the Tiger Bill quarry, **Greenwood** contained clusters (to 15 x 15 cm) of 3-4 cm triangular silvery yellow muscovite crystals. Silvery surficial muscovite pseudomorphs of schorl have been abundantly found at the Heath quarry, Greenwood.

Pocket muscovite crystals (to 2 cm) are found at the Emmons quarry, Greenwood. The crystals are actually composites of crystals which appear to be perfectly to imperfectly sutured and form a larger "individual". The actual individual component crystals (to 1 mm and much less) are zoned: clear nucleus and

cloudy rims at the suture contacts. The crystals have a vertically ribbed texture with a microscopic "sub-texture" of varying sized muscovite plates giving the megacrystal edges a microscopically feathery appearance. Additionally, the "terminations" of the megacrystals are skeletal. The muscovite has a silvery color on the cleavage and a light gray color on the vertical faces. The gray color has erroneously led a few collectors to assume the crystals are actually lepidolite. (These muscovites yield an evanescent red tinge, indicating lithium, to a blowpipe flame [Ray Sprague, personal communication, 1991]). Sprague (1991) wrote that there were: "... three types of growth: 'Ball Mica', a radiating 'Pillar Mica' and a 'Pseudo-Hexagonal' type. ... Signs indicated that most, if not all of the mica grew on the roof of the pocket, 'shelling' off onto the pocket floor." Associated minerals deposited on the muscovite clusters include clear quartz crystals (to 4 mm), albite crystals (to 1 mm), drusy bertrandite coatings (barely perceptible bladed crystals under 10x microscopic examination but covering several cm²), fluorapatite, occasional cassiterite, etched beryl, sericite and clay. Many of the muscovite crystals which are found in miarolitic cavities in blocky albite at the Emmons quarry show widely spaced platelets jutting from the crystal prisms producing a kind of "comb" texture. Many muscovite crystals (to 1 cm) found in vugs in albite at the Emmons quarry show widely spaced "shelves" of muscovite flakes jutting out of the otherwise corrugated prisms.

Putnam and Perham (1969) wrote: "Who saw the 8-foot mica book in Mexico, in [the] Ridlonville section, during road work, near the river?"

Very fine, thin platy yellow muscovite crystals (to 3 cm) with stepped growth were found in albite vugs at the Rose Quartz Crystal locality, **Newry**. Plumose muscovite is found at Smith Ledges prospect, **Newry**.

Heinrich et al. (1953) wrote of a mica, perhaps from the Dunton quarry, **Newry**: "In a specimen of mica from **Newry**, Maine labeled 'lepidolite,' the lithian muscovite structure grades into that of normal muscovite. The dozen Weissenberg photographs of flakes from this specimen show the critical reflections to vary in intensity between those of normal and those of lithian muscovite. Spectrographic analysis of this material indicated 4.1 percent Li₂O." Muscovite cleavages at the Dunton quarry are generally yellow to silvery yellow and can be over 20 x 20 cm. Some slightly undulating, very pale silvery lilac cleavages which have been supposed to be lepidolite, may in fact be lithian muscovite, but no descriptive passages accompany the analytical studies published.

The Nevel quarry, **Newry** has yielded by-product, silvery yellow muscovite during the mining of microcline. Quantitative determination of the alkali and alkaline earth variation of muscovite/albite pairs was reported by King (1980). Hess et al. (1943) provided an estimated spectrographic analysis of Nevel quarry (triphylite pegmatite) muscovite from the well-zoned apical portion of the pegmatite.

Some excellent sub-transparent muscovite "stacks" (to 4 x 6 cm) were found at the BB #7 quarry, **Norway**. The crystals

have a pale yellow to silvery color on the basal pinacoid and the basal pinacoids are relatively flat and show completely in-filled suturing between parallel mica stacks. Each stack shows an irregular to hexagonal cloudy core. The sides of the stacks are yellow-green with yellow color zones near the basal pinacoid and occasional pale pinkish purple zones near the point where the crystal was attached to matrix.

Large sheets (to 30 x 20 cm) of lightly ruled muscovite have come from the Mount Mica quarry, **Paris**, but the locality has not been famous for its commercial mica production. Muscovite books are frequently found enclosing green tourmaline crystals (to 1 x 5 cm) flat-lying and in jackstraw fashion or with green to blue tourmaline replacements of the edges of the mica books. King (1992c) described the replacement of muscovite by green elbaite. Nearly identical-appearing tourmaline replacements and interlaminated intergrowths of elbaite occur at most of the gem pocket-bearing Maine pegmatites: Pulsifer quarry and Groves quarry, **Auburn**; Harvard quarry, **Greenwood**; Dunton quarry, **Newry**; Mount Marie quarry, **Paris**; Berry-Havey quarry, **Poland**; Black Mountain quarry, **Rumford**, etc. Large triangular muscovite crystals (to 20 cm) are found lining crystal pockets at Mount Mica quarry. Frequently the silvery yellow muscovite pocket-crystals have a thin recrystallized selvage (to 5 mm) of slightly darker grayish yellow to silvery gray lithian muscovite. Overgrowths of euhedral muscovite on "euhedral" cores of annite (to 6 cm) are found in matrix. Peculiar fibrous muscovite overgrowths on platy muscovite in quartz were described on Mount Mica quarry specimens by King (1992d). The silvery parallel fibrous overgrowths (to many cm) very much resembled cymatolite, but were certainly not related to it in formation.

McKinley (1935) noted a schorl crystal from the Mount Mica quarry with a "finely foliated" sheaf-like overgrowth of pink montmorillonite-stained muscovite.

The Black Mountain quarry, **Rumford** has produced the largest quantity of yellow sheet and scrap mica in Maine. Maillot et al. (1949) reported that: "The total production from the Black Mountain quarries to August 1942 was approximately 1,950 tons of scrap mica, 33 tons of beryl, 460 tons of potash feldspar, 120 tons of soda feldspar, and 2 tons of spodumene." Plumose mica is found in the pegmatites of Whitecap Mountain, **Rumford**.

A peculiar fine-grained silvery muscovite schist with "log-jams" of rod-like andalusite crystals (1 x 0.2 cm) in the plane of foliation has been found in **Salem**.

Ahrens and Liebenberg (1950) determined SnO₂ (0.45 weight %) in **Stoneham** muscovite, and this was the highest value of their survey of 61 worldwide selected samples involving several mica species. Mortus (1969) noted of the Lord Hill quarry, **Stoneham**: "The smoky quartz from this area has a very heavy coating of a mica alteration which almost entirely disguises the quartz." There are many additionally interesting features of the muscovite from the Lord Hill quarry: pocket crystals, ball peen texture (q.v.), damourite variety (q.v.), margarodite variety (q.v.), and unusual chemistry. (The fluorine content of the muscovite is on the order of several weight percent and this trend

is separately under investigation.) During mining in the 1960's, numerous crystal pockets were opened which contained muscovite crystals, smoky quartz crystals (q.v.), phenakite crystals (q.v.), topaz crystals (q.v.), autunite crystals (q.v.), and fluorapatite crystals (q.v.). The pocket muscovite consisted of large pure clusters (to 25 cm) of silvery lustrous euhedral crystals (to 2 cm, but generally 5 mm) which formed on cleavelandite substrate. Frequently, the vertical faces of the muscovite had milky zones or overgrowths of muscovite. Occasionally, the surface of the muscovite crystals were covered, densely to sparsely, with phenakite crystals and/or fluorapatite crystals and on rare occasions, goyazite. The muscovite crystals sometimes form as parallel overgrowths on large muscovite cleavages.

The Aldrich quarry, Stoneham produced free-standing muscovite crystals (to 2 x 2 x 1 cm) in vugs in blocky albite.

Some of the best Maine muscovite crystals came from **Topsham**. Exceptional sharp triangular to pseudo-hexagonal thick books (5 x 7 x 2 cm) of muscovite were found lining cavities in pegmatite from an unspecified locality, probably the Trenton quarry, Topsham and specimens are preserved in the Cleaveland Cabinet of the Geology Department at Bowdoin College. Another fine-quality triangular Topsham muscovite crystal (20 x 25 cm) is preserved in the Cleaveland Cabinet, as well. Hunt (1871) wrote: "A remarkable example of a vein of considerable dimensions is seen in the feldspar-quarry [Trenton quarry] in Topsham, which occurs in a dark fine-grained friable micaceous schist. At the time of my visit, in 1869, the limits of the vein were not seen, though large quantities of white orthoclase and of vitreous quartz had already been extracted. These were each nearly pure, and in alternate bands, the quartz presenting drusy cavities lined with remarkable tabular crystals. One band was made up in great part of large crystals of mica, and portions of the vein consisted of a granular saccharoidal feldspar." Bastin (1910) reported muscovite books 20-25 cm in diameter from the Mount Ararat Eastern Slope quarry, Topsham. One muscovite "book" from Porcupine Hill quarry, Topsham is 30 x 20 cm.

The Beacon Light quarry, **Waterboro** is one of the early muscovite producers in Maine (MMJ, October 8, 1880).

Sterrett (1923) reported of **Waterford**: "A deposit on Beech Hill, in the town of Waterford, on the farm of George L. Kimball, has been operated for mica on a larger scale probably than any other deposit in the State. ... Some of the muscovite books are a foot across, but most of them are less than 5 inches."

Diamond or rhombic shaped muscovite crystals (to 2 cm) are found embedded in an unspecified quartz-feldspar pegmatite quarry in **Woodstock**. (These are undoubtedly the kinds of mica crystals that started Nathaniel Perry in the mineral business.)

Ball Muscovite

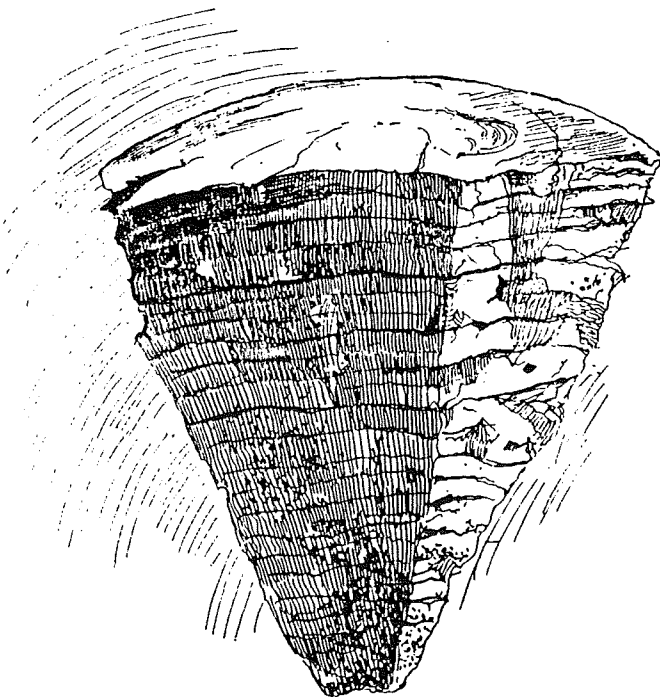
"Ball" muscovite, also called ball peen muscovite, is found in several Maine pegmatites. Almost without exception, ball muscovite is found in mineralogically unusual pegmatites, frequently with significant quantities of phosphates and/or gem

pockets. ("Ball" morphology can also be observed in lepidolites.) Excellent ball muscovite comes from the Hatch Farm quarry, **Auburn**, Bennett quarry, **Buckfield**, Gross prospect, **Greenwood**, Mount Rubellite quarry, **Hebron**, and Lord Hill quarry, **Stoneham**. (Other famous worldwide ball muscovite locations include the phosphate locality at the Fillow quarry, Branchville, Connecticut; the phosphate-rich and rose quartz crystal-producing pegmatite at Sapucaia, Minas Gerais, Brazil; and the gem tourmaline locality at the Chandler quarry, Raymond, New Hampshire.) It is unclear why ball muscovite and ball lepidolite form. Many mineralogically similar pegmatites do not have this texture.

Huntington (1889) wrote of ball muscovite from the Hatch Farm quarry, **Auburn**:

"Some time ago I received from Dr. D. F. Lincoln of Boston some remarkable specimens of curved mica... This crystal had its cleavage face very much curved, while the successive layers tapered back to an apex at the centre of curvature, the whole having the appearance of forming a portion of a sphere. The occurrence of these micas is very well described in a letter from Dr. Lincoln: -

"The specimens of mica were procured by me in 1885, from Mt. Apatite in Auburn, Maine. The rock of that locality resembles that of Mt. Mica, being a granite, with all its components (quartz, orthoclase, cleavelandite, muscovite, black tourmaline, etc.), in very large masses. The peculiar mica is found at one of these quarries at points on the border of the quartz deposit. ... One vertical face of the quarry presented a most interesting exposure. Here the mica stood out in bosses, or huge breasts, looking like broken spheres developed from numerous centres, and grouped very irregularly. The spherical surfaces, on analysis,



Ball Muscovite, Auburn (from Huntington, 1889)

consisted of groups of rhombic figures, each representing a crystal of mica, with curved cleavage and tapering to the centre of the sphere.'

Thus it appears as if these crystals were the result of two distinct tendencies acting together, one concretionary, exerted to make the mass solidify from centres, and the other the crystallizing force, tending to form at the same time the rhombic prism of 60° and 120° so characteristic of the mineral."

Muscovite Pseudomorphs

Prograde muscovite pseudomorphs after staurolite crystals (to 1+ cm) were described by Guidotti (1965b, 1968b, 1970, 1974) in the sillimanite zone, **Byron, TD**, and **TE**. Wolfe (1960) reported muscovite pseudomorphs of staurolite from the Cascade Brook area, **Sandy River Plantation** and near Smalls Falls, **Township D**. Guidotti (1968b) reported: "In the upper staurolite zone, moderately poikilitic, 1 cm subhedral to euhedral staurolite occurs in a medium-grained, well-foliated matrix of muscovite, biotite, quartz, and plagioclase. Coinciding approximately with the first appearance of sillimanite, staurolite in many specimens becomes anhedral with coarse laths of muscovite occurring around the outer rim... At progressively higher grades in the lower sillimanite zone the muscovite rimming becomes more pronounced and the enclosed staurolite shrinks... until it disappears at the isograd marking the upper sillimanite zone... The degree of pseudomorphing is readily observable even in the field. In some cases the pseudomorphs exhibit shapes typical of staurolite twins and occasionally include 2 mm garnets. Above the isograd marking the upper sillimanite zone the aggregates of muscovite in the pseudomorphs tend to recrystallize into single large plates, up to 2 cm across, and commonly lie at high angles

to the enclosing foliation... In some cases these muscovite plates contain swarms of fibrolitic sillimanite." Cheney and Guidotti (1973) reported on similar pseudomorphs from the Puzzle Mountain area, Andover and Newry

Newberg (1979) wrote of **Cushing**: "In the rocks of the Benner Hill sequence pseudomorphs of muscovite after staurolite [sic] are common evidence that at least in the southeast portion of the map area the rocks have been affected by retrograde metamorphism."

Newberg (1984) wrote of **Litchfield** and **West Gardiner**: "In the northwest part of the quadrangle, thin section examination of the Waterville Formation indicates that in many places there is evidence of pseudomorphs of randomly oriented coarse grained muscovite after staurolite porphyroblasts."

Moench (1970) reported of an outcrop of the Rangeley Formation, **Sandy River**: "Gray pelitic phyllite (metashale) with pseudomorphs chlorite and sericite after staurolite is dominant."

Warner and Pankiwskyj (1965) noted in **Wilton**: "East end of crop contains mica-rich rocks of the lower part of the Thompson Mountain Formation. Several tight folds can be seen. Note the upgrade pseudomorphs of muscovite + biotite after staurolite."

Excellent muscovite pseudomorphs of andalusite (up to 3 cm) characterize much of the pelitic portions of the Cape Elizabeth Formation, Cape Small (which includes Small Point), **Phippsburg** (Hussey, 1985, 1988). The muscovite pseudomorphs are associated with poikiloblastic andalusite, staurolite, biotite, garnet, quartz, and cordierite. These are figured in Hussey (1988). These pseudomorphs are interpreted to be replacements of poikiloblasts from an early metamorphism, and the new andalusite and staurolite are products of metamorphism during the Acadian orogeny.

N

***nacrite** = muscovite? (Mica Group)

Brunswick?; **Leeds?**; **Unity** - *James Neal Farm A*

Two different minerals have been named nacrite. Brongniart introduced the name nacrite in his *Traité Élémentaire de Minéralogie* in 1807, and his nacrite is currently known to be a polytype of kaolinite. This mineral has yet to be reported from Maine. In 1836(b), Thomson named another mineral nacrite from the James Neal farm, **Unity** and so there were two nacrites at one time. The literature was somewhat confused on the locality of the nacrite and it was usually listed as coming from **Brunswick** even as late as Houghton (1861). Alger (1844) wrote of both nacrites: "There seems no longer any propriety in retaining this mineral as a distinct species; all its characters allying it with common talc, or chlorite of the present work, the editor has assigned it to that place. It is evident, however, that the name nacrite has been applied to substances widely different in chemical composition; that, so called from Brunswick, Me., analyzed by Dr. Thomson, contains alumina instead of magnesia, and is a variety of common mica." Nacrite (of Thomson) was not well categorized by systematic works until Dana and Brush (1868): "Thomson, in an analysis of his *nacrite* ... from 'Brunswick' [should have been *Unity*], Maine, obtained the composition of a pyrophyllite. But the mineral is actually a green mica; the high silica, *as he says*, was due to mixed quartz." The interest in understanding Unity's nacrite died in the nineteenth century. Currently, the name is extinct with no specimens surviving to represent the material, and the whereabouts of the type locality awaits research in Unity's town records.

Morrill et al. (1958) listed nacrite from **Leeds** without substantiation.

Brush (1866) named cookeite and referred to it from Mount Mica quarry, **Paris** and Mount Rubellite quarry, **Hebron**: "Associated with the tourmaline and lepidolite of Hebron and Paris, Maine, there occurs a pearly micaceous mineral somewhat resembling *nacrite*." This was not intended as a nacrite report, however.

NATROLITE (Zeolite Group)



Litchfield - *Dennis Hill A*; **Perry** - *Loring Cove A*; **Windham?**

Natrolite reported from the Dennis Hill area, **Litchfield** consists of white to tan, parallel, coarsely fibrous, opaque 1 x 2 cm patches in nepheline and albite rock. The coarseness of the "natrolite" was such that the mineral looked more corrugated than fibrous and it appeared to be replacing nepheline. Natrolite is also a major component in hydronepheline (Thugutt, 1910). Thugutt's (1910) results indicated that hydronepheline was a fine-grained chalky mixture of natrolite (82%±), gibbsite (15%±), and diaspore (2%±).

Morrill and Hinckley (1959) listed natrolite "(rare)" from **Perry**, and Morrill et al. (1958) listed it from an unspecified locality in **Windham**. No specimens known.

natromontebasite? (Amblygonite Group)

Paris? - *Mount Mica Q*

Natromontebasite from the Mount Mica quarry, **Paris** has been listed in several mineral dealers' sales lists in 1990. A specimen labeled "natromontebasite" from Mount Mica quarry was chemically analyzed by electron microprobe (this study) and inconsequential sodium was found. No references are known and the specimens seem to be ordinary montebasite.

neomesselite? (Fairfieldite Group)

Newry? - *Nevel Q*

Neomesselite was named by Frondel (1955) to replace messelite in the nomenclature of the fairfieldite group after messelite had been discredited by Wolfe (1940). Čech and Padera (1958) resolved the nomenclature problem, reinstated messelite, and recommended that neomesselite be relegated to synonymy. In the short period of neomesselite's species recognition, several collectors called the Nevel quarry fairfieldite by the iron-rich implied name - neomesselite. Part of the problem was the comment by Frondel (1955): "Fairfieldite itself needs further study, since a close comparison of x-ray powder photographs of this mineral from some of its reported localities show slight unexplained differences. The material from Newry, Maine, and Hagendorf, Bavaria, is virtually identical in pattern with that of the fibrous neomesselite from Palermo and is relatively close to that of collinsite, whereas the fairfieldite from Branchville, Connecticut, and Buckfield, Maine, have identical patterns which differ slightly from those of the other fairfieldites and from neomesselite." While it is unknown what the chemistry of Fron-

del's (1955) Newry material was, messelite has been independently verified (this study) on a unique specimen from the Bell Pit, which was extensively opened from a small pre-existing prospect in 1964.

NEOTOCITE



TDR2 WELS - *Maple Mountain P*; **T9R3 WELS** - *Hovey Mountain P*

Neotocite is a microscopic fine-grained dark brown resinous component of the brown and black banded manganese ores of the Maple Mountain - Hovey Mountain district, **TDR2 WELS** and **T9R3 WELS**. Eilertsen (1952) noted: "... neotocite (amorphous) ... but these are almost wholly restricted to veinlets generally confined within the manganiferous, banded hematite." Pavlides and Milton (1962) wrote of the same rocks: "A substance amorphous to X-rays, and with an index of refraction slightly greater than 1.57, has been noted in at least one thin veinlet. This material may be neotocite, although the range of refractive index of neotocite cited by Larsen and Berman (1934, p. 48-51) is $1.47 \pm$ to $1.54 \pm$."

NEPHELINE (Feldspathoid Group)



Gardiner; **Litchfield** - *Dennis Hill A*; **Monmouth** - *southern Cochnewagon Pond A*; **Newfield** - *Straw Hill A*; **Parsonsfield** - *Randall Mountain stock*; **Wayne**; **West Gardiner** - *Spears Corner A*

Nepheline is a major component of some of the drift boulders collected on Dennis Hill, **Litchfield** and adjacent **Gardiner**, **West Gardiner**, and **Monmouth** locations. The nepheline is found as 3 - 7 cm massive grains intergrown with albite, annite, cancrinite, sodalite, zircon, etc. It is ashen gray to smoky gray or even white in color and has an oily luster and one good cleavage. Kunz (1892a) described nepheline and its associated minerals from Litchfield. Steiger (1900) reported on Litchfield nepheline solubility. Barker (1965) mapped the bed-rock occurrence.

Bayley (1892c) wrote of an unspecified locality of the Litchfield area: "Another of the prominent components is eleolite [nepheline], which appears as irregularly shaped masses or as large columnar crystals with a length of as much as two inches and a breadth of half an inch. The irregular masses are distributed uniformly throughout the rock, while the crystals occur only in those portions in which the darker constituents are lacking (i.e., in acid 'Schlieren'). In both cases the mineral possesses a gray

color and the characteristic oily luster of eleolite, while its cleavage cracks are marked by interpositions of long dark needles of a black mica."

True (1869) claimed: "*Elaeolite*. - Monmouth. This mineral was first discovered in this country, by the writer in 1837. It is found scattered in a trail of boulders a width of a mile and a half in that town, north into the town of Wayne, where it is probably found associated with the Syenites of that region."

Carpenter (1953) was responsible for reporting nepheline from **Newfield**:

"Dr. L. W. Carpenter, Limerick, Maine, has sent in 2 specimens which he had collected at Newfield, York Co., Me. One of the specimens is sunstone (oligoclase), associated with a black platy mass of columbite in a dark gray nephelinite. The sunstone is oligoclase with spots so thickly aventurine it looks copper-red and is about the best sunstone we ever saw from an American locality.

The other specimen is sodalite as a bright blue mass on dark gray nephelinite.

Here is Dr. Carpenter's letter, dated Aug. 11, 1953, telling us about the finding of the above specimens: -

'This is to report what I believe to be a new sodalite location. Last fall (1952), Forrest W. Carpenter and I while prospecting the stone walls, in Newfield, Me., noticed a blue-gray deposit on several of the wall boulders. Chipping these weathered spots, we found it to be blue sodalite. We broke up several of the boulders, and collected some very good specimens, some of which we have given to, or exchanged with, several rockhounds.

'At the time we discovered this sodalite we were unable to find any *in situ* and therefore did not report it. We supposed the boulders to be erratics. We had not been there for nearly a year until Aug. 4, 1953, when Mrs. Carpenter and I, together with Mr. and Mrs. James Leseman of 119 Parrott St., So. Portland, Me., felt it was time to look the place over. We found that since last fall a well had been drilled, and the cellar and a foundation area had been blasted out, about 100 yds. away, on the side of the hill. The rock blasted out proved to be the same as the rock in the wall, a yellow green nephelinite with much soda, and judging from the subconchoidal fracture, a considerable percentage of silica. We found the sodalite to be in thin veins, for the greatest part, but have several good specimens from $\frac{1}{4}$ to $\frac{1}{2}$ inches in thickness. We have found 4 colors, white, blue, light red, and a very little green. The location is on Straw Hill, Upper Newfield Rd., leading from Limerick, Me., to Newfield, Me. and approximately 4 mi. from Limerick Village. The land is owned by Arthur Carpenter, Jr."

Only one Newfield nepheline specimen is known (AMNH collection). The identification of columbite [by Peter Zodac?] is open to significant skepticism, and the comment concerning "silica" seems in error. The reported mineral is nepheline, or at least has all of its appearances (untested).

Gilman (1978) wrote of the Randall Mountain stock, **Parsonsfield**: "Orthoclase constitutes more than 95 percent of the rock. Mafic minerals are biotite, hornblende, and aegirine-augite. Nepheline was identified in one specimen as was sodalite."

Few specimens of **West Gardiner** nepheline are known, but this lack may be due to reforestation after farming ceased as many specimens from the Litchfield area came from "lines" of drift boulders. Kunz (1885) noted the localities in West Gardiner: "One mile and a half west of this line, across a pond in West Gardiner, these minerals are found associated with zircon, as in South Litchfield. On some of the West Gardiner farms there are ledges of rocks that are evidently the sources of these boulders. The boulders occur principally on the farms of Moses True, Capt. Joseph Wharff, and Rufus Smith."

nephrite? (Amphibole Group)

Eustis?; Portland? - Commercial Street A

Nephrite is a fine-grained amphibole rock which is considered to be the more common form of "true" jade (q.v.). Nephrite is found under very special circumstances and it is doubtful that the Maine reports of nephrite jade are substantiated.

Morrill et al. (1958) listed nephrite from **Eustis**, but the word nephrite may have been a translation of "jade" (q.v.) or bowenite (q.v.). "Serpentine jade" is known from Eustis, and some coarse-grained amphibole-bearing rock has been over-enthusiastically called jade by a few collectors.

True (1869) reported from **Portland**: "*Nephrite*. This magesian mineral has recently been discovered in blasting rocks for cellars on Commercial Street in Portland." Drilling into a mineral as hard as nephrite would have been a daunting task in this time period and that difficulty might have reasonably deserved notice in the 1869 report. No specimens known. The report might have indicated some of the amphiboles present in the Spring Point Formation (Arthur Hussey, personal communication, 1992).

niccolite = nickeline

NICKELINE

NiAs

Blue Hill? - Mammoth M, Twin Lead M; **Byron?**; **Calais?**; **Rumford?** - McCrillis Nickel M; **Union** - Harriman P

Stewart (MMJ, April 16, 1880) reported of the Twin Lead mine, **Blue Hill**: "The true ore-channel of the lode is a massive, well-defined quartz vein, which is permeated throughout by a variety of metallic elements such as Magnetic Iron, Zinc Blende, Mispickel, Arsenical Nickel, Iron Pyrites, Yellow Copper, Native Copper - in thin sheets - Chrysocolla, Antimonial Silver, Argentiferous Galena, and other undetermined substances." Morrill and Hinckley (1959) listed "nicolite" from the Twin Lead mine. "Nicolite" was reported from the Mammoth mine, Blue Hill

(MMJ, July 16, 1880): "Various mixtures of copper, galena, nicolite, blue carbonate, etc. were also found." No specimens known from Blue Hill. Identification probably based on blow-pipe analysis of pyrrhotite/pentlandite mixtures.

The McCrillis Nickel mine, **Rumford** has been supposed, by local folklore, to contain nickeline because the locality was a nickel mine. No verified samples are known from the locality and the supposition must be believed to be false. Nickeline is found at only a few of the world's nickel mines. Pentlandite (q.v.), a mineral not uncommon in Maine schists, was the probable nickel mineral sought.

Rainville and Park (1976) reported that at the Harriman prospect, **Union**: "Niccolite is locally abundant in pegmatites and is commonly rimmed by rammelsbergite." The size and physical appearance are not noted, but presumably pinkish bronze nickeline was found only in polished ore sections investigated by the microscope.

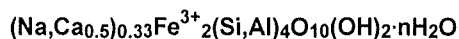
NIGGLIITE

PtSn

Union - Harriman P; **Warren** - Warren Nickel P

Niggliite is one of the rarest minerals known. The mineral was found at the Harriman prospect, **Union** and/or the Warren Nickel prospect, **Warren**. Rainville and Park (1976) only said: "The platinoids are extremely rare and are enclosed by pyrrhotite and pentlandite grains. Most grains are only a few micrometres in size and show good idiomorphic development. Most grains are isotropic, but one mineral displayed strong anisotropism. These grains were compared to several cobalt and platinoid minerals from the collection of P. Ramdohr at Heidelberg University. None of the isotropic minerals was identified except sperrylite (PtAs₂), but the anisotropic mineral has been identified as niggliite (PtTe - PtSn), because it compares favorably to samples of that mineral from South African deposits." Niggliite is obviously not visible in most hand specimens and requires special treatment for identification. Rainville and Park (1976) do not provide supporting data for their identification.

NONTRONITE (Smectite Group)



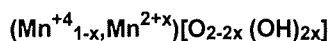
Topsham - Havey #2 Q, Swamp #1 Q, Yedlin L

The smectite nontronite is essentially the ferric analog of montmorillonite. Due to its iron-bearing nature, it is usually yellow green to "mustard yellow."

The Swamp #1 quarry, Havey #2 quarry, and Yedlin locality **Topsham** pegmatites seem to have a fair amount of nontronite

(chemical analysis and XRD, this study) as thin earthy films on fracture surfaces in microcline. The nontronite can have a distinctly yellow appearance and can look like autunite which doesn't fluoresce. The bright color of the nontronite fades with dehydration.

NSUTITE



Pyrite Creek in Long Pond quadrangle - Parlin Pond

Nsutite forms a black earthy cement between sand grains in sediment samples in Pyrite Creek in the Long Pond quadrangle, **Parlin Pond** (Nowlan, 1976a,b, Potter and Rossman, 1979). The nsutite cemented lumps are generally 5-7 mm and consist of black almost resinous to earthy masses and stains, with many lumps consisting almost exclusively of nsutite. The lumps which have formed in stream sediments can show a crude concentric banding. The lumps usually have a brown earthy exterior. Nowlan (1976a,b) chemically analyzed "325 samples of concretionary Mn-Fe oxides. ... for more than 30 elements," but only Potter and Rossman (1979) identified the species present in any of the concretions.

O

oligoclase (Feldspar Group) - see plagioclase series; major component in granites

olivine - a group of minerals; see fayalite and forsterite

opal (Silica Group) - see tridymite

Albany - Donahue P; **Auburn**; **Buckfield** - Bessey Q; **Casco** - Route #302 road cut; **Freeport** - U.S. Route #1 road cut; **Fryeburg** - Eagle Gray Q; **Greenwood** - Beryllium Corporation P, Emmons Q; **Jonesport?**; **Mexico** - U.S. Route #2 road cut; **Newry** - Dunton Q, Rose Quartz Crystal L; **Paris** - Hoopers Ledge Q, Mount Mica Q, Twitchell Q, Whispering Pines Q; **Rumford** - Black Mountain Q; **Topsham** - Interstate Route #95 road cut, Undivided Q, William Willes #1 Q, Yedlin L; **Warren** - Starrett Q

Opal is a varietal name in the Silica Group. Some opal can be definitely attributable to tridymite (q.v.) or, occasionally, cristobalite. Opal has not yet been verified as a variety of quartz, anywhere in the world. There are three main sub-varieties of opal: common opal, precious opal, and hyalite opal. Hyalite is so intractable to diffraction, by X-rays and even shorter wavelengths, that it can rarely be identified by this method. Hyalite usually consists of colorless botryoids (about 1 mm) in thin coatings on crystals in vugs or along fracture surfaces. It usually fluoresces green in short-wave ultraviolet light. Maine specimens are rarely conspicuous, much less showy.

Thin films of fluorescent (green by short wave ultraviolet light) hyalite have been found with white to pale yellow, milky, spiky botryoidal aragonite crystals (to 1 cm) in a road cut along U.S. Route #302, **Casco**.

Perham (1960) reported that excellent hyalite opal was found in a road cut, presumably U.S. Route #1, **Freeport**. Specimens in the Bowdoin College Cleaveland Cabinet consist of pale yellow, cloudy to transparent, highly fluorescent patches (to 3 x 3 cm) on fracture surfaces of coarse to pegmatitic biotite granite.

Yellow cloudy botryoidal hyalite opal (to 4 mm) is found coating fracture surfaces in pegmatitic granite at the Eagle Gray quarry, **Fryeburg**. White botryoidal to spherical spiked groups of aragonite crystals (to several mm) are sometimes associated. The hyalite opal fluoresces bright yellow-green in short wave ultraviolet light.

Fraser (1930) noted of the Dunton quarry, **Newry**: "Locally, opal has deposited on quartz crystals." Frondel (1950) listed opal associated with phosphuranylite from the Dunton

quarry. No specimens known. Transparent globular hyalite (to 1 mm) is found on albite crystals (to 4 mm) at the Dunton quarry. The hyalite opal fluoresces bright yellow-green in short-wave ultraviolet light. Hyalite opal in clear to bright pearly-white botryoids (to 1 mm) is found on albite crystals at the Rose Quartz Crystal locality, **Newry**, but the fluorescence is dim compared to other locations.

Seaman (1975c) noted opal from **Paris**: "... occurs at Mt. Mica in association with almandine garnet, black tourmaline, microcline, uranophane and autunite" as well as from unspecified areas in Buckfield and Rumford. Neil Wintringham (personal communication, 1992) noted: "The Twitchell Q material, collected in Oct[ober]. 1961 when the quarry had been worked for road metal, was the best I've seen for Maine; the thick, bubbly, glassy crusts were every bit as good as the Chalk Mtn., N[orth]. C[arolina]. material."

Yedlin (1942) lists an occurrence at the now so-called Yedlin prospect, **Topsham**: "HYALITE - The exposed surface of a large mass of quartz at one of the test pits was covered with a white blebby skin of this material. It was not fluorescent."

ophiolite - a rock term indicating a sequence of altered volcanic rocks and other rock types associated with oceanic crust

Alder Stream; Jim Pond

Ophiolite was listed by Lander (1955) among the "minerals" that are found in **Alder Stream** and **Jim Pond**.

orpiment?

Newfield - Bergendahl P

Orpiment has been suggested (Morrill et al., 1958) to occur, without substantiation, at the Bergendahl prospect, **Newfield**. The occurrence is highly unlikely.

orthite = obsolete name for allanite

ORTHOCLEASE (Feldspar Group)

$(K,Na)AlSi_3O_8$

"acid dikes" - **North Haven**, **Vinalhaven**; **Appleton** - *Lincoln Sill*; **Bryant Pond quadrangle**; **Buckfield quadrangle**; **Ludlow** -

Ludlow Q; **Mapleton** - Aroostook River A; Spider Lake quadrangle - Bluffer Pond Formation; York (**Ogunquit**) - Spouting Rock A, Pine Hill A

Orthoclase is an alkali feldspar which has monoclinic symmetry due to its high-temperature mode of origin. Temperature has been shown (Wright, 1968; Wright and Stewart, 1968) to be systematically responsible for the order-disorder relationship of silicon and aluminum components within potassium feldspar crystals. High temperature would favor the partially even distribution (partial disorder) of the aluminum and silicon and would produce orthoclase. Higher temperatures produce a completely disordered K-feldspar called sanidine. Authors are not universal in their nomenclatural treatment of the potassium feldspars. There are detectable changes in the physical and optical properties of potassium feldspar from ordered crystals (microcline) through successively less ordered crystals (orthoclase through sanidine). Adularia can be microcline or occasionally orthoclase. There was a period of time during the late nineteenth and early twentieth centuries when the name orthoclase was applied to virtually all members of the order-disorder series. Bastin (1911) called most of the microcline in Maine pegmatites by the name orthoclase. The variety "maximum microcline" or, simply microcline, **only** has been found in Maine granite pegmatites. (Foord and Martin (1979) have shown that a thin coating of sanidine can crystallize on amazonite from the Pike's Peak region, Colorado, but the method of formation is related to speed of crystal growth rather than high temperature.)

Guidotti et al. (1973) noted orthoclase with varying structural states distributed in the contact metamorphosed rocks in the potassium feldspar + sillimanite zone north of the Songo granodiorite in the **Bryant Pond** and **Buckfield quadrangles**.

One of the better Lincoln Sill exposures is in the Burkettville village gravel pit, northwestern **Appleton**. Elders (1969) wrote of orthoclase from the Lincoln Sill: "... porphyritic coarse-grained syenite forms discontinuous concordant lenses running from Boothbay Harbor for 80 km inland. ... Abundant euhedral zoned phenocrysts of orthoclase comprise more than 40% of the normal syenite. ... Many phenocrysts exhibit parallel growth and synneusis. Adjacent crystals were free to move to reduce joint surface area during growth. Hiatuses in crystal growth are marked by disconformities in zoning but definite patterns could not be traced from crystal to crystal." The "crystals" vary in structural state and are locally orthoclase- or microcline-rich. See additional discussion under microcline.

Gregory (1900) wrote of an unusual intergrowth from aplite veins in the Ludlow granite quarry, **Ludlow** and in the Mapleton granite, **Mapleton** exposed near the Aroostook River: "... orthoclase constitutes nearly all the feldspar, and that the remainder is oligoclase in well-developed crystal sections with Carlsbad twinning." The crystals were sharply divided with orthoclase "welded" against finely checkerboard twinned microcline. A more peculiar intergrowth was noted from a granite porphyry in Ludlow (Gregory, 1900): "Microcline occurs in indefinite, partly

developed structures in connection with orthoclase, and also as clear-cut crystal sections, with the characteristic cross hatching clearly defined. With the orthoclase it forms peculiar zonal growths. The outside of a microcline section may be separated from the inside by a zone of orthoclase; or the microcline may be completely surrounded by a band of orthoclase. In one case four zones - two orthoclase and two microcline - must be passed over in going from the periphery to the center of the crystal..." The size of the grains discussed was not indicated, but they were probably best measured in millimeters.

Smith (1901) noted orthoclase in acid dikes exposed on the shores of **North Haven** and **Vinalhaven**.

Hall (1970) wrote of the Ragged Mountain Member of the Bluffer Pond Formation, Spider Lake quadrangle: "The potassium feldspar has a small 2V (40°-50°) and is presumably orthoclase-sanidine."

Keeley (1924) noted orthoclase from Spouting Rock, Ogunquit, **York**, and of the Pine Hill area, **York** noted: "Sections of one of the porphyritic-included fragments show the apparent phenocrysts kaolinized to a porcelaneous appearance, but identifiable as orthoclase, one area showing distinctly microcline grid-iron texture, and another Carlsbad twinning. They are corroded at the margins and outlined by dark reaction rims." The report of "orthoclase" seems to be based on recognition of the recrystallization of the original orthoclase.

osannite? (Amphibole Group) = riebeckite?

Litchfield - *Locality C*

Daly (1918) wrote of locality C, north of Spears Corner, **Litchfield**: "The large body at C is made up partly of this biotitic syenite, partly of an amphibole-bearing mica-free phase which appears to graduate into the former through mica syenite with accessory amphibole; the feldspars and subordinate accessories remain the same throughout. The amphibole, a new variety, is powerfully pleochroic, with tints of deep grayish blue and greenish yellow. ... The amphibole obviously belongs to the alkaline series, and in its properties approximates osannite." Leake (1978) reported that correctly identified osannite was equivalent to riebeckite.

ottrellite? (Chloritoid Group)

Livermore? - *Sabattus phyllite*; **Portland?** - *Jewell phyllite*; **Winthrop?** - *Sabattus phyllite*

Katz (1917) used the, then, poorly defined mineral name ottrellite to specify a mineral found in the Jewell Phyllite, **Portland**. The Jewell Phyllite mineral is now called chloritoid (q.v.). Ottrellite, a manganese-rich member of the chloritoid group, has not yet been found in Maine. Alger (1848) demonstrated how confusing the nomenclature was: "*Ottrelite*, of MM. Desclozeaux [sic] and Damour, identical with *Phyllite*, of Dr. Thom-

son. The fact was pointed out by Mr. A[lger]. on the grounds of similarity in chemical composition, as well as in physical and crystallographic characters, so far as these latter have been determined. They both occur in small disks or plates, very thin, and the most perfect of them having the form of compressed or flattened rhomboidal tables. A specimen of Ottrelite, which he had received from Mr. Markoe, and another of Phyllite, from the hands of Prof. Nuttall, enabled Mr. A. to compare them carefully

with each other; and he had no hesitation in declaring them to be the same mineral."

Fisher (1941) noted of the **Winthrop/Livermore** area: "The frequency of these quartz-feldspar-garnet-diopside beds in the Sabattus formation suggests some correlative value because similar types occur in the staurolite and ottrelite phyllites in the middle-grade zone of metamorphism in the Livermore and Winthrop areas."

P

palermoite?

Paris? - Mount Mica Q

Palermoite was identified by visual examination of a siderite-cleavelandite thin section by Sidney A. Williams and was reported by Francis (1985). The siderite matrix has included within it peculiar crystals (less than 0.4 mm) which form "x" twins. The twins sometimes have thin granular, colorless patches along the edges of the crystals in the twins which suggest the optical properties of palermoite (S. A. Williams, personal communication, 1987). The actual report reads: "Isolated from the siderite are patches of very coarse, finely twinned oligoclase riddled with irregular stringers of quartz. The oligoclase is studied with wedge-shaped euhedra of brazilianite that show some marginal decay to palermoite, further to an irregular network of evansite seams. The final alteration assemblage includes kaolin and hisingerite" (S. A. Williams written communication to R. Thomsson, 1985). The siderite occurred in blue tourmaline eyes (q.v.). Examination of the thin sections (this study) did not confirm the identity of the palermoite due to its minute size (less than 0.03 mm). Additionally, the twinned host crystals could not be identified as brazilianite (q.v.) and they actually seem to be phosphophyllite (q.v.).

paragonite? (Mica Group)

North Haven Greenstone sequence? - Deer Isle, Islesboro, North Haven

Guidotti (1968a) discussed the absence of paragonite in northwestern Maine and the conditions of paragonite formation on a worldwide basis. Thomson and Guidotti (1989) looked for, but did not find, paragonite in "most likely" assemblages in southern Maine. Paragonite, when it is found, usually coexists with muscovite.

Smith et al. (1907), when describing an albite-pyroxene syenite's alteration from the North Haven Greenstone sequence, used an unsubstantiated identification: "Micaceous plates which are probably paragonite are developed abundantly in the albite crystals." The North Haven Greenstone is exposed on islands in Penobscot Bay, including **Deer Isle, Islesboro, and North Haven**. No specimens known.

PARGASITE (Amphibole Group)



Andover North Surplus - Dunn Notch A; **Cornish?** - Healy Farm A; **Littleton Formation** - **Andover North Surplus, Bethel, Mason; Norway** - Paris-Waterford road A; **Parsonsfield** - Dr. Swett's fields, Thistle Farm A; **Phippsburg** - The Basin L; **Rumford** - Great Falls A; **Sapling** - Indian Pond A; **Songo granodiorite** - Albany, Bethel

Fisher (1962) noted of the Songo granodiorite, **Albany** and **Bethel**: "Pargasite-hornblende series amphiboles are not uncommon." Fisher (1962) further noted from a biotite-amphibole schist in the Bethel area (including **Mason**): "This rock is a gray, medium-grained granular schist containing abundant 2-mm amphibole grains. ... Major minerals are andesine, biotite, pargasite, and quartz. The pargasite is so identified as it is optically positive, in spite of a considerable range of indices of refraction. A 20-foot thick exposure in a single outcrop is the only exposure of this rock within the quadrangle. It is here grouped with the metasedimentary rocks, but it may be a meta-andesite."

Milton (1961) reported a pargasite chemical analysis (OSM 11) in Whitecap Brook amphibolite [Littleton Formation] from a location in **Andover North Surplus**: "1415' elev. in bk. west of road north of Dunn Notch."

Large (to 1 x 0.7 cm), greenish black, slightly fibrous appearing cleavages are found in particular coarse beds in layered calc-silicate rock from the Doctor Healy farm area, South Cornish, **Cornish** and are associated with orange-red trapezohedral grossular crystals (to 1 cm) and interlocking white meionite crystals and grains (to 1.5 x 1.5 cm). These dark grains have been called hedenbergite by some collectors. However, specimens studied megascopically as well as optically (this study) indicate a member of the pargasite/hornblende series and not a pyroxene.

Shepard (1827) noted of **Norway**: "In Maine, at Norway, upon the road from Paris to Waterford, in Gneissoid [sic] Hornblende rock, crystals of *Phosphate of Lime*, of a greenish white color, imbedded in calcareous spar, and accompanied by *Pargasite* and *Sphene*." The report would have to be rejected by modern standards of reasoning except that pargasite is known from nearby quadrangles (Fisher, 1962; Milton, 1961). Pargasite was probably guessed based on the association with calcite, similar to the association from Pargas, Finland.

Jackson (1838a) wrote of **Parsonsfield**: "... we found an abundance of a rare variety of egeran, and beautiful crystals of

yellow garnet, pargasite, adularia and scapolite. They occur in a granular variety of limestone, which is scattered in profusion, in the fields near Dr. Swett's house." The locality is lost. One pargasite specimen is known (AMNH 83271, not seen).

Pargasite was first reported from **Phippsburg** by Jackson (1838a, 1839). Herbert Haven noted of The Basin, Phippsburg in his diary (Morrill, 1966): "We collected at an excavation and an old dump near the shore. There were Essonite garnets, sometimes called Hessonites, vesuvianite, pargasite, axinite, and diopside. We found another excavation farther back from the shore and there were still better specimens in that." No pargasite specimens known. (Pargasite, on a worldwide basis, is charcoal gray to black, forms in masses or prisms (to several cm), has a typical amphibole cleavage, and is frequently embedded in calcite.)

Jackson (1839) wrote of **Rumford**: "On a point just below the great falls, there is a bed of granular limestone, which was examined by my assistants, on a former occasion. This bed is of a coarse granular or crystalline variety of carbonate of lime, containing scattered green crystals of actynolite and pargasite, in small grains and fibres. The limestone is included between strata of mica slate rocks, which are greatly contorted by the power of the up-thrown granite, which cuts through its mass. Thus it will be seen that the granite veins have torn off masses of the limestone and mica slate, and swept them up to higher places than they originally occupied, while the disturbed appearance of the strata themselves evince most clearly the action of an injected igneous rock. A variety of crystallized silicates of various kinds, are found in the poorer limestone beds; observing their resemblance to similar productions of the Phippsburg limestone, I searched and found a number of those rare minerals which I had formerly discovered at the latter locality. Yellow garnet, massive and crystallized-egeran-pyroxene, of several species and varieties - such as sahlite, augite and pargasite. Phosphate of lime, of the variety called asparagus stone, &c. occur, with a few scattered crystals of scapolite."

Boone et al. (1989) reported on fibrous amphiboles (about 1 mm) from an amphibolite "block" from the western area of the northwest cove of Indian Pond, **Sapling**. Analyses #3 and 5 indicated sub-sodic silicic pargasite compositions not far from magnesio-hornblende.

pargasitic hornblende? (Amphibole Group)

Sapling? - Hurricane Mountain Formation mélange

Pargasitic hornblende is a species of the amphibole group (q.v.) which has a complex definition (Leake, 1978). Boone et al. (1989) noted "pargasitic hornblende" in "exotic blocks" in the Hurricane Mountain Formation mélange, north of Indian Pond area, central to southwestern **Sapling**: "The metabasite blocks range from chlorite-actinolite-pumpellyite-epidote-bearing metatuffs with well-preserved, primary pyroclastic textures, to actinolitic-edenitic winchite-albite-epidote-bearing, fine-

grained greenschists, to (in three of the largest rafts) pargasitic hornblende-zoisite-Mg chlorite-albite-bearing, strongly foliated amphibolite." Boone et al. (1989) showed a thin section (sample M-17) with "pargasitic hornblende" (to several mm). According to the diagrams of Leake (1978), the analyses of "M-17" samples are tschermakitic hornblende to magnesio-hornblende.

parsonsite?

Newry - Dunton Q

Pale yellow coatings of parsonsite on albite with zircon, uraninite, etc. have been found at the Ruggles mine, Grafton, New Hampshire, but were misreported as occurring at Newry by King (1987a) and at the Dunton quarry by Thompson et al. (1988, 1991).

pectolite?

Cornish - Day Hill L

Trefethen et al. (1955) reported of Day Hill, **Cornish**: "Locally crustified and vuggy skarn or tectonic zones are present containing such lime rich minerals as grossularite, idocrase, scapolite, pectolite, calcite, and scheelite in addition to the diopside and quartz." No descriptions or specimens known.

penninite (Chlorite Group) = peninine = clinochlore

Bridgewater; **TDR2 WELS** - Maple Mountain P; **Monticello**; **North Haven** - Ames Knob A; **Rockport** - Spruce Mountain summit; **T9R3 WELS** - Hovey Mountain P

Penninite is a variety of clinochlore (q.v.) with distinctive optical properties. This mineral has been reported by Smith (1901), Smith et al. (1907), Bastin (1908b), Eilertsen (1952), and Pavlides et al. (1965).

PENTLANDITE

(Ni,Fe,Co)₉S₈

Black Narrows A - East Moxie, The Forks; **Blue Hill**; Devonian tonalite - **Byron**, Roxbury, Weld, T6 North of Weld; **Oakfield**; **Pocomoonshine Gabbro-Diorite** - **Alexander**, Crawford, Princeton, Plantation 21; **Rumford** - McCrillis M; **Squaretown** - Burnt Nubble A; **Union** - Harriman P; **Warren** - Warren Nickel P

Li (1942) wrote of the copper mines, in general, in **Blue Hill**: "Thompson (1923) reports that 'a polished section showed the occurrence of pentlandite along microscopic fissures in the pyrrhotite.' No pentlandite has been found in the specimens

examined by the writer. However, a dimethyl gloxine [sic] test on pyrrhotite powder yielded evidence of the presence of nickel." (See also discussion under nickeline.)

Moench and Pankiwskyj (1988) noted of a Devonian garnetiferous biotite tonalite (mapped in detail by Moench and Hildreth, 1976), **Byron, Roxbury, Weld, and T6 North of Weld**: "The rusty spots are weathered 1-cm nodules of intergrown pyrrhotite and pentlandite."

Houston (1954, 1956) gave an extensive discussion of pentlandite at Black Narrows, **East Moxie and The Forks**; Harriman prospect, **Union**; and Warren Nickel prospect, **Warren**:

"Pentlandite in the ore is easily detected microscopically by the brighter, orange to flesh colors in reflected light, compared to pyrrhotite. The mineral also has excellent octahedral parting in most specimens. Many of the grains have been partially replaced by violarite, which is easily stained by HNO₃ leaving the pentlandite in bold contrast.

Pentlandite is found in minor amounts in all of the ores except at Katahdin [Iron Works]. In contrast with those of the other deposits, the ores in peridotite (Union, Black Narrows and the peridotite phase of the St. Stephen complex) pentlandite is more abundant compared to total sulphide content. It varies from 10% of the total sulphide content at Union, to 35% at St. Stephen. The overall percentage of pentlandite in the peridotite is low, however, averaging from .1 to 1 percent, since the sulphide content of the peridotite is low. ...

In the ores in peridotite, pentlandite occurs near the margins of pyrrhotite masses. It is rounded to subhedral with unusually well developed parting. Most of the pentlandite grains have at least one well developed crystal face against the pyrrhotite. The subrounded forms of the pentlandite, suggestive of corrosion, and the fact that the pyrrhotite conforms to the crystal boundaries and enters minor cracks in the pentlandite, seems to prove that pentlandite formed first.

The most striking characteristic of the pentlandite of the ores in peridotite is its close association with magnetite (Plate 3). Veinlets of magnetite penetrate along parting planes of the pentlandite and along contacts between pentlandite and the silicates. Some larger masses of magnetite contain inclusions of subrounded pentlandite and in many cases the pentlandite is rimmed by magnetite. These characteristics are especially developed in the ores at Union, Maine."

The foregoing discussion indicates that pentlandite is a microscopic mineral and the description is based on microscopic examination of polished specimens. Pentlandite might be visible in knots of brassy sulfides as tiny grains which reflect pinpoints of light off of parting surfaces.

Ludman (1986; and almost exactly in 1990a) reported of the Pocomoonshine Gabbro-Diorite, **Alexander, Crawford, Princeton, and Plantation 21**: "Finely disseminated sulfide minerals, including pyrite, pyrrhotite, pentlandite, and chalcopyrite, are found throughout the Pocomoonshine gabbro-diorite, but generally comprise less than 1% of the rock. These minerals commonly occur as small single crystals, but sulfide glomerocrysts as large as 3 cm in diameter may be present locally."

The McCrillis Nickel mine, also Rumford Nickel mine, **Rumford** is located on Howe Hill. Though the ore has been generally regarded as pyrrhotite (the Rangeley Formation is locally pyrrhotite-bearing and the Perry Mountain Formation is "rusty-weathering"), the nickel-bearing portion of the ore was probably pentlandite. Morrill et al. (1958) located the mine, but Moench and Hildreth (1976) did not.

Johnson and Anderson (1981) wrote of the Burnt Nubble area, **Squaretown**: "The principle geologic feature on the map is the norite-gabbro intrusive, which is part of the Moxie Pluton described in detail by Espenshade and Boudette (1967). ... Sulfide minerals, primarily pyrrhotite, but including minor amounts of chalcopyrite and pentlandite, are found in both the intrusive and intruded rock..."

"Pentlandite is the second most abundant sulfide in both [Harriman prospect, **Union** and Warren Nickel prospect, **Warren**] ore bodies. It occurs as (1) large granular masses sometimes exceeding 1 mm in diameter; (2) narrow veins within pyrrhotite and between pyrrhotite grains; (3) subhedral grains bordering or enclosed by pyrrhotite; (4) flames or rosettes exsolved from pyrrhotite; (5) intimate intergrowths with chalcopyrite, in places resulting from replacement of pentlandite by chalcopyrite; and (6) subround or irregular grains in mosaic intergrowths with chalcopyrite and pyrrhotite ... Pentlandite comprises an average of 5 wt percent of the total sulfides. ... W. A. Hockings and V. L. Doane (unpub. data) obtained a value of 34 ± 2 wt percent nickel in pentlandite, which is in agreement with our analyses. ... The average cobalt value of 2.6 wt percent is higher than the average ..." (Rainville and Park, 1976).

*PERHAMITE



Greenwood - Emmons Q; **Newry** - Bell Pit, Dunton Q, Rose Quartz Crystal L?; **West Paris** - Ski Pike L on Cobble Hill

The type localities for Perhamite are the Bell Pit, **Newry** and the Dunton quarry, Newry (Dunn and Appleman, 1977, Perham Stevens, 1978). The mineral was listed as a brown hexagonal unknown and a pearly botryoidal unknown by King (1975b). Perhamite is becoming more familiar and it is being found in a number of localities. The Toms quarry, Angaston, South Australia, Australia has snow-white porcelainous masses of perhamite, but that locality does not ordinarily have crystals, while Billaud and Boudeulle (1986) described microcrystalline perhamite from the phosphorites of Quercy, France.

Perhamite, from the Bell Pit, is tannish brown to orange tabular, hexagonal, sometimes with slightly serrated edges. Individual crystals (to 3 mm) are scarce and most of the crystals are grouped in rosettes, sometimes forming almost hollow central cores in the rosettes. A faint pearly luster can be seen through the "c" pinacoid. The matrix consists of tan scalenohedral siderite crystals (to 3 mm) with chevron-like striations in vugs (to 5 cm)

in quartz. Associated species include montebrasite crystals (to 4 mm), golden amber eosphorite crystals (to 3 mm), and transparent colorless wardite (to 2 mm). Perhamite cleavages show a slightly "wrinkled" six-fold sectional twinning or zonation.

Dunton quarry perhamite is snow-white and is found in association with beryllium phosphates such as tan botryoidal hydroxyl-herderite (to 2 mm), silky snow-white moraesite needles (to 1 mm), and massive fibrous beryllonite. Additional associated species include frosted smooth bipyramids of wardite (to 1 mm) in clusters (to 3 mm), clean, unstained cleavelandite, and green tourmaline. Due to the preponderance of white minerals in the association, perhamite is very inconspicuous at this locality. Almost completely botryoidal rosettes of perhamite are found at the Dunton quarry. When broken open they show a partially radial pattern while moraesite "botryoids" consist of a tangle of curved fibers. Perhamite can form spherical clusters of distinctly separate flakes projecting from a central core. A few snow-white distinctly hexagonal and foliated perhamite crystals are found in clusters. Ungrouped crystals are very unusual. Perhamite also can very closely resemble snow-white cookeite from the Dunton quarry, but perhamite is very, very brittle while cookeite is flexible. A fine needle scraped against an unimportant sample when viewed through a microscope can provide a useful means for identification. Similar-appearing crandallite, from the Dunton quarry, generally is not completely white, the crandallite being generally stained brown to black on crystal edges.

Perhamite has been visually identified from the Rose Quartz crystal prospects in Newry, where it formed spherical rosettes (to 2 mm) of micaceous white hexagonal plates associated with rose quartz crystals in cleavelandite, but specimens provided by collectors for testing are crandallite.

Perhamite was found at the Emmons quarry, **Greenwood** shortly after the Newry material was described. In some ways the material is superior to the original find. The hexagonal crystals (to 3 mm) show small horizontally striated vitreous prisms and form rosettes of crystals (to 5 mm). The rosettes, however, can resemble rosettes of tiny mica crystals of the same size and color (tan to colorless) as the Greenwood perhamite. The matrix consists of albite crystal vugs (to 1 cm) in cleavelandite.

Perhamite from the Ski Pike locality on Cobble Hill, **West Paris**, is composed of excellent clear to tan rosettes of serrated-edge perhamite crystals (to 6 mm) in albite. Some of the rosettes can resemble shaggy botryoids of mica, while a few exceptional specimens are transparent colorless rosettes of crystals. All clusters of perhamite at this locality are cyclically twinned and the rosettes have a central cavity or "hopper-development" (Ray Sprague, personal communication, 1990).

pericline (Feldspar Group) = a particular variety of plagioclase

Cutler - Cutler diabase; **Lincolnvile** - U.S. Route #1 road cut; **Norway** - Horse Hill A; **Vinalhaven** - olivine diabase

Pericline is generally reserved for albite crystals which have a wedge-shaped morphology dominated by pericline twinning. Megascopically, pericline crystals have a wedge shape somewhat different than adularia, but the distinction between pericline (plagioclase) and adularia (K-feldspar) shapes sometimes disappears in practice.

Gates (1961) noted pericline twinning in plagioclase from the Cutler diabase, **Cutler**.

Opaque tan pericline crystals (to 8 mm) were found in a U.S. Route #1 road cut, **Lincolnvile** in a vuggy matrix containing gray-green splintery amphibole.

MacKenzie (1923) noted pericline twinning in oligoclase crystals from the Horse Hill area, **Norway**, as did Smith (1901) in labradorite from an olivine diabase from **Vinalhaven**.

peristerite (Feldspar Group) - a chatoyant variety of oligoclase

Topsham - Consolidated #1 Q, Swamp #1 Q, Yedlin L

Three major kinds of chatoyant feldspars are known: moonstone, labradorite, and peristerite. Moonstone has not yet been found in Maine, and labradorite does not occur in Maine granitic pegmatites. Peristerite shows a flash of internally "reflected" light of a blue-white to blue color. This internal flash, which can only be viewed at particular angles, is called chatoyancy.

Peristerite has been found at several pegmatites in **Topsham**. A few specimens of blue to white peristerite occur in otherwise non-chatoyant tan oligoclase at the Yedlin locality. Relatively large blue chatoyant peristerite cleavages (to 10 x 10 cm) occur at the the Swamp #1 quarry. Some peristerite found near monazite-(Ce) or uraninite from the Swamp #1 quarry can have a pale golden yellow color.

perovskite?

Old Speck Mountain quadrangle?; Sanford? - Webster P

Milton (1961) wrote of basalt dikes that were too small to map in the Old Speck Mountain quadrangle: "Specimens from the larger dikes are diabase, consisting mostly of rather coarse laths of labradorite and grains of pigeonite... Chlorite and calcite are abundant, probably replacing primary mafic minerals, although there are no recognizable pseudomorphs. The chlorite contains minute isotropic grains, perhaps garnet or perovskite."

Fairbanks (1955) reported of **Sanford**: "'Webster's quarry' *South Sanford*, York Co., Me. Large crystals of perovskite [sic] [...] Have made many visits to this locality without finding perovskite. Found them by digging through the waste dump..." Supposed perovskite from Sanford is invariably black sphalerite (Gene Bearss, personal communication, 1990). No Sanford perovskite specimens known.

perthite (Feldspar Group) - mixture of plagioclase and K-feldspar

Perthite is a mixture of two feldspars where K-feldspar is in excess of plagioclase. At relatively high temperatures, Na and K easily substitute for each other, and if the feldspar crystallizes and cools quickly, a homogeneous distribution of these elements results. If the feldspar cools relatively slowly, especially if it is in contact with an aqueous fluid, the Na and K can redistribute within the solid and form bands, layers, strings, threads, patches, etc. which are alternately K- and Na-rich. The resulting mixture of two feldspars is called perthite. When plagioclase dominates over K-feldspar, the mixture is called antiperthite. Virtually all of Maine's pegmatitic microcline is perthite. Barth (1969) and Smith (1974) provided reviews of perthite formation.

PETALITE

LiAlSi₄O₁₀

Buckfield? - *Dudley Ledge Q (=Westinghouse Q); China?*; **Greenwood** - *Emmons Q?, Harvard Q?, Tamminen Q, Tamminen Senior P?; Hartford?*; **Newry?** - *Bell Pit, Dunton Q; Norway?*; **Paris** - *Mount Marie Q, Mount Mica Q?*; **Peru** - *Perry P*; **Rumford?** - *Black Mountain Q*

Petalite is one of the low-silica equivalents of spodumene and its significance in Maine's pegmatites is discussed in the chapter on pegmatite formation.

Houghton (1861) reported: "China.- Petalite.?" The mineral is so rare that no reference specimens are available and some material, perhaps a feldspar, was undoubtedly misidentified.

Eight tons of petalite were supposed to have been recovered as lithium ore from the Tamminen quarry or a quarry "a few hundred feet south" of the Tamminen quarry, **Greenwood** (Richmond and Gonyer, 1938): "The exceptional purity of the mineral is noteworthy. Several fragments consist of clear gem material, some of which was used for chemical analysis and optical study." Despite the uncertain locality of the Richmond and Gonyer (1938) report, certainly tons of petalite have come from the Tamminen quarry subsequently. In addition, the quarries to the south of the Tamminen quarry are not known for any petalite production. A frequent label seen in collections is petalite from **Norway**, yet no Norway localities are known and the material so labeled has all of the visual characteristics of the Tamminen quarry material. The petalite mentioned by Richmond and Gonyer (1938) most assuredly came from the Tamminen quarry ("The government geologists doing the work said the petalite came from my quarry." Nestor Tamminen, personal communication, 1990; see also Mitchell, 1982). (See further locality discussion under pollucite.) The cream-colored to golden tan Tamminen quarry petalite is usually stained by earthy salmon-pink montmorillonite and has a distinctive appearance. (Quensel (1937a) noted the alteration of petalite to montmorillonite at

Varuträsk, Sweden.) Petalite has a perfect, but commonly interrupted, cleavage which frequently shows portions with rippled to striped twin intergrowths (reminiscent of coarse plagioclase twinning) perpendicular to that cleavage surface. Additional cleavages are present, but of much lower perfection. A platy to blocky appearance is usually apparent in petalite due to its cleavages and thread-like intergrowths, which resemble perthite texture. Cleavelandite, quartz, green to bi-colored tourmaline, and lepidolite are found intergrown with, or replacing, petalite at the Tamminen quarry. Masses over 20 cm were common during mining. Gosse (1968) noted that some gem stones were cut from Tamminen quarry petalite and some recently (1992) faceted flawless gems (1.85 ct and 1.65 ct) are known (Art Grant, personal communication, 1992). Morrill et al. (1958) wrote that petalite crystals occurred at the Tamminen quarry. The petalite crystal report seems to be a mistake for the report of pollucite crystals (Richmond and Gonyer, 1938) from the same location. Petalite crystals are not known from Maine, but are known from Elba, Italy and Wyoming. Seaman (1975c) and Smith (1993) reiterated the error.

A specimen labeled petalite exists from the Harvard quarry, Greenwood (AMNH), but it has no matrix and looks identical to the montmorillonite-stained petalite from the Tamminen quarry (Carl Francis, personal communication, 1989). (The Harvard quarry is not known for having pink to pinkish brown staining, on any of its minerals, by montmorillonite. No other Harvard quarry "petalite" specimens are known.)

Marble (1951c) reported petalite from the Emmons quarry, Greenwood. No specimens known.

The "petalite" crystal specimens from the Dunton quarry, **Newry** (Herbert Haven collection) are actually albite and microcline crystals. Dick Nevel (written communication to Wallace Richmond, May 25, 1938) described Newry "petalite": "Very fresh with no degree of alteration. Laminations show up better than in most of the Greenwood material, a large percent of which is partly or wholly altered and in some cases obliterating traces of the layers. Specimen [Newry] pure white, glassy. None of this material was observed during operations at the gem mine years ago and this, the piece I have found, was in the dumps when we worked them over several years ago. It is not listed among Newry minerals." Platy, creamy white masses (to 1 cm) associated with siderite, quartz, fine-grained montebrasite, etc. from the Bell Pit, Newry (Bjareby collection) have a peculiar lamellar character similar to petalite from the Tamminen quarry, but are montebrasite.

Petalite from Mount Marie quarry, **Paris** consists of cloudy, glassy white to gray-white cleavages (to 7 cm) which are occasionally stained pale hot-pink due to montmorillonite as an incipient alteration along micro-cracks. The petalite has a slightly "layered" appearance due to the cleavage and resembles some pollucite. Microcline, albite, and quartz are associated.

Addison Verrill in Hitchcock (1862a) first announced petalite from the Mount Mica quarry, **Paris** with a description which is credible except that there are no known specimens:

"This mineral was formerly obtained here, in large and fine specimens, but none have been found, to my knowledge, for several years. Like lepidolite, this also contains Lithium. The specimens that I have seen are small masses weighing one or two ounces; the color is gray or dull reddish with a glassy lustre, which becomes somewhat pearly on the cleavage surfaces. This is considered a rare mineral; in this country very few localities are known." Petalite was also listed by Hamlin (1895), Morrill et al. (1958), and Seaman (1975c) from the Mount Mica quarry, but no specimens are known. Houghton (1861) did not list it from Paris.

The first scientifically verified locality for petalite in Maine, and the third verified locality in the world, was the Perry prospect, **Peru** (Clarke, 1890). It was found there in glassy colorless cleavages (to 7 cm) frozen in pegmatite. Clarke (1890) wrote: "The petalite is intimately and irregularly intergrown with the spodumene, and occurs in white, pearly, cleavable masses much resembling some varieties of albite. To some extent it is stained by dendritic manganese, but in general the mineral is exceedingly pure." The exact location of the Perry prospect is not known at this writing, despite the article by Marble (1928) and "directions" by Morrill et al. (1958).

The reports of additional petalite locations (Bailey, 1893; Burr, 1930; Morrill et al., 1958) are unsupported by known specimens: Dudley Ledge Q (Westinghouse Q), **Buckfield**; Tamminen Senior prospect and Uncle Tom Mountain (Emmons quarry), **Greenwood**; **Hartford**; and Black Mountain quarry, **Rumford**; though the reports can not be *a priori* rejected.

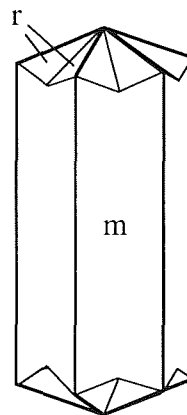
phenacite = variant spelling of phenakite no longer used

PHENAKITE

Be₂SiO₄

Albany? - Pingree Ledge Q?; **Greenwood?** - Harvard Q; **Hebron?** - Mount Rubellite Q; **Newry?** - Dunton Q; **Rumford?** - Goddard Ledge Q; **Stoneham** - Lord Hill Q, Sugarloaf Mountain A?; **Stow?**; **Topsham** - William Willes #1 Q, Square Pit; **Waterford?** - Burnell Hill Q

One of the world's great phenakite crystals was found, unlabeled, in the collection of the late Charlie Bragg (Ron Larrivee, personal communication, 1993). The doubly terminated, translucent to slightly gemmy, light smoky-tan crystal (4.0 x 4.2 cm) shows the characteristic rotational twinning of phenakite typical of specimens from Mount Antero, Colorado. A small bit (about 8 x 12 mm) of salmon pink microcline is attached to the base of the phenakite. The crystal is believed to be from **Albany** as Charlie's wife, Maxine Bragg, remembered him being active in that area when he came home announcing: "Look what I found today" (Ron Larrivee, personal communication, 1993). Charlie Bragg found some phenakite crystals (about 1 cm) at



Phenakite rotation twin

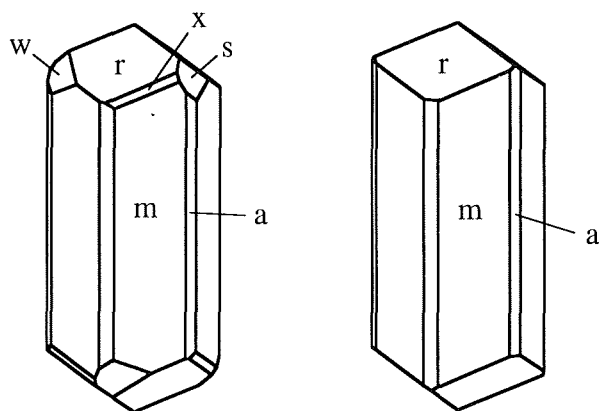
Pingree Ledge, Albany (Robert Hinkley, personal communication, 1993), but no specimens are available from this locality.

Phenakite was listed from the Harvard quarry, **Greenwood** by Morrill et al. (1958) and, later, Seaman (1975c) wrote: "Small phenakite crystals have also been noted at the Harvard Quarry in Greenwood. Crystals are colorless and are striated lengthwise." No specimens known.

Phenakite was reported from the Mount Rubellite quarry, **Hebron** by Yeates (1890a), but the report was retracted by him (Yeates, 1890b) as the material was not phenakite, but tabular fluorapatite of a peculiar tabular habit. The angles of phenakite's normal rhombohedra and its prism are coincidentally almost identical with the fluorapatite's hexagonal bipyramid with its prism. The wedge-shaped fluorapatite crystals are now known as Hebron - style fluorapatite.

Frew (1958) listed phenakite without description from Goddard Ledge quarry, **Rumford**. No specimens known.

Phenakite has long been known from the Lord Hill quarry, **Stoneham**. However, in 1888a, Kunz announced the discovery of phenakite from "near Stoneham, Me.," but the report was retracted (Kunz, 1888b): "In the September number of this Journal ..., the finding of phenacite and topaz near Stoneham, Me., is announced; the locality should have been on Bald Mountain, North Chatham, N.H. Both towns are on the Maine and New Hampshire state line, hence the error now corrected." The discovery of phenakite from Lord Hill quarry does not appear to have been formally announced, but Kunz (1892a) again noted of phenakite: "... and in the *neighborhood* [emphasis added] of Stoneham, Me." Sampter (1948) claimed: "Phenakite, which I was the first to find on Lord's Hill, in July, 1947, is the second occurrence of this rare mineral found in this *vicinity* [emphasis added]. The crystals were verified by Dr. F. H. Pough ... in September, 1947... The phenakite crystals from Lord's Hill, Me., are prismatic in habit and entirely different from those of the famous Chatham, N. H., locality, which is only a little over a mile west, by air." Pough (1953) noted of the Lord Hill quarry: "... prismatic crystals up to ³/₄ inch long grow on smoky quartz."



Phenakite, Lord Hill, Stoneham

Phenakite was probably not known at the Lord Hill quarry before the Sampter find (Fred Pough, personal communication, 1991).

The elongated, colorless, and transparent phenakite crystals (rarely larger than 7 mm) from the Lord Hill quarry consist of a rhombohedron in combination with a vertically striated hexagonal prism. The crystals can be found on a variety of matrices, but muscovite and quartz crystals are the most frequent. Phenakite on lightly etched smoky quartz crystals (to 30 cm) sometimes completely coats several adjacent prism and termination faces, but the "back" halves of the crystals are usually devoid of phenakite, indicating a directional control of the deposition of phenakite. The phenakite is usually tightly clustered on the quartz surface and can form a lustrous drusy coating. No twinning has been observed in Lord Hill quarry specimens.

Phenakite is listed without description as occurring at a locality on Sugarloaf Mountain, Stoneham (Frew, 1958). No specimens known.

A phenakite specimen exists (USNM# 0002859 [not seen]) labeled from an unspecified locality in **Stow** [perhaps = Stoneham?].

Transparent, elongated phenakite crystals (to 3 mm) are found thickly coating fracture surfaces of green beryl from the Square Pit, **Topsham**. The phenakite shows a rhombohedral termination with several different rhombohedra and with a vertically deeply striated to corrugated hexagonal prism (Gene Bearss, personal communication, 1990). Phenakite was found at the William Willes #1 quarry, Topsham (Cliff Trebilcock, personal communication, 1990).

Morrill et al. (1958) listed of Burnell Hill quarries, **Waterford**: "Phenacite Xls (to 1" on Amethyst)." No specimens are known. This reported association is fantastic.

phengite (Mica Group) = magnesian or ferroan silicic muscovite

Bradstreet - Catheart Mountain P; **Sapling** - Hurricane Mountain Formation mélange

Deer et al. (1966) wrote: "The name phengite is used to describe muscovites in which the Si:Al ratio is greater than 3:1 and in which increase of Si is accompanied by substitution of Mg or Fe²⁺ for Al in octahedral sites." and "(Si₆Al₂) can vary to (Si₇Al)." Deer et al. (1966) further indicated: "An important member of the illite group is phengite, in which potassium is not deficient and excess silica is compensated by replacement of [Al]⁶ by [Mg, Fe²⁺]⁶." Ideal phengite would be K[Al₂(Mg, Fe²⁺)] [Si_{3.5}Al_{0.5}]O₁₀(OH)₂ as all three octahedral positions would then be filled. Lower silicon compositions would be possible only if higher valence cations were to substitute in the third octahedral position. Phengite represents a kind of compositional anomaly and most muscovites are strictly dioctahedral. The partial composition (Si_{3.25}Al_{0.75}), without regard to the Mg:Fe ratio, is used as a "species" boundary between phengite and muscovite by some clay/mica mineralogists.

Molling and Ayuso (1990) noted the variation of the muscovite-phengite series in the Catheart Mountain molybdenum prospect, **Bradstreet**: "Muscovite compositions approach the ideal formula if plagioclase is replaced (<62% phengite) and become more phengitic (>67% phengite) if the precursors are chlorite and epidote. Coarse-grained muscovites are more phengitic adjacent to chalcopyrite (60% phengite) and less phengitic adjacent to molybdenite (30% phengite)." Molting and Ayuso (1990) did not indicate, by chemical tables, what they felt their phengite actually was.

Boone et al. (1989) noted of metasiltstones, etc. of the Hurricane Mountain Formation, **Sapling**: "...common mineral constituents are fine-grained white mica giving a diffraction pattern of a 3T polytype (phengite?)" as that particular polytype is scarce in dioctahedral muscovites.

phetite? - a name of unknown significance used by Hanley (1936)

Litchfield?

phillipsite? (Zeolite Group)

Stratford? - Cupra? M (probable mislabeling of specimen from Quebec, Canada)

The phillipsite variety of wellsite is present in the Smithsonian Institution collection in exceptional transparent cruciform-twinning crystals (to 4 mm) in milky quartz vugs from a set of locality names which have never appeared in Maine gazetteers: **Stratford** and Cupra mine. The locality information was given to the eventual donor of the material, Pete Dunn, who had no additional data provided to him (Pete Dunn, personal communication, 1989; John White, personal communication, 1990). The Smithsonian specimen was also noticed by Tschernich (1992). A review of the American mineral locality literature did

not reveal the probable location (Don Cooke, personal communication, 1991). However, Woodrow Thompson (personal communication, 1994) has pointed out the existence of a Cupra mine in Stratford, Quebec, Canada. This mine is not far from the Maine border. In the mineral list for the Cupra mine, Sabina (1992) included harmotome, which is a zeolite-group mineral closely related to phillipsite. Therefore, it seems likely that this Canadian locality was the actual source of the material reported from Maine.

PHLOGOPITE (Mica Group) - see extended discussion of phlogopite's interrelationship with other micas under biotite series heading.

phosphate of lime = apatite

Blue Hill - *Long Island A*

Jackson (1838a) described an apatite occurrence on Long Island, **Blue Hill**: "Phosphate of lime, of a light green color, is exceedingly abundant upon this island, there being veins of it 10 inches wide, traversing the granite." No specimens known.

phosphoferrite? (Reddingite Group)

Newry? - *Halls Ridge A*

Phosphoferrite is the iron-bearing relative of reddingite (q.v.). Phosphoferrite was listed from Halls Ridge, **Newry** in the Bjareby collection catalog, but the specimen was not located. No other additional references or specimens known.

PHOSPHOPHYLLITE

Zn₂(Fe,Mn)(PO₄)₂·4H₂O

Newry - *Bell Pit, Dunton Q; Paris?* - *Mount Mica Q; Rumford* - *Red Hill Q*

Tabular to prismatic phosphophyllite crystals (to 3 mm) are found in the siderite assemblage from the Bell Pit, **Newry**, with or without associated sphalerite. The phosphophyllite grades from colorless through pale shades of green.

Yellow, cloudy to opaque, fish-tail twinned phosphophyllite crystals (to 5 mm) have been found in siderite/phosphate assemblages in blue tourmaline eyes in cleavelandite at the Dunton quarry, **Newry**. The crystals have a blunt, wedge-shaped appearance and could have been the basis for the earlier reports of brazilianite at the Dunton quarry.

A specimen which has been previously identified as brazilianite (q.v.) could be phosphophyllite based on morphology as

well as some optical properties seen in thin sections of albite with siderite and blue elbaite from the Mount Mica quarry, Paris.

A single specimen from the Gunnar Bjareby collection was distributed by a mineral dealer as "parahopeite" from Red Hill, **Rumford**. Chemical analysis and X-ray diffraction (this study) identified the mineral as phosphophyllite. The phosphophyllite occurs as an arcuate cluster (to 3 x 0.8 cm) of blue-green to blue-gray wedge-shaped crystals (to 7 mm) and cleavages. The phosphophyllite has minute "dots" of presumed vivianite inclusions and is associated with light green beryl, microcline, pyrite, triplite?, jahnsite-(CaMnFe), beraunite, strunzite, and slightly zincian botryoidal rockbridgeite. This specimen might be the largest known American phosphophyllite crystal.

PHOSPHOSIDERITE

Fe³⁺(PO₄)₂·2H₂O

Greenwood - *Emmons Q, Tamminen Q; Poland* - *Berry-Havey Q; Stoneham* - *Lord Hill Q*

Yellow-tan transparent bladed to prismatic phosphosiderite crystals (to 1 mm) striated perpendicular to their elongation, along with small pink to pinkish amber phosphosiderite in tiny granular crystals (very much less than 1 mm), are found in altered lithiophilite at the Emmons quarry, **Greenwood** (Gene Bearss, personal communication, 1992).

A single earthy to waxy mass (2 mm) of grayish lilac phosphosiderite has been found on chalky pinkish tan to brownish pink lithiophilite from the Tamminen quarry, **Greenwood**.

Light grayish purple phosphosiderite botryoids (to 0.5 mm) with a minutely drusy crystalline surface are found with hureaulite and stewartite at the intersection of muscovite and quartz at the Berry-Havey quarry, Poland (Gene Bearss, personal communication, 1993).

Lilac to purple botryoidal phosphosiderite (each botryoid much less than 1 mm) in cellular to plumose patterns almost completely lines black-stained fractures in triplite from the Lord Hill quarry, **Stoneham**.

PHOSPHURANYLITE

Ca(UO₂)₃(PO₄)₂(OH)₂·H₂O

Georgetown - *Consolidated Q; Hebron* - *Hibbs Q; Newry* - *Dunton Q; Phippsburg* - *Thomas Q; Rumford* - *Black Mountain Q*

At the various world locations, phosphuranylite is a bright yellow, gemmy mineral which forms extremely minute needles (very much less than 1 mm) barely visible using microscopic

examination, but forming a densely filled patch (usually to several millimeters). The general description for the species by Frondel (1950) said: "Phosphuranylite is a relatively common although inconspicuous mineral that typically occurs in the weathered zone of granite pegmatites. ... Very commonly the mineral coats irregular cracks in quartz, mica or feldspar in the near vicinity of altered uraninite. ... Phosphuranylite occurs as thin films or coatings that appear dense, earthy or minutely scaly to the unaided eye, and that are seen to be composed of thin scales with a rectangular outline under the microscope. Macroscopic crystals have not been observed. The color varies from deep golden yellow to rich yellow and is one of the distinctive characters of the substance." Although phosphuranylite is fluorescent in both short and long wave ultraviolet light, the response is only moderate compared to autunite.

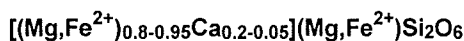
Phosphuranylite (chemical analysis and XRD, this study) occurs at the Consolidated quarry, **Georgetown** as bright yellow translucent dustings of bladed rectangular crystals (to 0.2 mm) frequently abundantly coating and impregnating smoky quartz/albite pegmatite. The phosphuranylite sometimes shows amber to orange highlights suggesting a stain. The phosphuranylite frequently shows a microscopically "spangled" appearance due to subparallel, closely spaced crystals; their fluorescence is moderate in short or long wave ultraviolet light.

Phosphuranylite has been visually identified as bright pale yellow earthy coatings (to several cm) on a schorl crystal embedded in quartz and albite at the Hibbs quarry, **Hebron**. The Hibbs quarry phosphuranylite fluoresces slightly (yellow) in short wave ultraviolet light.

Frondel (1950) said of **Newry** material that it occurred with: "A large block of muscovite containing quartz and uraninite along the margins and coated with phosphuranylite along fractures and in opened cleavages of the mica." Frondel (1958c) wrote: "Phosphuranylite is a secondary mineral, found associated with meta-autunite and, less commonly, with uranophane, beta-uranophane, hydrated uranium oxides, and opal. The mineral is found typically in the weathered zone of pegmatites that carry uraninite, and often occurs as films in cracks and crevices in the immediate neighborhood of altered uraninite crystals." No other description of Newry material is known. In addition, no specimen of phosphuranylite was located from Newry at Harvard University to represent the studies by Frondel (1950, 1956, 1958c). Only one uraninite specimen with secondary yellow uranium species, which is apparently from the Dunton quarry, is preserved (HU 90143). The specimen is composed of a 2.5 x 3 cm mass of uraninite with yellow muscovite plates (to 2 cm), some cleavelandite, and a thin rind of gummite of variegated yellow-orange to orange-red material and a patch of bright yellow crust (to 4 mm) which might be phosphuranylite.

Phosphuranylite from the Thomas quarry, **Phippsburg** (Bjareby #711) consists of bright yellow vitreous to waxy patches (to 5 mm), which have no internal structure, on tan microcline matrix.

PIGEONITE (Pyroxene Group)



Andover - *Farmers Hill A; basaltic dikes* - **Squa Pan, TDR2 WELS; Brooksville** - *Cape Rosier A; Grafton* - *Black Brook A; Spider Lake quadrangle* - *Carpenter Pond Formation, Munsungun Lake Formation; Spruce Top Greenstone?* - **TDR2 WELS, TER2 WELS, T9R3 WELS; Whiting** - *Indian Lake A road cut; York* - *Cape Neddick gabbro*

Pigeonite is a peculiar clinopyroxene which is generally restricted to mafic and ultramafic igneous rocks. It is generally a fine-grained (to several mm) component of rocks and occurs as dark brown to black-appearing grains frozen in the ground-mass of the rock. It has not been found as free-standing crystals in vugs in Maine rocks. Morimoto (1989) reported that the name pigeonite shall apply to both ends of the compositional spectrum, i.e. $\text{Mg} > \text{Fe}^{2+}$ or $\text{Fe}^{2+} > \text{Mg}$ with adjectives indicating composition: magnesian or ferroan.

Moench and Hildreth (1976) noted and mapped dikes near the southeastern corner of **Andover**: "... Pigeonite-bearing basaltic andesite on Farmers Hills. Least altered rock contains about 35 percent pigeonite, 50-60 percent zoned oligoclase-bytownite..."

Bouley and Hodder (1984) mapped basaltic rocks on various portions of Cape Rosier, **Brooksville** and wrote: "Titanaugite, augite, and pigeonite are the most abundant pyroxenes, variably replaced by pseudomorphous uraninite, chlorite, and talc."

Hall (1970) noted pigeonite in the Carpenter Pond and Munsungun Lake Formations, Spider Lake quadrangle.

Pavlidis and Milton (1962) noted of the Spruce Top Greenstone, **TDR2 WELS, TER2 WELS, and T9R3 WELS**: "Apparently, two types of pyroxene are present in the greenstone. A colorless augitic variety with weak to moderate birefringence, and in places with hourglass structure, is the common type. The other type, noted in only a few rocks, may be pigeonitic; it is colorless, has weak to moderate birefringence, and a small $2V$." The identification was not upgraded by Pavlidis et al. (1965), but similar material was indicated on Collins Ridge, **TDR2 WELS** and Nineteen Mountain, **TER2 WELS**. Pavlidis (1973) definitely noted pigeonite in metamorphosed basaltic dikes in **Squa Pan** and **TDR2 WELS**.

Milton (1961) wrote of a mappable basalt dike in **Grafton**: "A volcanic vent composed of basaltic breccia is exposed over a distance of several hundred yards in a tributary to Black Brook, Grafton. ... Phenocrysts are pigeonitic augite, barkevitic hornblende, (in large part replaced by serpentine and carbonate), plagioclase, and quartz. The olivine phenocrysts are commonly surrounded by a heavy augite rim and the hornblende by a rim of augite and opaque minerals." Milton (1961) also reported from unspecified occurrences: "Specimens from the larger dikes are

diabase, consisting mostly of rather coarse laths of labradorite and grains of pigeonite... Chlorite and calcite are abundant, probably replacing primary mafic minerals, although there are no recognizable pseudomorphs. The chlorite contains minute isotropic grains, perhaps garnet or perovskite."

Gates (1978) reported accessory pigeonite from altered basalt flows of the Dennys Formation exposed in a road cut on U.S. Route #1, near Indian Lake, **Whiting**.

pinite (Mica Group) = fine-grained muscovite

Hebron - Mt. Rubellite?; **Newry** - Dunton Q, Martin P; **Paris**; **Rumford** - Black Mountain Q; **Sapling** - Lobster Mountain volcanics

Pinite is a fine-grained green to yellow compact muscovite with a waxy luster. It is generally an alteration of spodumene, cordierite, etc. The variety of muscovite, damourite, is essentially the same material, while sericite tends to be earthier. Pinite was noted by Holman (1935) from the Dunton quarry, **Newry**.

Spodumene from the Martin prospect, Newry can be partially to completely replaced by unctuous pale greenish yellow pinite.

Boone et al. (1989) wrote of **Sapling**: "Pelitic beds within the Lobster Mountain volcanoclastic succession developed porphyroblastic cordierite where contact metamorphosed close to feeder dikes of the Middle to Late Ordovician volcanic succession. The cordierite is now largely pinitized and occurs as ellipsoidal spots flattened in the plane of a single slaty cleavage. The pinite pseudomorphs and the cleavage are interpreted to be of Acadian age."

pistacite (Epidote Group) = epidote, sometimes with the distinction of being darker than ordinary epidote

Sapling - China Island; **Spider Lake quadrangle** - Carpenter Pond Formation; **Whitneyville** - quartz diorite

Boone et al. (1989) wrote of an epidote-amphibolite on China Island, **Sapling**: "Epidote is zoned from pistacite-rich cores to Al-rich rims."

Hall (1970) wrote of the Carpenter Pond Formation, Spider Lake quadrangle: "The Carpenter Pond volcanics are primarily andesite with an interstitial to intergranular texture. Commonly they contain amygdules with chlorite centers and epidote (pistacite) rims."

Terzaghi (1946) noted the abundance of epidote in the rocks of the Columbia Falls quadrangle and referred to one sample of quartz diorite from **Whitneyville** as containing pistacite, a pistachio-green variety of epidote.

Plagioclase Series = a group name for feldspars with albite and anorthite as end-members

The feldspars are divided into sub-groups of which the alkali feldspars (microcline and orthoclase, q.v.) and plagioclase feldspars are the most familiar. The major identifying characteristic of plagioclase is its twinning. Crystals of plagioclase have a deeply striated "side" view which resembles the side view of the pages in a closed book, but with pages of differing thickness. Cleavages of plagioclase also have this striated appearance.

The plagioclase series has two end-members: albite and anorthite (Deer et al., 1966). The substitution of calcium for sodium in the mineral requires that aluminum also substitute for silicon. The components $[\text{Ca}^{2+}\text{Al}^{3+}]$ satisfy the need of the plagioclase structure to "share" five electrons. The components $[\text{Na}^{+}\text{Si}^{4+}]$ also satisfy the need for five electrons to be shared. Any other combination $[\text{Na}^{+}\text{Al}^{3+}]$ or $[\text{Ca}^{2+}\text{Si}^{4+}]$ is imbalanced (4 or 6) compared with the required five. The coupled chemical substitution $\text{NaSi} \leftrightarrow \text{CaAl}$ preserves charge balance.

More frequently, chemical formulas are written with a duplication of elemental symbols, even though the total number of atoms required in the formula does not change. Albite is usually written $\text{NaAlSi}_3\text{O}_8$, yet the formula is better written $[\text{NaSi}]\text{AlSi}_2\text{O}_8$ and anorthite is better written $[\text{CaAl}]\text{AlSi}_2\text{O}_8$. When the end-member species are written this way, it can be immediately seen that they have a common basis in their formulas and that two elements are coupled together when they substitute for each other. Coupled substitutions are common in many minerals. The intermediate chemical composition between albite and anorthite can be written $([\text{NaSi}], [\text{CaAl}])\text{AlSi}_2\text{O}_8$.

Tschermak (1865) unified the seemingly chaotic chemical variation of these minerals into one series by recognizing the interrelationship of existing mineral names which had already been proposed. Certain rock types almost always have certain compositions of plagioclase in them and Tschermak apportioned the range of composition among five steps: Albite-oligoclase-andesine-labradorite-bytownite-Anorthite. Dana (1892) stated: "Between the isomorphous series Albite ... Anorthite ... there are a number of intermediate **subspecies** [emphasis added], regarded as isomorphous mixtures of these molecules, and defined according to the ratio in which they enter; ... Oligoclase ... Andesine ... Labradorite ... and Bytownite" (See also Ford, 1932; Deer et al., 1966; Barth, 1969 for summaries of albite/anorthite nomenclature.)

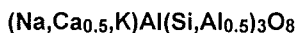
A common abbreviation (An_{xx}) expresses the composition of the feldspar as a percentage of the chemical range from anorthite (An_{100}) to albite (An_0). Using the abbreviation (An_{xx}), the range of compositions are: albite (An_{0-10}), oligoclase (An_{10+30}), andesine (An_{30+50}), labradorite (An_{50+70}), bytownite (An_{70+90}), and anorthite (An_{90+100}). When this abbreviation is seen it can be applied to the chemical formula. For example, An_{36} would indicate $([\text{NaSi}]_{.64}, [\text{CaAl}]_{.36})\text{AlSi}_2\text{O}_8$ and it would be simple to add the atoms together: $(\text{Na}_{.64}, \text{Ca}_{.36})\text{Al}_{1.36}\text{Si}_{2.64}\text{O}_8$. When whole

numbers are present all through most chemical formulas, it suggests that the formula is the "ideal" one for the mineral. When decimals are found in the formula, it usually suggests that it represents an actual chemical analysis. Several clays and a few other minerals have decimals in their "ideal" formulas.

Petrologists recognize a distinct advantage from identifying intermediate plagioclases and that usage of varietal names is not discouraged. Oligoclase is frequently found in granites and related rocks as well as some quartz veins, gneisses, and many other rocks. Andesine is found in calc-silicate "skarn" rocks, schists, and in some basalts and related igneous rocks. Labradorite is frequently found in basalt while bytownite and anorthite are scarce.

Albite can contain potassium and grade into the alkali feldspar, also called the K-feldspar, series. Ordinarily, potassium-bearing albite will separate into two feldspars, albite and microcline, and the combination forms a mechanical mixture called antiperthite (see also perthite). The mixture can be seen by using a hand lens to see what appear to be "threads" pervading the matrix. When oligoclase or labradorite form, they too can "un-mix" into more favorable chemical variants, but both variants are plagioclases. The formation of an intergrowth of two feldspars can result in a mineral which affects light quite dramatically and may show internal flashes of pale blue color. The un-mixing of oligoclase, into two feldspars which give a flash of light, is called peristerite.

Plagioclase Series - ALBITE (Feldspar Group)



Albany - Bumpus Q, Donahue P, Johnson Q, Pingree Ledge Q, Scribner Q, Stearns P, Wardwell Q; **Auburn** - Greenlaw Q, Maine Feldspar Q, Pulsifer Q, Towne (= Keith) Q, Wade Q; **Blue Hill** - Owen Lead M; **Bowdoin** - Truziani Q; **Brunswick** - LaChance Q; **Buckfield** - Bennett Q, Bessey Q, General Electric Q; **TD** - Bemis Stream P; **Franklin**; **Georgetown** - Consolidated Q; **Gilead** - Wheeler Q; **Greenwood** - Emmons Q, Harvard Q, Heikkinen Q, Tamminen Q, Tiger Bill Q, Waisanen Q, West Hayes Ledge Q, Witt Hill L; **Hartford** - Ragged Jack Mountain P; **Hebron** - Hibbs Q, Mount Rubellite Q; **Jonesboro** - Bodwell Q; **Lincolntonville** - U.S. Route #1 road cut; **Litchfield** - Dennis Hill L; **Mapleton** - road cut; **Minot** - LaFlamme Q, Sturtevant Q; **Newry** - Bell Pit, Dunton Q, Nevel Q, Rose Quartz Crystal L, Scotty Q; **Norway** - BB #7 Q; **Owen**; **Oxford** - Jordan Q; **Paris** - Hoopers Ledge Q, Lower Hoopers Ledge P, Mount Marie Q, Mount Mica Q, Slattery Q, Twitchell Q, Whispering Pines Q; **Peru** - Hedgehog Hill Q, Lobikis Q; **Poland** - Berry-Havey Q; **Rumford** - Black Mountain Q, Goddard Ledge Q, Red Hill Q; **Saint George** - McConchie Black Granite Q; **Sanford** - Webster P = andesine; **Stoneham** - Cole Q, Lord Hill Q; **Stow** - Deer Hill Q; **Topsham** - Fisher Q, Porcupine Hill Q, Square Pit, Swamp Q, Trenton Q, Yedlin L; **Warren** - Starrett Q; **West Gardiner** - drift boulders?; **West**

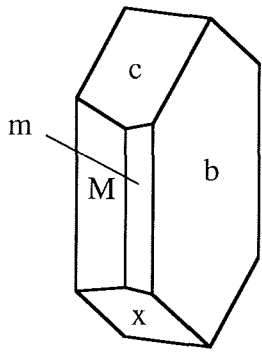
Paris - Perham Q; **Woodstock** - Woodstock M; **T10SD** - Catherine Hill Q

Albite is one of the chief members of the plagioclase series and varies in chemical composition from An_0 (that is, 100% albite) to An_{10} . Albite is found at almost every granite pegmatite in Maine, at least in small quantities; as well as in granites, quartz veins, and a variety of sodium-rich rocks. It is normally white or off-white and can be identified by looking at twin striations found on some of the cleavage surfaces. The finely-spaced parallel lines on the cleavages and on certain crystal faces are unmistakable proof for identifying plagioclase and for this reason are frequently called "plagioclase twinning." As a rule of thumb, clear feldspar crystals (less than 1 cm) in vugs in Maine pegmatites are albite. (Mineralogists distinguish between low albite and high albite based on the detailed structural state of the material present. Virtually all of the specimens in Maine, of collector interest, are low albite.)

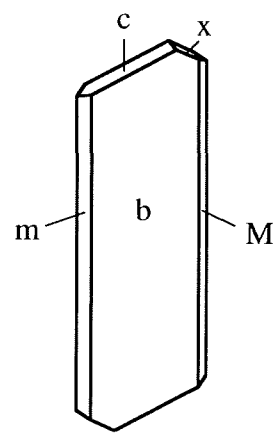
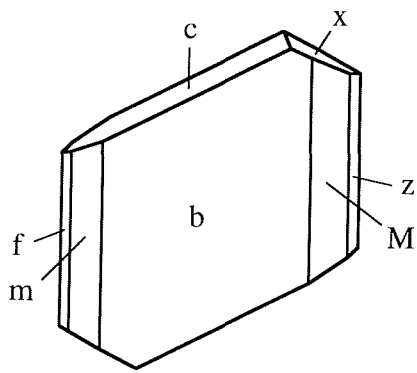
Cleavelandite (see below) is an almost pure albite which has very platy morphology. Additionally, some peculiar albite crystals in Maine pegmatites have a rhombic aspect which corresponds to the rare varieties valencianite (q.v.) and zygadite (q.v.). The difference between the two varieties lies only in the relative dimensions of the rhombic crystals: valencianite is blocky while zygadite forms thin plates. Due to collector unfamiliarity of these crystal habits of albite, they were sometimes mistaken for other species or were even suspected as entirely new species. Zygadite and valencianite albite particularly come from the Tamminen quarry, **Greenwood**, Dunton quarry, **Newry**, Mount Mica quarries, **Paris**, Black Mountain quarries, **Rumford**, as well as other Maine locations. The characteristic feature of these varieties includes their sharply pointed rhombic aspect. Such crystals when in parallel growth present a "sawtooth" appearance. Some of the unusual quartz pseudomorphs found at the Harvard quarry, Greenwood were probably after valencianite or zygadite variety of albite. Albite crystals can have a wide variety of aspects and can very much mimic some rarer minerals. Some collectors have over-enthusiastically misidentified such albite as montebasite, hydroxyl-hercynite, etc.

Feldspar mining started in the Topsham district about 1865 and spread across western Maine. The mining boom lasted just less than one hundred years, but numerous quarries and prospects were opened. This mining activity provided the exposures which produced collectible minerals which were frequently of little interest to the miners. Bastin (1910, 1911) noted that: "A few crystals of albite are 4 to 5 inches across." from the Trenton quarry (also called G. D. Willes Q), **Topsham**.

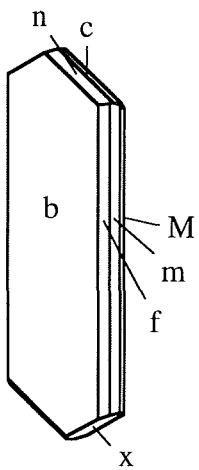
The market acceptance of the higher priced feldspar from Maine when compared with the price of feldspar from other American pegmatite districts resulted from the higher soda content of Maine's K-feldspar ores. High-soda feldspar melts at a lower temperature and produces a better ceramic glaze than low soda K-feldspars (Watts, 1916). Maillot et al. (1949) indicated that the albite production of the Black Mountain quarry, **Rum-**



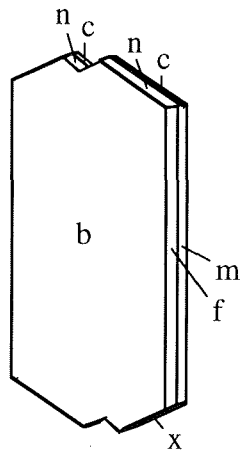
Dunton Q, Newry



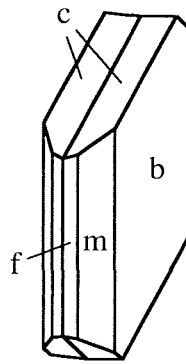
Fisher Q, Topsham



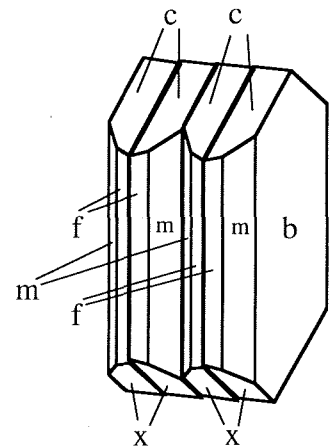
Lord Hill Q, Stoneham



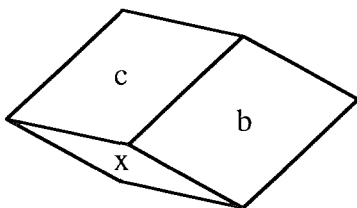
Parallel crystals,
Lord Hill Q, Stoneham



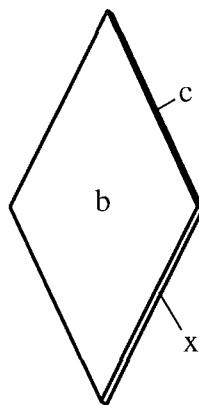
Albite twin,
Dunton Q, Newry



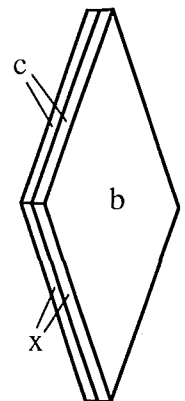
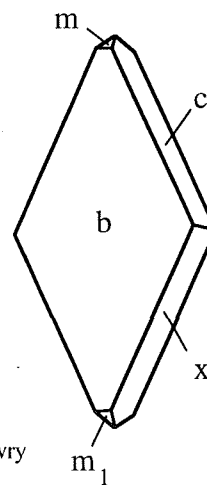
Albite repeated twin,
Johnson Q, Newry



Valencianite, Mount Mica Q, Paris



Zygadite,
Dunton Q, Newry



Zygadite twin,
Dunton Q, Newry

Plagioclase Series - Albite

ford was 120 tons of mostly cleavelandite. Clarke (1886c, 1887b, 1892, 1900c) published analyses of albite and microcline from **Litchfield**. Many Maine albite specimens were analyzed by Bastin (1910, 1911). Jackson (1838a) noted of feldspar (albite?) from the Mount Mica quarry, **Paris**: "*Feldspar* is valuable for making the nicer kinds of porcelian [sic] and artificial teeth. All the mineral teeth are made principally of feldspar." Hess et al. (1943) made an extensive spectrographic study of Maine pegmatite minerals, including albite, and reported on their content of rare alkalis.

Blocky albite crystals (to 2 x 2 cm) are found in vugs with muscovite crystals at the lower Hoopers Ledge prospect, **Paris**. Plumose multiply intergrown cream-white albite crystals (to 1 cm) were found at the Trenton quarry, **Topsham**. The clusters (to 20 cm) of crystals have a "toothy" surface texture of projecting crystals (BMS collection). The marvelous pocket-grown albite crystal clusters (to 10 x 20 cm) from the West Hayes Ledge quarry, **Greenwood** show somewhat arcuate sub-parallel "brushes" of albite crystals.

Green blocky plagioclase has been found at a number of Maine pegmatites: Route #1 road cut, **Freeport**; **Orchard quarry**, **Buckfield**; **Swamp #1 quarry**, **Topsham**; etc.

Plagioclase Series - ALBITE, Variety cleavelandite (Feldspar Group)

Auburn - *Greenlaw Q, Groves Q; Keith Q, Maine Feldspar Q, Pulsifer Q, Wade Q; Barnard?; Brunswick* - *LaChance Q; Buckfield* - *Bennett Q, General Electric Q, Westinghouse Q; Georgetown* - *Consolidated Q, Tourmaline P; TE* - *Bemis Stream P; Greenwood* - *Emmons Q, Harvard Q, Tamminen Q, Waisanen Q; Hebron* - *Hibbs Q, Mount Rubellite Q; Newry* - *Bell Pit, Crooker Q, Dunton Q, Nevel Q, Rose Quartz Crystal L, Scotty Q; Norway* - *BB # 7 Q, Tubbs Ledge Q; Paris* - *Mount Marie Q, Mount Mica Q; Rumford* - *Black Mountain Q, Elliot Q; Standish* - *Oak Hill P; Stoneham* - *Lord Hill Q; Stow?* - *Shell Pond A; Topsham* - *Fisher Q; Warren* - *Starrett Q*

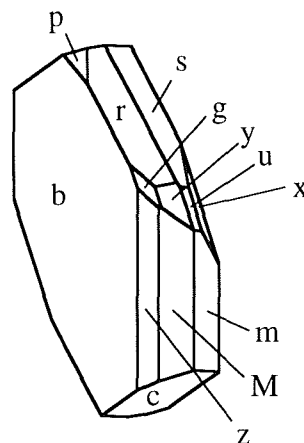
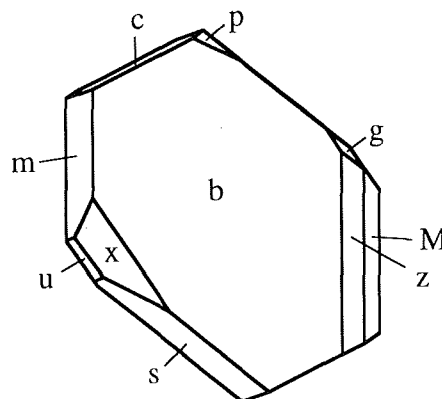
Cleavelandite was first described from Chesterfield, Massachusetts by Henry Brooke in 1823. Brooke recognized that the material was the same species as albite, but gave the name because of the unusual platy nature of the material. Even though cleavelandite is a variety, Parker Cleaveland was lucky that his namesake is so widespread and its appearance frequently heralds the presence of gem pockets in pegmatites. The mineral is among the first learned by Maine collectors and miners. While ordinary albite is blocky in massive chunks and albite crystals are prismatic with a tabular aspect, cleavelandite consists of platy crystals which are very thin. The intergrowth of cleavelandite blades can take on a variety of appearances. Subparallel aggregates can be wavy and undulating, while some samples are intersecting in "house-of-cards" fashion. Albite crystals in vugs should not be called cleavelandite *a priori*. Thin platy albite crystals which are

rooted in cleavelandite might qualify as cleavelandite crystals, but the varietal name primarily applies to massive material. (Rhombic platy Maine albite crystals are the unusual variety zygadite or valencianite. Blocky and prismatic albite crystals are simply called albite.) Shepard (1830) first recognized cleavelandite in Maine enclosed in muscovite along with elbaite from Mount Mica quarry, **Paris**. The best locations for cleavelandite in Maine are the **Dunton quarry**, **Newry**; **Bennett quarry**, **Buckfield**; **Keith and Pulsifer quarries**, **Auburn**; and the **Black Mountain quarries**, **Rumford** (where literally tons of material are on the dumps and in place in the ledges). Freshly mined cleavelandite generally has a pale blue-white color, but it usually bleaches to white on exposure to sunlight.

The **Pulsifer quarry**, **Auburn** produced some fine cleavelandite crystals (to 7 cm), frequently with muscovite "roses" perched on the thin edges of the cleavelandite.

Large cleavelandite rosettes (to 30 cm) at the **Bennett quarry**, **Buckfield** have been common in the gem pocket assemblage. **Landes (1925)** wrote of the **Bennett quarry**:

"The platy variety of albite, cleavelandite, is one of the commonest pocket minerals. It is not found outside of Class II and is therefore



Cleavelandite, Bennett Q, Buckfield

an unflinching index of the first hydrothermal period. The Buckfield cleavelandite is found in single crystals, sheaves of plates, and fan-like aggregates. It is white and usually translucent although one group contained several parallel transparent crystals. The plates vary in thickness from very minute up to 8 millimeters but most are considerably under 3 millimeters.

The crystals of cleavelandite are invariably twinned on the albite law. One group showed crystals of sufficient perfection to be measurable and the following forms, some of them quite rare, were identified: b (010), c (001), m (110), M (1 $\bar{1}$ 0), z (130), r (403), y (201), p (111), g (221), u (2 $\bar{2}$ 1), s (443), and x (241). The habit of these crystals is unusual for albite owing to the prominent development of the dome r (403) and the pyramid s (443) which truncates its edge with the pinacoid.

Cleavelandite usually replaces earlier minerals, although it may also fill open spaces. One of the early replaced minerals was microcline. Several specimens were found with veins of cleavelandite through the microcline. The depositing solutions had worked into cleavage cracks in the magmatic feldspar and the cleavelandite replaced outward from this plane of weakness. ... This mineral is a most important criterion of the proximity of pockets."

Fine bladed cleavelandite was found at the Dunton quarry, **Newry**, as well. (Note: the exceptional "saw tooth" clusters of albite from Newry; Mount Mica quarry, Paris; and elsewhere are actually a rare variety of albite called zygadite or valencianite and not cleavelandite.) Large chunks of cleavelandite are found at the Dunton quarry. In many cases, overlapping replacement cleavelandite units are found (King, 1980). Each generation of cleavelandite can have a slightly different mineral assemblage. The cleavelandite at the Dunton quarry can host the blue tourmaline eyes, well-known for their diversity of mineral associations. Beryllonite is usually embedded in cleavelandite at the Dunton quarry, as well. The interstices of "house-of-cards" intersecting cleavelandite can host a wide variety of rare minerals.

Green cleavelandite has frequently been found at the Mount Mica quarry, **Paris**, but the color seems photosensitive and definitely lightens in color when intergranular water evaporates.

Special significance has been attributed to cleavelandite's presence at a location, but Cole (1951) noted of the North Rumford Mica quarry (=Elliot Q), **Rumford**: "In addition to the large amount of albite feldspar here, there is a wide band of the platy variety of albite, cleavelandite, showing in one of the walls, and much more in the dumps. The cleavelandite is as coarsely laminated as that of the Newry mine. With so much of this variety of albite present, it is strange that some of the lithia bearing minerals are not present, but so far as the writer knows, or has personally observed, none has been reported or found."

Kunz (1884a₂) wrote of **Stoneham**: "Cleavelandite in fine, large plates and cleavages, by the ton, is of a snowy white color or turns to this color, from a dark brown, after a short exposure to the action of the sun. Pockets in it are, as elsewhere, lined with beautiful minerals. In and at the juncture with the mica the fine topazes were found. The color [dark brown?] is due to the decomposition of the triplite.

Putnam and Perham (1968) wrote of **Stow**: "Columbite and cleavelandite have been reported from a brook near Shell Pond in the Stow, Maine, area. Has anyone seen any lately?"

A few nice cleavelandite crystal clusters were found lining the Fisher pocket, **Topsham**.

Plagioclase Series - oligoclase (Feldspar Group) - major component in granites

Alfred; Biddeford; Blue Hill; Bristol; Brunswick; Dedham; Frankfort; Franklin; Freeport; Fryeburg; Guilford; Hallowell; Hartland; Hollis; Jay; Jonesboro; Jonesport; Kennebunkport; Marshfield - Marshfield granite Q; Milbridge; Mount Desert; Muscle Ridge Plantation; Norridgewock; Norway - Horse Hill L; Oxford, Pownal; Roxbury - Noisy Brook Gneiss; Saint George; Searsport; South Brooksville; South Thomaston; Stonington; Sullivan; Swans Island; Swanville; Topsham - Consolidated #1 Q, Swamp #1 Q, Yedlin L; Tremont; Vinalhaven; Waldoboro; Wells; Westbrook; Whitefield; Woodstock

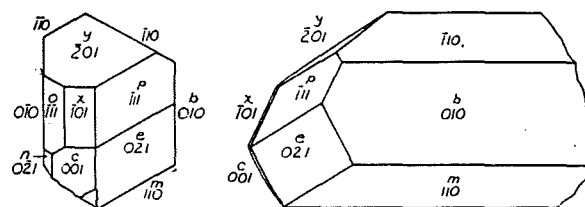
Oligoclase is a variety of plagioclase (q.v.) where the chemical composition varies from An₁₀₊ to An₃₀. Oligoclase is a major component in many granites and many granite pegmatites, but rarely forms interesting specimens. The "lost" locality on Horse Hill, **Norway** deserves mention. Manchester and Bather (1918) mentioned that the Horse Hill locality was on the Ordway farm. MacKenzie (1923) described the detailed crystallography of glassy, sometimes transparent, oligoclase crystals (to 3.8 x 1.8 x 3.2 cm) found in association with sharp creamy-white microcline crystals (to 110 x 50 x 83 cm) embedded in quartz. MacKenzie (1923) wrote:

"Both of the feldspars form exceptionally well crystallized individuals. Microcline and oligoclase are found in juxtaposition in groups of crystals, as well as separately crystallized.

MICROCLINE. This material forms crystals up to two inches long, of a creamy white tint, and often with a somewhat pearly lustre not seen in the oligoclase. It is more generally altered than the oligoclase, and only rarely is glassy. On the whole, however, the minerals are very similar in appearance, and frequently can be distinguished only with difficulty. Carlsbad twins are common. The following forms have been observed:

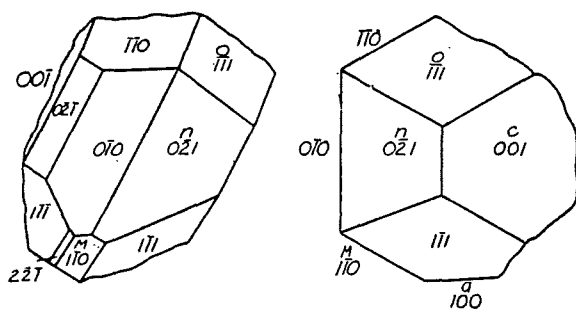
b	(010)	z	(1-30)
c	(001)	x	(-101)
m	(110)	y	(-201)
M	(1-10)	p	(-111)
f	(130)	o	(-1-11)
n (021)			

OLIGOCLASE: ... The oligoclase crystals are usually white or creamy white, and often in part or wholly glassy and transparent, with a vitreous lustre. The individual crystals are polysynthetically twinned according to the albite law, the plates being in two unequal sets, the

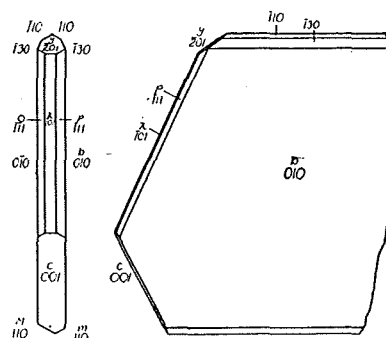


Oligoclase. Left, plan; right, projection on 010.

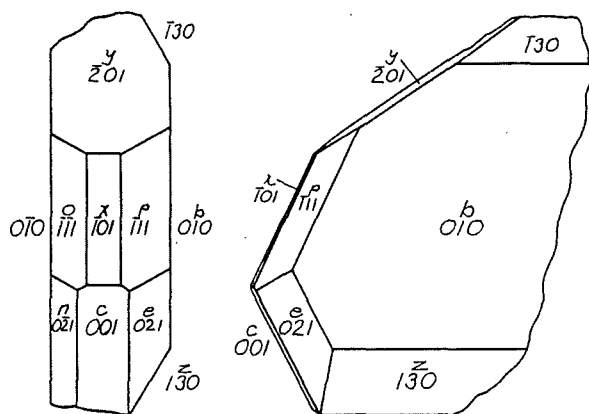
Oligoclase. Carlsbad twin. Left, plan; right, projection on 010.



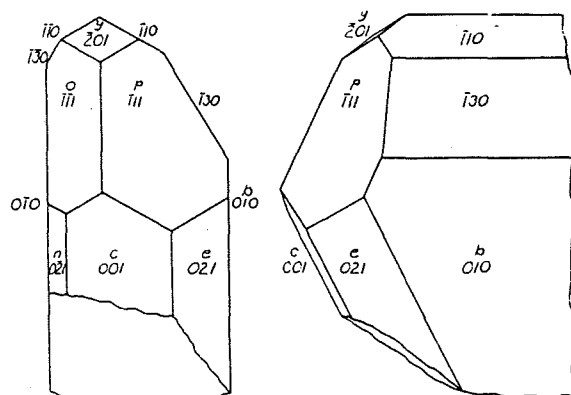
Oligoclase. Left, projection on $0\bar{1}0$; right, plan.



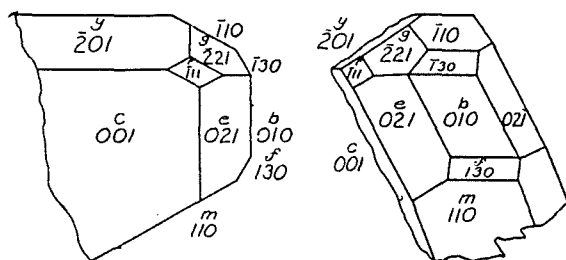
Oligoclase. Left, plan; right, projection on 010.



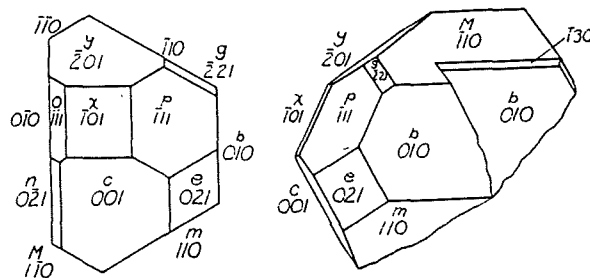
Oligoclase. Left, plan; right, projection on 010.



Oligoclase. Left, plan; right, projection on 010.



Oligoclase. Left, plan; right, projection on 010.



Oligoclase. Left, plan; right, projection on 010.

thinner ranging from 0.005 mm. to 0.1 mm., and the thicker from 0.02 mm. to 0.3 mm. thick. In addition, the oligoclase is frequently twinned after the Carlsbad, and also after the pericline law. A parting parallel to the latter twinning plane has been noted in some crystals."

Dale (1907), Smith (1923), and Jackson (1953) note many oligoclase locations in granite and schist. The oligoclase variety of peristerite occurs at a number of Topsham pegmatites including the Consolidated #1 quarry, Swamp #1 quarry, and Yedlin locality.

Plagioclase Series - andesine (Feldspar Group)

Brunswick; Calais; Cornish - Day Hill L; **Denmark; Mapleton** - road cut; **North Haven** - Ames Knob A; **Pejepscot gneiss; Saint George** - McConchie Black Granite Q; **Sanford** - Webster P, 200 meter P; **Warren** - Warren Nickel P

Andesine is a variety of plagioclase (q.v.) in which the chemical composition varies from An_{30+} to An_{50} . Andesine is found in Maine calc-silicate rocks, metamorphic rocks, and some igneous rocks.

Smith et al. (1907) reported that a red andesite (rock) from the slopes of Ames Knob, **North Haven** had "large" andesine phenocrysts. Andesine has been reported by many geologists working on Maine material (e.g. Pejepscot gneiss (Fisher, 1941), **Warren** (Rainville and Park, 1976), **Saint George** (Smith, 1923)). Some of Smith's (1923) granites and black granites had oligoclase/andesine.

Andesine crystals (to 3 cm) have been found at the Day Hill locality, **Cornish**. The crystals are snow white and show numerous faces. The andesine can be present in individual crystals and occasionally in clusters in diopside.

Leavitt and Leavitt (1993) said of **Sanford**: "Off-white to greenish white crystals of andesine are found throughout the deposit, but seem most common in the Main Pit. Crystals range in size from microscopic to 4 by 6 cm." Sanford andesine crystals are blocky, dull to oily in luster, and have a rhombic cross-section.

Plagioclase Series - labradorite (Feldspar Group)

Addison - Pleasant River Q, Thornberg Q; **Appleton?** - Lincoln Sill; **Baileyville** - Hall Q, Tarbox Q; **Berwick** - Miniutti Q, Spence and Coombs Q; **Calais** - Beaver Lake Q; **Carrabassett Valley** - in large boulders; **Chapman** - Edmunds Hill A; **Cutler** - Pembroke Group diabase; Dead River valley; **Dexter** - drift boulders; **Frankfort?** - Mount Waldo A; **Franklin** - Bianchi Q; **Lewiston; Lincolnville** - Heal Q; **Litchfield?**; **Monhegan Plantation; Parsonsfield; Rumford; Saint George** - McConchie Q; **Sanford?**, **South Berwick; Sullivan?**; **Thomaston?**; **Union** - Hariman P; **Vinalhaven** - Bodwell Q; **Warren** - Warren Nickel P; **York?**

Labradorite is a variety of plagioclase (q.v.) where the chemical composition varies from An_{50+} to An_{70} . Much has been made of the play of colors (chatoyancy) seen in a few spectacular labradorite specimens. Not all labradorite shows a play of colors and the phenomenon is restricted to only a part of the compositions assigned to the variety. Labradorite is a common microscopic component of most basalts. So-called "black granites" are usually coarse basalts called gabbros. "Black granites" such as those from Addison or Hermon (Dale, 1907; Smith, 1923) have been used in ornamental work as they take a high polish. The abundant labradorite in a few black granites shows labradorescence. (Many Maine collections contain innumerable specimens of a labradorite-bearing rock called "larvikite" which were collected from the foot of Mount Waldo, **Frankfort** in a scrap pile where a stone importer business formerly existed. The rock was originally from Larvik, Norway (the country).) Labradorite is present in most Maine basalts and gabbros, but is usually an inconspicuous mineral and collector-grade specimens are unknown.

The so-called labradorite crystals from **Appleton** are actually Carlsbad twinned microcline/orthoclase phenocrysts from the Lincoln Sill.

Plagioclase Series - bytownite (Feldspar Group)

Casco Bay Group; Farmington - West Farmington Road A; **Monhegan** - olivine norite, White Head Q

Bytownite is a variety of plagioclase (q.v.) where the chemical composition varies from An_{70+} to An_{90} .

Bytownite was reported from amphibolites of the Casco Bay Group by Hussey (1988).

Boone (1955) reported bytownite, **Farmington**: "Lime-silicate rock also occurs as regular interbeds - probably relicts of thin limestone beds - within the pelitic schist and gneiss and displays a different appearance and texture than the lime-silicate seams and lenses described above. An example is lime-silicate schist from near the West Farmington road, 2.4 miles from Farmington Falls. The rock is fine- to medium-grained, and may be termed gneissic or banded schist; the banding is evident from alternate layers and streaks of biotite-rich, and actinolite-rich bands. The characteristic mineral assemblage is quartz, biotite, actinolite, sphene, chlorite, and bytownite."

Lord (1900) wrote of the **Monhegan** bytownite variety of anorthite: "Of the minerals composing the olivine-noryte and allied rock-types, feldspar is by far the most important. It is of allotriomorphic development, in keeping with the granite-granular structure of the rock. The irregular, stout, tabular crystals vary in length from two to ten mm and in breadth from one to five mm, and show in polarized light well developed polysynthetic twinning after the albite and pericline laws. Many of these composite individuals are, furthermore, united in accordance with the Karlsbader law."

Plagioclase Series - ANORTHITE (Feldspar Group)



Cape Elizabeth Formation; Cornish? - Berry Ledge L, Day Hill L; Phippsburg - The Basin L; Raymond - Camp Hinds L; Sanford? - Webster P; Waterville Formation - Augusta, Manchester, Sidney

Anorthite is the end-member name of the calcium-rich portion of the plagioclase series where the chemical composition varies from An_{90+} to An_{100} . End-member anorthite is uncommon.

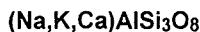
Ferry (1976) discussed the metamorphic reactions involving anorthite in the Waterville Formation in the **Manchester - Augusta - Sidney** area and gave analyses.

Anorthite has been reported as essentially end-member material from the The Basin locality, **Phippsburg** (Clarke, 1894): "In a large series of specimens collected at Phippsburg, Maine, by T. F. Lamb of Portland, these two minerals occur under unusual circumstances. The mass of the material consists of cinnamon garnet, with occasional green pyroxene, similar to the well-known occurrences at Raymond, Maine, and elsewhere, the rock itself being evidently a highly metamorphosed contact limestone. Occasionally there is imbedded in the masses of garnet a dark gray mineral, nearly black, in brilliant plates, in nowise suggesting [clinozoisite]. ... The anorthite, also verified optically by Mr. J. S. Diller, and by partial analysis by Mr. George Steiger, is associated sometimes with the [clinozoisite], and sometimes in coarse crystals, only with the garnet." The "partial" analysis totaled 98.22%. The anorthite is currently scarce at this locality, and probably consisted of white masses which had two perfect cleavages which help distinguish feldspar from scapolite. One specimen (HH 11093) consists of blocky 1-2 cm crystals, with a tan stain, which resemble adularia (plagioclase striations uncommon).

A very low-sodium, potassium-bearing anorthite from **Raymond** was analyzed by Melville (1893) who said: "White crystals, associated with idocrase, cinnamon garnet, pyroxene, and scapolite. ... The locality is near the boundary between the towns of Raymond and Gray, and is perhaps in the latter. It adjoins the northern end of Little Sebago lake." The Camp Hinds locality in Raymond may or may not be the same as the historically described locality. The northern end of Little Sebago Lake is in Gray.

The original analysis of Maine "anorthite" (Webster, 1848) showed that the **Sanford** species was actually the andesine variety of albite. Webster (1848) said that the mineral: "... will probably prove to be anorthite, with albite." The current designation of the feldspar from the Webster prospect and nearby areas is actually andesine, which is essentially as Webster (1848) imprecisely suggested. When the Sanford specimen was first identified, feldspar had not long been separated into its various species and so the confusion in nomenclature is understandable.

Plagioclase Series - ANORTHOCLASE (Feldspar Group) - a high temperature variety of plagioclase feldspar



Casco Bay A - Cape Elizabeth, Freeport, Harpswell, Portland, South Portland; York - Scotland A

Anorthoclase is a distinctive triclinic plagioclase feldspar which has formed at high temperatures. There is a variation possible in Na:K ratio from $\text{Pl}_{95}\text{Or}_5$ through $\text{Pl}_{60}\text{Or}_{40}$ [where Pl is plagioclase with high sodium composition and Or indicates K-feldspar] (Wright and Stewart, 1968). Deer et al. (1966) used essentially the same definition. Anorthoclase is the plagioclase equivalent of orthoclase. High potassium "anorthoclases" can unmix into perthite or cryptoperthite.

Lord (1898) noted anorthoclase as a component of olivine diabase porphyry dikes mapped in **Cape Elizabeth, Freeport, Harpswell, Portland, and South Portland**. Lord (1898) also described camptonite dikes containing anorthoclase near Portland Head Light and in Pond Cove, **South Portland**, and on Crotch Island (Cliff Island), **Portland**. Lord (1898) chemically analyzed the anorthoclase from camptonite, compared the anorthoclase with murchisonite, and wrote: "The *anorthoclase* crystals are lath-shaped parallel to a , and show in places a tendency to radial arrangement. They are characterized optically by a small angle of extinction (the angle $a:a = \text{ca. } 10^\circ$), which renders them easily distinguishable from the labradorite of the diabase-porphry. Polysynthetic twinning could not be identified - the crystals being apparently single individuals."

Wandke (1922a) noted anorthoclase from a tinguaitite dike, **York**: "... near the crest of a hill just north of 'Scotland', York, Maine."

PLATINUM



Dallas - Nile Brook; Hermon - Hermon Hill Q; Machias River? - "west of Ashland"; Piscataquis County? - Katahdin Iron Works?; Rangeley - Nile Brook; Salem? - Quick Stream; Sandy River A?; Union? - Harriman P; Warren? - Warren Nickel P

Platinum is a glamorous metal whose existence in Maine has marginal substantiation. Some writers blithely discuss its occurrence, yet careful scrutiny does not yield much proof. Oral reports of platinum have not been substantiated with actual samples of undeniable Maine origin.

The report of a one ounce platinum nugget from the panning for gold on the Machias river "west of **Ashland**" (Stevens, 1989) is very intriguing. If a one ounce platinum nugget were found in Maine it would perhaps be a North American record eclipsing the platinum nuggets from Fox Gulch, Good News Bay, Alaska; Six Rivers area, Oregon; the several California districts;

Tulameen River area, British Columbia, and other platinum-producing districts. The heavy minerals found while gold panning, should be very carefully checked for signs of silvery grains along with the black magnetite or ilmenite, red garnet, and gold, etc. found in a pan, sluice, or dredge. It has been suggested that some of the silvery grains identified as platinum by some panners are actually amalgam from former panners using mercury in order to recover more gold than they could otherwise (Joe Martin, personal communication, 1990). Maine platinum was not listed in Howe and Holtz (1919), due to its scarcity and poorly established nature.

Dale (1907) and Smith (1923) reported of a black granite specimen from the Hermon Hill quarry, **Hermon**: "Ora W. Knight, a [a Letter addressed to Dr. Hanson, Oct. 3, 1905.] State assayer of Maine, reports that it contains a very small amount of platinum which is very irregularly and unevenly distributed." The sample may have consisted of a magnetite knot in the rock. No specimens known.

Platinum has been reported from **Rangely** since August 6, 1880 when it was announced in the *Maine Mining Journal* by Frank Bartlett:

"During the spring and summer months, Mr. R. B. King of this city, has given considerable attention to the exploration of the Rangely region and as a result of his work had succeeded in finding gold in many places especially on Nile's brook and the small streams near the foot of the lake. Mr. King has quite a quantity of gold that he and his assistants have washed out of the black sand in that country and he is strongly of the opinion that a profitable business might be commenced with a small outlay of capital. The gold is rather coarse than fine, some nuggets having been found weighing two of three pennyweights. Mr. King noticed amongst the gold many grains of a silver white color and in some instances one-half of a nugget would be gold and the other half apparently silver. This led him to have an analysis of the grains in order to satisfy himself regarding the composition of these peculiar nuggets which seemed not to be an alloy but had every appearance of being welded together though at the same time they were different in color and hardness.

My analysis proved the compound to be gold, platinum and iridium and possibly osmium and some others of the rarer metals, although no tests were made for anything but gold, platinum and iridium, the quantity not being large enough to operate on in testing for other metals which at best occur only in minute quantities, yet usually associated with the platinum ores."

Hunt (1854) reported the discovery of platinum and iridosmine just to the northwest of Maine in nearby Lac Megantic area Quebec. There, too, subsequent reports have cited his report and, there too, no specimens are known, so the nearness of another platinum-producing district offers no additional credibility to Maine's reports except their independent(?) nature.

Stevens (1989) wrote: "Several people have found platinum along the Sandy River and its tributaries." No specimens known.

Sanford and Stone (1914) and Schrader et al. (1917) wrote of platinum: "Knox County, in peridotite, East Union... Piscataquis County, in pyrrhotitic ores [Katahdin Iron Works Mine?]." Rainville and Park (1976) wrote of the Harriman prospect, **Union** and the Warren Nickel prospect, **Warren**: "The platinoids are extremely rare and are enclosed by pyrrhotite and pentlandite grains. Most grains are only a few micrometres in size and show good idiomorphic development. Most grains are isotropic, but one mineral displayed strong anisotropism. These grains were compared to several cobalt and platinoid minerals from the collection of P. Ramdohr at Heidelberg University. None of the isotropic minerals was identified except sperrylite (PtAs_2), but the anisotropic mineral has been identified as niggliite (PtTe-PtSn), because it compares favorably to samples of that mineral from South African deposits." Houston (1954, 1956) and Rainville and Park (1976) did not report native platinum as a mineral.

pleonaste? (Spinel Group) = ferroan spinel

Blue Hill - *Ellsworth Schist*; **Union?** - *Harriman P*

Li (1942) wrote of the Ellsworth Schist, **Blue Hill**: "Minerals occurring in minor quantity in the dark bands seem to have formed at the expense of biotite. The bladed andalusite pseudomorphic after biotite and close association of magnetite and spinel with biotite all suggest such an origin. ... The andalusite includes dusty carbonaceous matter, magnetite, hercynite, and green spinel (pleonaste)." Forsyth (1953) noted gahnite (q.v.) in the Ellsworth Schist.

Bastin (1908a) wrote of the **Union** pyrrhotite: "*Spinel*. - A few grains of a dark green isotropic mineral occur in certain portions of the rock in irregular association with pyrrhotite and hornblende or as inclusions in the latter mineral. Its grains are without regularity in form and range in size up to 0.4mm though mostly under 0.2mm. The mineral is probably pleonaste or chlorospinel."

plumbago = graphite

plumbojarosite? (Jarosite Group) - Maine ores

Plumbojarosite was suggested without description or specific location as a constituent of "Maine ores." (citation unknown)

POLLUCITE (Zeolite Group)

$(\text{Cs,Na})_2\text{Al}_2\text{Si}_4\text{O}_{12}\cdot\text{H}_2\text{O}$

Auburn - *Keith (= Towne) Q, Maine Feldspar Q*; **Brunswick?** - *Bagley Ledge Q*; **Buckfield** - *Bennett Q, Dudley Ledge Q (=Westinghouse Q), General Electric Q, Owls Head Q*; **TD** - *Bemis Stream P*; **Greenwood** - *Emmons Q, Harvard Q, Tamminen Q*;

Hebron - Mount Rubellite Q; **Minot?** - LaFlamme Q; **Newry** - Crooker Q, Dunton Q, Kinglet Q, Martin P; **Norway** - BB #1 Q, BB #7 Q; **Paris** - Mount Marie Q, Mount Mica Q; **Rumford** - Black Mountain quarries; **Stoneham** - Beryllonite L; **West Paris** - Cobble Hill Q

Pollucite is a member of the zeolite group, but it is usually not associated with other zeolites. Pollucite looks very similar to quartz and can be easily mistaken for it (and vice versa!). Pollucite has enjoyed a peculiar history, both in Maine and in Elba, Italy. Wells (1891) described Mount Rubellite, **Hebron** as the second world locality and provided a review of the species history to that point. The mineral was named from Italy in 1846, long before the element cesium was discovered in 1860. The mineral was originally thought to be a potassium mineral until 1864 when the cesium contents were discovered by Pisani. Brush, who had discovered cesium in Hebron lepidolite, worked on the interpretation of the Italian pollucite analyses, calculated a new formula for the mineral, and began an interest in systematic cesium chemistry at Yale which proceeded in a series of at least 30 major articles in the *American Journal of Science* by various Yale authors between 1863 and 1917. The discovery of a rich source of cesium in Maine undoubtedly allowed the Yale chemists and mineralogists the opportunity to extract cesium from pollucite in sufficient quantities to allow them to "scoop" the other chemists of the world in investigating the chemical reactions and spectrum of this element as well as rubidium, which also occurred in abundance in the lepidolite and pollucite. Dana (1892) noted the seminal role of Hebron pollucite in the study of cesium: "The unusually large amount of caesium obtained from this source has enabled Wells and Penfield to make some important researches upon the caesium trihalides." Young Bertram Boltwood began his interest in uranium chemistry as coauthor with Wells (1895) when they studied chemical reactions involving uranium and cesium. After radioactivity had been discovered the next year (1896), it was inevitable that Boltwood would continue his uranium and radioactivity research. (The consequences of fortuitously timed, unrelated events weave an interesting path as Boltwood's early interest in cesium and uranium, and then radioactivity, eventually led to the recognition of isotopes of elements.)

Hess et al. (1943) wrote of the General Electric quarries (Hodgeon Hill), **Buckfield**:

"Pollucite was found only with the crystals of microcline. All was crushed, and some was earthy looking. One cavity from which pollucite had been taken showed a rude crystal form 6 or 7 inches across. The cavity was lined with mica (lepidolite) in plates 1/8 inch across and normal to the pollucite. Mr. Nevel said that all of the pollucite found here had a similar envelope.

About 3,000 pounds of pollucite was taken out during the first season [1925]. Mr. Dudley (according to a personal letter of W. D. Nevel) took out masses of pollucite that contained as much as 600 pounds. In 1927 one mass weighing 450 pounds and another weighing

950 pounds were taken out. The largest mass was said to have been about 6 feet long and very irregular but to have averaged 10 or 12 inches in thickness. The pegmatite was mined for a length of 300 feet to a depth of 10 to 20 feet.

Another pegmatite, known as the 'lower vein' about a quarter of a mile northeast of that just described and also worked for pollucite, seemed to have the same geological characteristics, that is it also was a replacement along a crack in granite. A pit about 300 feet long, 15 feet wide, and 10 to 15 feet deep was dug, and, as in the other pegmatite, the pollucite was confined to a narrow zone of late high-temperature minerals in the middle. How much pollucite was obtained from the two pegmatites is unknown, but, including perhaps 100 or 200 pounds from other places, the General Electric Co. took from these two pegmatites and the Dunton pegmatite[, Newry] approximately:

	Pounds
High-grade pollucite, 20 to 25 percent Cs,	23,500
Medium-grade pollucite, 6 to 12 percent Cs, . . .	1,100
Low-grade pollucite, 0 to 6 percent Cs,	8,000
Total, all grades	32,600

Dudley pegmatites [=Westinghouse Qs], **Buckfield**. - In the hill north of Perien S. Dudley's house, about 2 miles southwest of Buckfield, the Westinghouse Lamp Co. mined during 1927 the third pegmatite in which Mr. Dudley had previously discovered pollucite.

The pegmatite cut a coarse biotite granite, and at the time it was examined an excavation about 25 feet wide and 50 feet long had been made. In the face of the excavation the pegmatite was almost wholly an aplitic mass but was cut by two bands of cleavelandite with other late higher-temperature minerals, and it was in these bands that the pollucite was found. In fig. 9 a rough field sketch of the face of the excavation is shown. A total of about 800 pounds of pollucite was taken out by the company.

Owls Head, Buckfield. - During the second half of the 1920's, W. D. Nevel, agent for the General Electric Co., worked a pegmatite on Owls Head, a hill 2-1/2 miles S., 15° to 20° W. of the village of Buckfield, but results are unknown. (Personal communication from E. M. Bailey, dated April 29, 1941.) In 1941 a discovery of pollucite on the same hill was announced, but whether in the same pegmatite is also unknown.

Uncle Tom Mountain, Greenwood. - Uncle Tom Mountain, 1,700 feet high, is about the middle of the southwest line of the town of Greenwood and is a little more than 2-1/2 miles west of the village of the same name, 8 miles west of West Paris, and 5-1/2 miles southwest of the village of Bryant Pond. By road the distances are longer, of course.

In 1931 the Oxford Mining & Milling Co. (now United Feldspar & Minerals Corporation) operated a quarry for potash feldspar in a pegmatite on the Emmons farm, on the east side of the mountain. The face of the quarry was about 20 feet wide and 25 feet high. The feldspar was in large bodies in which replacement was not prominent, nevertheless, in a comparatively small body that had been replaced along cracks in the feldspar a mass of pollucite was found from which a total of 4,638 pounds containing 29 percent Cs₂O was obtained. (Personal Communication from J. H. Weis.) It must have been very irregular in shape, because it was said to have been 3 feet in diameter and 16 feet in length

and such a body of regular shape would contain about 10 tons. (Personal communication from W.D. Nevel.) It enclosed one pink beryl that was almost equidimensional and 12 to 16 inches through. Most of the pollucite was glassy, though crushed, but part was kaolinized. Some spodumene was found but little if any lepidolite. Since then no pollucite has been found in this pegmatite."

LaCroix (1922) indicated having visited a pollucite-bearing Buckfield pegmatite in 1913 where he also observed pollucite masses of kilogram weight associated with "beaucoup" amblygonite [sic], lepidolite, cesian beryl, columbite, cassiterite, and triphylite.

The discovery of pollucite, at Mount Rubellite quarry, **Hebron**, was made by Loren Merrill on material which was visually provocative. "It was associated with quartz, a crystal of which was in one case imbedded in the pollucite, also with psilomelane and with another mineral which proves to be a nearly colorless caesium-beryl. The pollucite was in the form of irregular fragments, mostly between $\frac{1}{4}$ and 10 grams in weight, very similar to those figured by Breithaupt in his original description of the mineral from Elba. The substance of many of the fragments, such as were used for the analysis, was of the most perfect physical character, perfectly colorless and as brilliant and transparent as the finest glass. ... Unfortunately, none of the fragments have any distinct crystalline faces" (Wells, 1891). Hess et al. (1943) noted: "In 1928 Merrill, acting for the General Electric Co., again worked the pegmatite in a search for pollucite, but, in spite of the probability indicated by the cesium-bearing minerals already taken out, none is known to have been found."

Pollucite had been discovered in **Rumford** earlier than in Hebron, but was reported later.

"During the spring of 1885, Mr. E. M. Bailey of Andover, Maine, sent to Prof. S. L. Penfield for identification some specimens from Black Mountain, Rumford, Me. Among these, one which had the appearance of ordinary white quartz or beryl proved to be the very rare and interesting mineral pollucite. The following summer, the locality was visited by Professor Penfield accompanied by Mr. Bailey and a supply of pollucite and its associated minerals was obtained. ... The material at Hebron was all found as loose pieces in two cavities, while at Rumford, which is about thirty miles north of Hebron, it is found intimately associated with quartz, albite, muscovite, tourmaline, lepidolite and spodumene. The specimens are not very attractive in appearance as neither the pollucite nor the associated minerals, with the exception of tourmaline, occurs well crystallized. The irregular masses of pollucite are sometimes quite large, so that, for example, for a distance of ten centimeters there will be continuous pollucite. Small particles of the mineral are colorless and perfectly transparent, but the masses look as if they had been crushed and the appearance is therefore white. The quartz at the locality is mostly smoky so that it is readily told from the pollucite at a glance, but some of it is quite white, and then it is almost impossible without physical or chemical tests to distinguish the two minerals apart. A great deal of credit is due to Mr. Bailey for having observed that the pollucite was something different from quartz, which

needed investigation. ... It is possible and even quite probable that pollucite is not at all a rare mineral at the tourmaline and lepidolite localities in Maine, but has been overlooked as it resembles quartz so closely and does not occur in characteristic crystals" (Foote, 1896).

Pollucite became important as an ore of cesium in the mid-1920's. It was quarried in **Buckfield** at the Bennett quarry and General Electric quarry by Dick Nevel, and at the Westinghouse quarry by Howard Irish, and later at the Dunton quarry, **Newry** by Nevel. Fairbanks (1928) reported that "... it was discovered that thermionic effects caused by caesium in the radio vacuum tube increases the efficiency of the tube at a much lower consumption of electric current than has been found in the other types of tubes." During the late 1950's, pollucite was stockpiled at the BB # 7 quarry, **Norway**, but there was no commercial interest in the mineral at that time. Part of the rationale for stockpiling the pollucite included: "Although there was almost no market for the mineral at that time, it was hoped that planned development of thermonuclear converters and ion propulsion motors for space [travel] would create a strong demand for cesium" (Neil Wintringham, personal communication, 1992). During the 1920's, just one half kilogram of pollucite was valued at nearly a week's wages for a laborer. Technology was later able to by-pass the need for cesium placed into radio tubes, etc.

Description of Pollucite

Pollucite is found at many of the pegmatites in Maine and is usually restricted to replacement zones and the margins of gem pocket assemblages. It varies in appearance slightly and very much resembles fractured quartz, though in pollucite the fractures commonly show a distinctive sub-parallel pattern. In many cases, a parallel lamination or interlayering with thin seams of other minerals is seen in some of the massive pollucite. Fairbanks (1928) observed:

"While pollucite resembles quartz, its luster is slightly different and may be best described as somewhat 'oily.' Conchoidal fracture is common to both minerals but appears to be more completely developed in pollucite. Pollucite is, of course, more apt to show alteration. The hardness of the two are close (pollucite 6.5, quartz 7). The specific gravities are also fairly close (pollucite 2.90, quartz 2.65) and feldspar may be intimately intermixed affecting the determination.

The slight difference in luster and the fact that pollucite is decomposed by acid are of greatest use in the field."

Hess et al. (1943) noted of the Maine Feldspar quarry, **Auburn**: "... a little pollucite, spodumene, amblygonite, and lepidolite are reported to have been found." No specimens known.

Fisher and Bernard (1934) wrote of the Keith (Towne) quarry, Auburn: "Pollucite, an important caesium mineral, occurs in small amounts in albite."

The only specimen known of pollucite from the "lost" Bagley Ledge quarry, **Brunswick** is a faceted gem at the Museum of Science, Boston, Massachusetts.

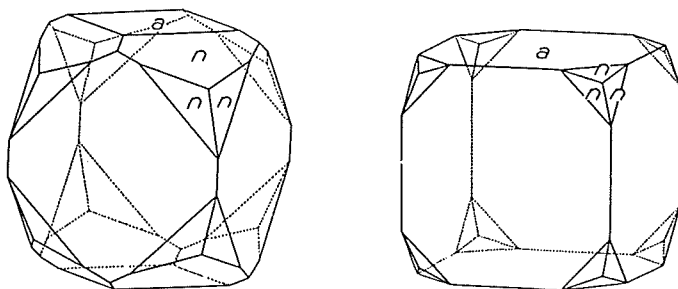
Landes (1925) wrote of the Bennett quarry, **Buckfield**: "A few small fragments of this rare mineral... were found at Buckfield. It is white and glassy and lacks any very striking physical characteristics that are distinctive. The only associated mineral is lepidolite, in vein form and obviously much later." In 1993, a new discovery of pollucite was made at the Bennett quarry (Ray Woodman, personal communication, 1993). A mass (about 1 x 1 x 0.7 m) was found in the east end of the pit, associated with lithiophilite, lepidolite, and spodumene. The granular interlaminated pollucite, facetable in some fragments, is salmon pink. The gemmy pollucite varied from deep rose through light champagne in color. White, tan, to amber veinlets of spodumene (to several mm thick and several cm long) cut across the pollucite. Sometimes the veinlets contain granular quartz and are partially replaced by cookeite, lepidolite, and/or kaolinite (chemical analyses and XRD, this study). The spodumene is unknown #8 of King (1994).

Pollucite from the Dudley Ledge quarry (AMNH 18354) (= Westinghouse quarry), Buckfield is typical in all appearances. The pollucite was coarsely granular (individual grains to 1 cm) with some subparallel fracture planes with spacing of 0.5 to 2 cm. Some of the Dudley Ledge quarry pollucite is facetable or nearly so. Associated species include microcline and some fine-grained porcelaneous tan to pink montebrasite(?) masses (to several cm).

Harvard quarry, **Greenwood** pollucite is usually highly altered to pink montmorillonite and partly replaced by cleavelandite. The mineral is granular and a layering can be perceived in the partly replaced masses. Pollucite is very scarce at the Harvard quarry.

Richmond and Gonyer (1938) discovered laminated pollucite-quartz replacements of petalite from Greenwood. The exact locality was confusingly stated. The Tamminen quarry is mentioned several times in the text, but the X-ray data indicated massive pollucite from the Tamminen quarry and *crystals* from the Oxford Mining and Milling company quarry, while "two Greenwood localities" are referred to under optical properties. The clear suggestion in the article, however, is that both a large

quantity of petalite (eight tons) and the lumps of pollucite containing pollucite crystals (2-4 mm) came from the same location. Their only locality statement was mixed with discussion of finds at the Harvard quarry and Tamminen quarry (Richmond and Gonyer, 1938): "It is interesting to compare these drawings and fig. 2 with the reproduction of a quartz pseudomorph described by Landes (1925) in his memoir on the Greenwood ledge near the top of Noyes Mountain. The nature of this pseudomorph is here discussed, and in a footnote on page 409 it is suggested that it might have been after pollucite. This discovery of crystals with the same habit in so near a locality practically establishes the conclusion. Pollucite in formless glassy masses, often of large size, has been found in various Maine pegmatites. It occurred in the Tamminen pit *only a few hundred feet north of the locality here described* [emphasis added], as well as in feldspar quarries at Hebron, Buckfield, and Mt. Mica, and in particularly large spherical masses at Newry." (Even the chemical analyses of Greenwood pollucite were so inexplicitly labeled that it can not be ascertained if any of the crystals were analyzed and if any of the pollucite from the Harvard quarry was among the samples "giving the formula of material from Noyes Mountain and Hebron." Hess et al. (1943) apparently accepted the distinction between the Tamminen quarry and the Oxford Mining and Milling quarry as factual. Hess et al. (1943) briefly wrote of Greenwood pollucite: "At the Tamminen feldspar quarry at the foot of Noyes Mountain near the Norway-Locke Mills road, also operated by the United Feldspar & Minerals Corporation, some pollucite has been found, but it was badly weathered, and the cesium content was very low. (Letter of J. H. Weis.) The quarry has been exhausted." The Tim Heath quarry is a few hundred feet south of the Tamminen quarry, but it is not known to contain petalite or pollucite. Nestor Tamminen (personal communication, 1990) remembers being told by a "government geologist" in the late 1930's that the pollucite crystals had come from his quarry. The Tamminen quarry was being leased by the Oxford Mining and Milling company during the pollucite crystal discovery period along with numerous other local pegmatite quarries in that part of Greenwood (see also Mitchell, 1982, but with source information uncited). Katie Tamminen (1952) wrote: "On September 18, 1930, we leased our pasture to Mr. Donahue for five years. Later, Oxford Mining and Milling Company, of West Paris, leased it from him. Almost immediately, they ran into several kinds of minerals, the most unusual being the combination of pollucite and petalite as it was first discovered on the Isle of Elba. Also, very small specimens of pollucite crystals, at that time, the only ones ever found in the United States, were discovered." Specimens of Tamminen quarry pollucite which have been preserved (HU 94630) consist of fragments of pink-stained petalite (to 7 cm) with veinlets (2-3 mm wide) which are parallel to the cleavage and which sporadically contain cubo-trapezohedral grayish white cloudy pollucite crystals (to 2 mm) along with granular quartz and a silky mica which is probably cookeite. The openings in the veinlets are small with barely enough room to accommodate the well-formed, smooth-faced pollucite crystals.



Pollucite, Tamminen Q, Greenwood
(from Richmond and Gonyer, 1938)

There are, currently, at least three pollucite crystal localities in the world: San Piero di Campo, Elba, Italy, an unspecified pegmatite in the Gilgit area, Haramosh valley, Pakistan, and Greenwood, Maine.

Marble (1951c) noted of the Emmons quarry, Greenwood: "... the pink Beryl and the Pollucite were not recognized by the miners at first but were thrown on the dump as Quartz." Stan Perham (1966) added: "A crystal of pollucite, or possibly pollucite replacing some other crystal mass, seventeen feet long, twenty-one inches wide, and seventeen to nineteen inches thick, was found during the work of Mr. Richard Wagar for the Oxford Mining and Milling Company of West Paris, Maine, in their mining of feldspar at Uncle Tom Mountain during 1935; about three tons of material was saved from this work." No pollucite crystals come from the Emmons quarry (Uncle Tom Mountain quarry) and the mass found was probably a replacement. Emmons quarry pollucite can be gemmy vitreous to dull and cracked with a dusting of pale pink montmorillonite interspersed (Ray Sprague, personal communication, 1992). Hess et al. (1943) noted that about 2108 kg of pollucite were found at the Emmons quarry in a unit about 1 x 5 m in 1931, not 1935.

Hess et al. (1943) noted of **Hebron**: "A half mile east of Hebron Academy, near Cushman farm, a little pollucite of gem quality was obtained by W. D. Nevel (Personal communication, Dec. 8, 1931)." Piutti (1910, 1913) reported on minor helium contents in Hebron and Paris pollucite.

Pollucite from Dunton quarry, **Newry** was found in large colorless to cloudy "spherical" masses (in a few cases over 100 kilograms). The mineral is coarsely brecciated (3 - 7 mm or even larger) with intergranular recrystallization of albite or pink clays, and a distinct layering is easily seen in the specimens. Fraser (1930) reported: "Pollucite is commonly found in fractured masses, the fractures being filled with a dull white variety of chalcedony. This association is so general in this deposit that it can often be used as a criterion to distinguish pollucite from quartz." Specimens currently available for description do not show the described veining of chalcedony. Two chemical analyses of Dunton quarry pollucite were found in the files of Curt Segeler. The analyses, made by Frank Lewis, Brooklyn Navy Yard chemist (~1945), are respectively: specific gravity 3.008, 3.037; refractive index 1.524(8), 1.525(2); chemistry - $\text{SiO}_2 = 43.54, 43.44$; $\text{Al}_2\text{O}_3 = 16.36, 15.80$; $\text{CsO} = 36.38, 36.76$; $\text{K}_2\text{O} = 0.33, 0.36$; $\text{Na}_2\text{O} = 1.70, 2.02$; $\text{Li}_2\text{O} = 0.05, 0.02$; $\text{CaO} = 0.12, 0.22$; $\text{H}_2\text{O} = 1.54, 1.48$; total = 100.02, 100.10.

The BB #7 quarry, **Norway** had clear yet brecciated pollucite (grains 2-4 mm) in large masses. Much of the pollucite sold to collectors in Maine during the 1950's and 1960's was from this locality, but was labeled "Oxford County" by high-graders to obscure the origin of the material.

Hess et al. (1943) noted of the Mount Mica quarry, **Paris**: "In 1910, Loren B. Merrill took out 800 pounds of pollucite (according to a letter from Howard M. Irish of Buckfield, Maine, Aug. 28, 1940), but none has been found since." Anonymous

(1948) noted of Mount Marie Q, Paris: "On the east wall and southeast corner were deposits of pollucite and montmorillonite."

Mount Mica quarry pollucite masses are typical for the species. The mineral has the typical fractured to angular granular appearance which grades from colorless, to cloudy white, to intermixed colorless or cloudy white with creamy tan-stained pollucite. The Mount Mica quarry masses can have fine-grained, very pale lilac lepidolite or tan kaolinite fracture fillings (to several mm thick); and white to pink elbaite (to 8 x 1 cm) or watermelon-zoned elbaite (to several cm) can crosscut the pollucite.

Newnham (1967) and Beger (1969) determined the crystal structure of pollucite on specimens from the Black Mountain quarry, **Rumford**. No recently found pollucite specimens are known from this locality.

The Beryllonite locality, **Stoneham** has cream-colored to smoky gray pollucite in pure masses (up to 15 cm). The mineral shows the parallel fractures and bands of minerals (muscovite, clay, or albite)(1-2 mm thick) that help to identify the species (Henry Barbour, personal communication, 1990).

Pollucite from Bemis Stream prospect, **Township D** is found associated with dark grass-green elbaite, etched to "fibrous" spodumene, montmorillonite, gray lepidolite, and cleavelandite. The pink clayey montmorillonite stains the clear fractured pollucite, which is highly etched and sometimes sufficiently dissolved to expose "septa" of cleavelandite. A black stain coats some of the cleavelandite.

Hess et al. (1943) wrote of **West Paris**: "In a pegmatite on Cobble Hill in the northeast corner of the town of Norway [sic], about 3-1/2 miles southwest of West Paris, a vug was discovered in 1931 that was about 2 feet in diameter and contained clear plates of muscovite 3 inches across with a border of lepidolite 3/16 inch wide. There was also some pure lepidolite. Pollucite was found extending from the vug into the pegmatite, and about 100 pounds was extracted. (Letter of W. D. Nevel.)"

Frew (1958) also reported pollucite without description from LaFlamme quarry, **Minot** and Mount Marie quarry, **Paris**, but no specimens are known. Wells (1891), Foote (1896), Fleischer and Ksanda (1939, 1940), Hess et al. (1943), and Ahrens (1948) reported chemical analyses and experimental results on Greenwood and Norway pollucites. Burr (1939d) briefly reviewed Maine occurrences and uses of pollucite.

portlandite? - probably misidentified or local name

Portland

Morrill et al. (1958) reported portlandite from an unspecified locality in **Portland**. The report is unsubstantiated.

POWELLITE (Scheelite Group)

CaMoO₄

Newfield - Bergendahl Farm A; **Sanford** - Webster P; **T10SD?** - Catherine Hill P

Powellite is easily detectable by its fluorescence in short-wave ultraviolet light and its non-fluorescence in long-wave ultraviolet light. Powellite cannot be distinguished from scheelite by this test as their responses overlap.

Carpenter and Zodac (1955) reported powellite with molybdenite from the Hans Bergendahl farm area, **Newfield** where a basalt dike was in contact with pegmatite: "The powellite consists of brownish incrustations on and with molybdenite; the powellite [fluoresces] yellow under the mineral light [short-wave ultraviolet]."

Powellite is found as a coating on, or replacement of, molybdenite crystals (to 5 mm) from the Webster quarry, **Sanford**. Sometimes the molybdenite is completely replaced by tan powellite and can look like altered mica, but with the characteristic yellow fluorescence in short-wave ultraviolet only. Fairbanks (1947) reported: "The tungsten mineral powellite has not been previously reported from Sanford, Maine, a well known locality. Recently, E. E. Fairbanks of Old Orchard Beach, Maine, discovered a zone in the vesuvianite-bearing, contact metamorphic deposit at Sanford, in which hydrothermal alteration had developed powellite from molybdenite. The powellite is strongly fluorescent." Trefethen et al. (1955) also noted powellite at the Webster prospect. Leavitt and Leavitt (1993) observed specimens to 1 cm.

PREHNITE

Ca₂Al₂Si₃O₁₀(OH)₂

Andover North Surplus - East B Hill A, Upton road A; **Auburn** - Keith Q; **Baring** - U.S. Route #1 road cut; **Brassua Lake quadrangle** - drill core 5B-85-2; **Brunswick** - Route #24 road cut; **Bryant Pond** - Woodstock Granite Q; **Calais** - U. S. Route #1 road cut; **TDR2 WELS**, **Ellsworth?**; **Farmington** - Farmington Falls U.S. Route #2 road cut; **Flagstaff Lake pluton** - Coplin, Dallas, Davis, Eustis, Lang, Rangeley, Stetsontown, Tim Pond; **Grafton** - Dunn Notch A; **Harpswell** - Harpswell Island School A, Long Point A; **Jay** - International Paper Company mill access road cut; **Livermore**; **Lobster** - Big Island A; **Manchester** - Route #17 road cut; **Newry** - Plumbago Mountain A; **Perry** - Gin Cove, Loring Cove; **Portland** - Fish Point A, Grand Trunk railroad cut - Eastern Promenade; regional metamorphic mineral in portions of the Winterville, Jemmland, and Frenchville Formations in Aroostook County - **Ashland**, **Castle Hill**, **Nashville**, **Perham**, **Portage Lake**, **Stockholm**, **Wade**, **Westmanland**, **T12R7 WELS**, **T12R8 WELS**, **T12R9 WELS**, **T13R5 WELS**, **T13R7 WELS**, **T13R8**

WELS, **T13R9 WELS**, **T14R5 WELS**, **T14R6 WELS**, **T14R7 WELS**, **T15R5 WELS**, **T16R4 WELS**, **T16R5 WELS**; "sills and dikes" - Kennebago Lake quadrangle; **Spruce Top Greenstone** - **TDR2 WELS**, **TER2 WELS**, **T9R3 WELS**; **Winthrop** - Towle M; **Woodstock**; **T3R5 BKP WKR** - Beck Pond outlet A; **T3R11 WELS** - Ripogenus Dam area

Prehnite is a widespread mineral in Maine. Its presence is frequently obscure when it is an alteration mineral, though several localities have produced important specimens of crystals. Indicating its nature as an alteration, Boudette (1991) explained of "dikes and sills" in the Kennebago Lake quadrangle: "Typical alteration assemblages include remnants of original minerals in which plagioclase is 'moth-eaten' by products of saussuritization (albite, epidote-zoisite, carbonate, leucoxene, and prehnite), sericite, and ferromagnesian minerals mantled with actinolite and chlorite."

Milton (1961) wrote of **Andover North Surplus**: "Prehnite also occurs in veins cutting amphibolite. Usually these are of microscopic size, but drusy coatings with individual crystals distinguishable to the naked eye were found in the new road cut on the East B Hill Road above Dunn Notch." Milton (1960) also noted prehnite veinlets along the Upton road, Andover North Surplus.

Boone et al. (1989) noted from the 85-94 foot level of drill core 5B-85-2 in the Hurricane Mountain Formation mélange, **Brassua Lake quadrangle**: "Microboudinaged, prehnite-chlorite-quartz veins."

Prehnite has two modes of occurrence in the Brunswick-Harpswell area (Arthur Hussey, personal communication, 1992). Prehnite occurs as joint fillings in amphibolite at Long Point, **Harpswell**. Prehnite also occurs as disseminated small flakes in phlogopitic biotite beds interlayered with amphibolite, notably in road cuts along Route #24 south of Cooks Corner, **Brunswick** (outcrop registered for Maine Critical Areas program) and near the Harpswell Island School, Great Island (also known as Sebascodegan Island), **Harpswell**.

Prehnite was found in abundance during early 1960's road construction along U. S. Route #1 south of **Calais** (pronounced kal - iss) village (Gray and Gray, 1961). The almost colorless to generally dark yellow-green prehnite formed individual crystals (to 1 x 1 cm) which grew in masses of prehnite, and which had some "box-works" texture where a previously formed platy mineral had dissolved out. The prehnite sometimes formed in large cavities, and the groups of prehnite crystals were found completely coating transparent smoky quartz crystals (to 30 cm). Some small crystals (2-4 mm) are completely transparent, but larger crystals are cloudy. The individual crystals have a square cross-section and a simple gable-roof termination. Stilbite and/or laumontite is sometimes associated.

Pavlidis and Milton (1962) noted of the Spruce Top Greenstone, **TDR2 WELS**, **TER2 WELS**, and **T9R3 WELS** that prehnite was: "... restricted in areal distribution. ... Prehnite occurs both in veinlets and in amygdulites only in the greenstones

on the southeast hill of Collins Ridge [TDR2 WELS]..." Pavlides (1973) further noted "interstitial prehnite" within metamorphosed dikes in **Squa Pan** and **TDR2 WELS**.

A specimen from an unspecified locality in **Ellsworth** is undoubtedly mislabeled. It has an unusual fine-grained matrix of greenstone or fine-grained calc-silicate rock with "axehead" clusters of gray prehnite crystals (to 4 mm). The "axeheads" are radially arranged prehnite crystals which resemble a double-bit axehead. The matrix contains 1-2 mm chalcopyrite grains.

A few cloudy white prehnite crystals were found with etched white calcite in a cavity with meionite in vesuvianite at the road cut on U. S. Route #2, Farmington Falls, **Farmington**.

White bladed prehnite crystals (to 3 mm) were found in prehnite veinlets cutting biotite schist on the access road to the International Paper mill, **Jay**.

Simmons (1987) wrote of Big Island area, Lobster lake, **Lobster**: "Prehnite crystals locally crosscut the sedimentary texture of the tuffaceous sandstone."

Abundant prismatic individual prehnite crystals (to 6 mm) of two different crystal habits were found lining a vein exposed in the Route #17 road cut north of **Manchester** village (Ray Woodman, personal communication, 1974).

True (1869) reported on the **Portland** locality: "*Prehnite*. - Portland. Fine specimens of this mineral have been found in the railroad cut at Fish Point." This exposure cuts the Spring Point Formation (Arthur Hussey, personal communication, 1992).

Excellent clear to white rosettes (to 5 mm) of square platy prehnite crystals (to 3 mm) are found in quartz-pumpellyite-(Mg) veins in basalt on the north shore of Loring Cove, **Perry**.

Typical white, rectangular platy prehnite crystals (to 5 mm) were found in seams in metasedimentary rock at the Towle mine, **Winthrop**.

"*Prehnite* ... Specimens of a mammillary form have been obtained at the Granite quarries near Bryant's Pond, in Woodstock" (True, 1869). No specimens known.

Richter and Roy (1976) reported prehnite as a regional metamorphic mineral in portions of the Winterville, Jemmland, and Frenchville Formations in Aroostook County, approximately in **Ashland, Castle Hill, Nashville, Perham, Portage Lake, Stockholm, Wade, Westmanland, T12R7 WELS, T12R8 WELS, T12R9 WELS, T13R5 WELS, T13R7 WELS, T13R8 WELS, T13R9 WELS, T14R5 WELS, T14R6 WELS, T14R7 WELS, T15R5 WELS, T16R4 WELS, T16R5 WELS**. Within this area, Richter and Roy (1976) used three mineral assemblages to define metamorphic zones: prehnite and analcime; prehnite and pumpellyite; and prehnite, actinolite, and epidote. Roy (1987) reported: "Osberg (1974; personal communication) believes that the scattered presence of prehnite veins found throughout New England and prehnite-pumpellyite metamorphism in the area of this report may be due to a widespread, possibly post-Triassic, thermal event that is unrelated to the Paleozoic history of deformations recorded in the rocks."

Boucot et al. (1959) reported of the Beck Pond outlet area, **T3R5 BKPWKR**: "The hornfels is a gray-green crystalline rock

containing many sub-angular to angular quartz grains up to coarse sand-size. Alteration has partly recrystallized the originally limy minerals; the quartz grains are in a milky-green matrix, and many small veinlets of black prehnite up to 1 centimeter thick are present."

prochlorite (Chlorite Group) = clinochlore

Cutler; Eastport; Marshfield; Monmouth; Newry - "Newry M"; Raymond; Saint George; Topsham

Verrow (1940) noted prochlorite from the "Newry mine," **Newry**, but it is uncertain if he meant the Nevel quarry or the Dunton quarry. Burr (1930) listed many towns.

proustite?

Sullivan? - Sullivan M

No specimens or descriptions of **Sullivan** proustite are known. This is probably a fraudulently reported mineral to make a mining property attractive to investors. (It is unlikely that both proustite and pyrargyrite (q.v.) come from the same small mine.) The earliest known proustite reference is Morrill and Hinckley (1959), while pyrargyrite was reported in the nineteenth century.

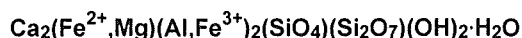
psilomelane? - see romanecchite

pumpellyite group - see pumpellyite-(Fe²⁺); pumpellyite-(Mg)

The pumpellyite group is composed of several members which are found in Maine: pumpellyite-(Fe²⁺) and pumpellyite-(Mg), in addition to members of the series not yet found in Maine: pumpellyite-(Mn); pumpellyite-(Fe³⁺); julgoldite-(Fe²⁺); julgoldite-(Fe³⁺); julgoldite-(Mg). Pumpellyite is a fine-grained fibrous green to blue-green mineral whose presence is generally only observable by microscopical examination of thin sections. Pumpellyite is found in relatively low-grade metamorphic rocks or slightly hydrothermally altered basalts, etc.

Pumpellyite was originally described as a magnesium-rich mineral. When later members of the group were recognized, new names were erected to specify the various compositional differences. The name pumpellyite has been used in an informal way without regard to the chemical variability of the group. Continuing reports of just the name pumpellyite, unspecified by chemical analyses, are still prevalent. "Pumpellyite and epidote are easily confounded in thin section and by x-ray diffraction" (Gary Boone, personal communication, 1990).

PUMPELLYITE-(Fe²⁺) (Pumpellyite Group)



Brassua Lake quadrangle - drill core 5B-85-2; regional metamorphic mineral in portions of the Winterville, Jemmland, and Frenchville Formations in Aroostook County - Ashland, Castle Hill, Nashville Plantation, Perham, Portage Lake, Stockholm, Wade, Westmanland Plantation, T12R7 WELS, T12R8 WELS, T12R9 WELS, T13R5 WELS, T13R7 WELS, T13R8 WELS, T13R9 WELS, T14R5 WELS, T14R6 WELS, T14R7 WELS, T15R5 WELS, T16R4 WELS, T16R5 WELS; Sapling - Round Pond Block A

Boone et al. (1989) reported: "Metabasite blocks, ranging from massive to well foliated, and showing different degrees of metamorphism, are common in the northwest Indian Pond area. The Round Pond Block ... displays pumpellyite-actinolite grade greenstone with relict tuffaceous and accretionary lapilli textures at its southwest end. The block is 0.8 km (0.5 mi) long, and features just described grade into foliated greenstone and greenschist containing a higher pressure assemblage (lacking pumpellyite, but containing sodic-calcic amphibole near winchite in composition [=highly substituted edenite (q.v.)]; cf. section on metamorphism of metabasite blocks) at the northeast end." Chemical analysis of the sample by Boone et al. (1989) indicated a 3:1 Fe:Mg ratio. Boone et al. (1989) further noted of the 105-121 foot interval of drill core 5B-85-2, **Brassua Lake quadrangle**: "Deformed quartz veins cutting quasi-brittly folded, quartz-pumpellyite veins."

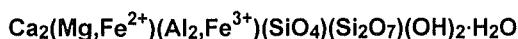
Fine-grained pumpellyite-(Fe²⁺) needles (less than 1 mm) were found distributed over a large area as a regional component of schists (Coombs et al., 1970; Richter and Roy, 1976): in portions of the Winterville, Jemmland, and Frenchville Formations in Aroostook County, **Ashland, Castle Hill, Nashville, Perham, Portage Lake, Stockholm, Wade, Westmanland, T12R7 WELS, T12R8 WELS, T12R9 WELS, T13R5 WELS, T13R7 WELS, T13R8 WELS, T13R9 WELS, T14R5 WELS, T14R6 WELS, T14R7 WELS, T15R5 WELS, T16R4 WELS, T16R5 WELS**. The material is not distinguishable in hand specimen, although much-impregnated specimens may have a green cast due to abundant pumpellyite-(Fe²⁺). Richter and Roy (1976) discussed the mineral:

"Pumpellyite occurs in both the igneous and sedimentary rocks as brightly pleochroic (α , γ colorless; β = bright green) crystals with anomalous yellowish-brown interference colors. The deep-green color probably reflects a relatively high iron content (Coombs, 1953). In the volcanic rocks of the Winterville Formation, relatively coarse grained pumpellyite, which has been observed in 19 of the localities, forms prisms and subhedral aggregates in veins with prehnite or in cavities with epidote and chlorite... Finer grained pumpellyite appears as overgrowths on plagioclase crystals that are also partially replaced by calcite

and as small crystals in chlorite patches. In many of the devitrified tuffs of the Jemmland Formation, pumpellyite is concentrated in thin mats that follow the bedding planes...

Extremely fine grained fibrous pumpellyite occurs as rounded, fine-grained, monomineralic aggregates in graywacke in all metamorphic zones. It is difficult to distinguish whether the pumpellyite is detrital, a replacement of a clast, or recrystallized from the matrix. Because the aggregates of pumpellyite are delicate and because they occur with other indisputable metamorphic minerals, they are here interpreted to have been formed in place ... Pumpellyite also occurs in the matrix of graywacke at locality 90 [Ashland area] in fanlike clusters... Pumpellyite has been observed in 18 percent of the specimens from the Silurian graywacke and conglomerate." Roy (1987) summarized: "Basalt of the Winterville Formation is typically amygdaloidal, variably phenocrystic, rarely pillowed and highly fractured with secondary calcite and lesser pumpellyite and/or epidote filling the amygdaloids and veins..."

PUMPELLYITE-(Mg) (Pumpellyite Group)



Deer Isle - North Haven Formation; Meddybemps granite? - Alexander, Cooper, Meddybemps; metamorphosed basaltic dikes - Squa Pan, TDR2 WELS; Pembroke - U.S. Route #1 road cut; Perry - Loring Cove A, Perry Formation; T7R14 WELS - Caucomgomoc Lake A

Pinette and Osberg (1989) noted of the North Haven Formation exposed on Eagle Island, Fling Island, Hard Head Island, and The Porcupines (islands), **Deer Isle**: "Microscopically, the mafic phyllites and pillow basalts, locally amygdaloidal, contain phenocrysts of plagioclase with pilotaxitic texture and augite. ... Locally, acicular mineral aggregates tentatively identified as pumpellyite also occur within the albite. In this regard, D. B. Stewart (pers. commun., 1982) has microprobe data to confirm the presence of pumpellyite in similar rocks just to the north of the study area."

Ludman and Hill (1990) reported possible pumpellyite from the Meddybemps granite, **Alexander, Cooper, and Meddybemps**: "Reddish-brown alteration minerals along thin fractures in the granite are common in many thin sections. In some samples, biotite has been altered to an intensely pleochroic (emerald green to pale green) mineral with anomalous birefringence colors that may be pumpellyite."

Gates and Moench (1981) wrote of a diabase sill exposed in a road cut of U. S. Route #1 near the Pennamaquan River and Crow Brook, **Pembroke**: "Diabase sills that intrude the Leighton and Hersey Formations have a relict ophitic or subophitic texture. ... One altered sample ... sample No. 29... from the interior of a sill is coarse grained and composed of albite to sodic oligoclase, prehnite, sunbursts of vividly pleochroic blue-green to straw-yel-

low pumpellyite (showing anomalous interference colors), epidote, deep-green chlorite, magnetite, augite, a few spots of calcite, and sparse saponite possibly after olivine."

Perhaps the only locality in Maine for free-standing pumpellyite-(Mg) crystals (to 1 mm) occurs in prehnite crystal and quartz crystal seams in basalt exposed near the northern shore of Loring Cove, Perry. The dark green to slightly olive-green pumpellyite-(Mg) crystals are translucent to transparent and are found lining vugs in solution cavities under crusts of prehnite crystals or within vugs within the quartz/prehnite matrix. The pumpellyite-(Mg) crystals can be drusy, lining vugs, or occur as somewhat felted masses with some jackstraw individuals sprinkled over the drusy base. In many specimens, the pumpellyite-(Mg) is found as inclusions in transparent quartz crystals (to 1 x 0.3 mm) and some specimens are so impregnated with pumpellyite-(Mg) in the matrix as to impart a dark green color over many centimeters.

Pavlidis (1973) noted of metamorphosed basaltic dikes in **Squa Pan** or **TDR2 WELS**: "One dike contains fine-grained, very sparse pumpellyite."

Pollock (1985) and Whittier and Pollock (1986) reported sub-greenschist facies (pumpellyite + chlorite) metamorphism in Silurian basalts in the Caucomgomoc Lake area, **T7R14 WELS**.

purple phosphate of lime?

Topsham?

True (1869) reported of **Topsham**: "This mineral exists sparingly in the granite ledge on the banks of the Androscoggin, just below the bridge of the Androscoggin Railroad." This material cannot be identified with certainty. It may have been an apatite, though it probably is vivianite with mistaken chemistry.

PURPURITE (Triphylite Group)



Auburn - Groves Q, Pulsifer Q; **Cornish?** - Berry Ledge L; **Greenwood** - Emmons Q, Tamminen Q; **Hebron?**; **Newry?** - Dunton Q; **Norway** - BB #7 Q, Tubbs Ledge P; **Paris?** - Mount Mica Q; **Peru?** - Lobikis Q, Perry P; **Poland** - Berry-Havey Q; **Rumford** - Black Mountain Q?, Brown-Thurston P, Red Hill Q?; **Standish?** - Breakheart Hill P, Oak Hill P; **Stoneham?** - Lord Hill Q; **Warren?** - Starrett P

Purpurite is visually indistinguishable from heterosite (q.v.). Because of this reason, many localities have reports of purpurite, but the close scrutiny of the specimens by chemical analysis has revealed their misidentified nature (see Moore, in press). See also discussion for heterosite. Purpurite is found at lithiophilite-bearing, not triphylite-bearing, localities.

Carpenter (1951b) reported purpurite from the Berry Ledge calc-silicate locality, **Cornish**. The report is completely unreasonable. No specimens known.

At the Tamminen quarry, **Greenwood**, dark purple cleavages (to 4 cm) of purpurite occur frozen in black-stained quartz and cleavelandite matrix, and small patches (to several cm) of purpurite have been observed on the margins of black-stained lithiophilite.

Morrill et al. (1958) listed purpurite from an unspecified locality, **Hebron**. No specimens known.

Holman (1935) listed purpurite from the Dunton quarry, **Newry** without substantiation. Chemical analyses (this study and Moore, in press) indicate that the Dunton quarry has the look-alike mineral heterosite.

Numerous "purpurite" specimens have been found at the iron-rich Lobikis pegmatite quarry, **Peru** and are actually heterosite. Marble (1928) noted of the Perry prospect, Peru: "There is also considerable of the altered form of triphylite, commonly called purpurite, but Dr. Palache says the preferred name is Heterosite."

Small purple-black masses (to 7 mm) of purpurite from the Berry-Havey quarry, **Poland** are found on the black-stained margins of lithiophilite in quartz. Associated species can include triplite, dickinsonite, uraninite, and uranophane.

Hess et al. (1943) wrote of a prospect on Black Mountain, near the Black Mountain quarry, **Rumford**: "Another opening has been made in pegmatite 30 or 40 feet above the middle pit already described... The only signs of rare alkalis seen in the pit were blue tourmalines and small pieces of purpurite (manganese phosphate made by the weathering of lithiophilite) close to the northwest wall." No specimens known. The report might refer to: "... Pit #4 of the Black Mtn. group, which is 30-40 ft. E and uphill from the main pit, is the site for both triphylite and heterosite" (Neil Wintringham, personal communication, 1992).

Large masses (to 20 cm) of purplish black ferroan purpurite (51% purpurite, Moore, in press) are found intergrown with varie-gated salmon-pink albite and muscovite with occasional löllingite at the Brown-Thurston prospect, above the Black Mountain quarry, **Rumford**.

Maillot et al. (1949) listed "purpurite" from the Black Mountain quarry, proper. No data known. Analyzed specimens have proven to be heterosite. (Lithiophilite is not found at the Black Mountain quarry.) Similarly, Shainin (1949) reported purpurite associated with triphylite in the Ridge Pegmatite of the Red Hill quarry group, Rumford.

Purpurite was reported by Dolloff (1936) from the Oak Hill prospect and a quartz vein on Breakheart Hill, **Standish**. The mineral is described in some detail including: "A moment's notice of the streak, which can be done with the scratch of a hammer, enables one to predict the occurrence of other minerals of the third period." Though not stated, one presumes a bright purple-colored streak was observed, and this is apparent on one of his specimens (AMNH 68708). The association is iron-rich and the observed mineral was undoubtedly heterosite (q.v.).

Hess et al. (1943) noted of the Starrett prospect, **Warren**: "Small lumps of lithiophilite, partly changed to purpurite..." Sundelius (1963) noted heterosite (q.v.).

pyrargyrite?

Ag₃SbS₃

Franklin? - *Franklin M*; **Hancock?**; **Sullivan?** - *Sullivan M*

Pyrargyrite was listed from the Sullivan mine, **Sullivan** (Kempton, 1879). No specimens or descriptions known. This is probably a fraudulently reported mineral in order to make a mining property appear rich in silver and therefore attractive to stock investors. (It is unlikely that both pyrargyrite and proustite (q.v.) come from the same small mine.) Emmons (1910) did not observe the species and Li (1942) reported: "None of the specimens examined by the writer yielded any silver-bearing minerals." The late Philip Foster (personal communication, 1964), a noted mineral collector, said that he had been trying to locate any piece of a ruby silver mineral from Maine since the 1920's and had not succeeded in seeing a single specimen.

Additional localities (Franklin mine, **Franklin** and **Hancock**), are recorded in Morrill and Hinckley (1959), but they are unsubstantiated by specimens or data.

PYRITE (Pyrite Group)

FeS₂

Acton - *Boston-Acton M*; **Addison** - *Thornberg Q*; **Albany** - *Donahue P*; **Albion**; **Anson**; **Appleton** - *Appleton Mining and Smelting Company M*; **Auburn** - *Groves Q*; **Bar Harbor**; **Bingham** - *"Saw Mills A"*; **Blue Hill** - *Black Hawk M, Blue Hill M, Camdage M, Douglass M, Granger M, Lady Elgin M, Mammoth M, Owen M, Owen Lead M, Revere M, Saunders M, Stewart M, Stover Hill M, Twin Lead M, Wheal Freddie*; **Bowdoinham**; **Brooksville** - *Blodgett P, Callahan M (= Cape Rosier M), Maine Lake Ice Company Granite Q, Perkins P*; **Bryant Pond** - *Bryant Pond Granite Q*; **Buckfield** - *Bennett Q, General Electric Q, Orchard Q*; **Bucksport** - *Snow M*; **Calais** - *Beaver Lake Black Granite Q, Gardners Lake Black Granite Q, Maine Red Granite Q, Mingo-Bailey and Company Q*; **Carmel** - *Carmel Antimony M, Harrington M*; **Carthage** - *Sanders Farm P*; **Casco** - *Chute P*; **Castine** - *Emerson M*; **Castle Hill** - *volcanic rocks*; **China**; **Clinton**; **Columbia** - *Harrington M*; **Concord** - *Robinson M, The Old Bluff A*; **Cooper**; **Corinna**; **Deer Isle** - *Deer Isle M, North Deer Isle A*; **Dexter**; **Dover-Foxcroft** - *Piscataquis River falls A*; **Eastport** - *Moose Island A, Road Metal Q*; **Ellsworth** - *Dunham M*; **Fairfield**, **Falmouth**, **Farmington** - *Nortons Ledge A*; **Frankfort** - *Mosquito Mountain*; **Franklin** - *Franklin M, Franklin Extension M, Havey and Robertson M, Swan M*; **Freeport** - *Freeport*

Granite Q, Wolfs Neck A; **Gardiner**; **Gouldsboro** - *Gouldsboro M, Keron P, West Bay M*; **Greenwood** - *Heikkinen Q, Nubble Q, Ohtonen Q*; **Guilford** - *Bennett M*; **Hallowell**; **Hampden** - *Consolidated Hampden M, Fowler M, Lawrence M*; **Hancock** - *Cline M, Copperopolis M, Elliot M, Emmet M*; **Harmony**; **Herman** - *Davis M*; **Hiram** - *Frenchmans Gold M*; **Hodgdon** - *Westford Hill A*; **Industry**; **Jackson** - *Jackson Gold Mining and Milling company M*; **Jay**; **Jonesport** - *Jonesport Q, Minerva Cove Granite Q*; **Kennebunk** - *U. S. Granite Q*; **King and Bartlett** - *Butler Pond A, Rush Pond A*; **Kingfield**; **Knox** - *Stone M*; **Lebanon**; **Lewis-ton**; **Lexington**; **Lincolnville** - *Heal Black Granite Q, Lincolnville Gold and Silver Mining Company M*; **Linneus** - *Drew Hill sulfide veins*; **Litchfield**; **Long Island Plantation** - *Atlantic M*; **Lubec** - *Lubec Lead M, West Quoddy Head*; **Machias** - *Kennebec Village Q*; **Machiasport**; **Manchester**; **Mapleton**; **Marshfield** - *Marshfield Granite Q*; **Mason** - *Peabody Mountain Q*; **Milbridge** - *Cherryfield M*; **Milton** - *Mount Glines P*; **Minot**; **Monmouth**; **Monson**; **Mount Desert** - *Nelson Rockefeller estate*; **Mount Vernon**; **Newfield** - *Bergendahl P*; **New Portland**; **Newry** - *Bell Pit, Dunton Q, Nevel Q, Rose Quartz Crystal L, Scotty Q*; **New Sweden** - *volcanic rocks*; **Norridgewock** - *Dodlin Hill Q*; **North Yarmouth**; **Owls Head** - *Owls Head M*; **Oxbow** - *Cupsuptic River Q*; **Paris** - *Mount Mica Q, Whispering Pines Q*; *pelitic rocks* - **Carroll**, **T7R2 NBPP**; **Pembroke** - *Barrett P (=, Dolsan Pit), Big Hill M*; **Penobscot** - *Annear M, Hercules M, Highland P, Limeburner P*; **Peru**; **Phillips**; **Phippsburg** - *Mount Arat Q*; **Pittston** - *Pittston M*; **Portland** - *Jewell Island*; **Pownal**; **Prospect** - *Fort Knox M*; **Raymond**; **Rockland**; **Rockport** - *Riverside M*; **Rumford** - *Black Mountain Q, Goddards Ledge Q (= Ford Hill Q), Red Hill Q, Rumford Falls A*; **Saint George** - *McConchie Q*; **Searsport** - *Bog Hill Granite Q*; **Sebec** - *Lime Q*; **Sedgwick** - *Edgemoggin [sic] M*; **Skowhegan** - *Mill street A*; **Smyrna** - *railroad cut*; **South Berwick**; **Stoneham** - *Aldrich Q*; **Stonington** - *Parker-Ryan Q*; **Stow** - *Deer Hill Q*; **Sullivan** - *Beacon Hill M, Milton M, Morancy M, Petee Black Granite Q, Salem-Sullivan M, Sullivan Village Q, Sullivan M, Whaleback M*; **Surry** - *Campbell M, Donlon M, Oakland M, Route #15 road cut*; **Thomaston** - *Dragon Cement Q, Williams Q*; **Thorndike**; **Trescott** - *Trescott M*; **Troy**; **Turner**; **Unity**; **Union** - *Harriman P, Union P*; **Vassalboro**; **Wales**; **Warren** - *Knox M, Warren Nickel P*; **Waterboro**; **Waterville**; **Wayne**; **Wesley** - *Rollins M*; **Westbrook**; **West Falmouth** - *Beulah Farm A*; **West Paris** - *Perham Q*; **Winslow** - *Winslow Tin M*; **Winthrop** - *Copperas M*; **T3R5 BKP WKR** - *Spencer Stream A*; **T10SD** - *Catherine Hill Q*

Jackson (1838a) noted before the "bloodless" Aroostook War: "In case war should take place, we shall be able to extract all the sulphur required in the manufacture of gun-powder from pyrites, and should then be independent of the volcanoes of the Mediterranean." While Jackson (1838a) was referring to Jewells Island, Portland and areas in Brooksville near the present day Callahan mine, good pyrite specimens are scarce in Maine. Young (1962, 1963) reported pyrite from many "silver" mines and sometimes as the only sulfide visible at the location visited.

Additional localities are listed by Smith (1904), Seaman (1975c), Boucot et al. (1959) and Burr (1941).

Burroughs (1979) noted of the Butler and Rush Ponds areas, **King and Bartlett**: "Pyrite cubes up to 1-cm in width are disseminated throughout the slate."

Doyle et al. (1961) noted of the dark gray phyllite and schist of the sulfide-bearing contact zone with the Lucerne granite, **Carroll, Kossuth, and Springfield**: "Pyrite occurs throughout as individual undeformed cubic crystals."

Excellent cubic pyrite crystals (to 2 cm) are found in fissile shale in the Cupsuptic River road metal quarry, **Oxbow**.

Pyrite from the Whispering Pines quarry, **Paris** has been found as unusual fracture fillings in quartz. The fine-grained pyrite veins (to several mm thick) can easily separate along the contact with the matrix (Neil Wintringham, personal communication, 1992).

pyrochlore? (Pyrochlore Group)

$(\text{Ca},\text{Na})_2(\text{Nb},\text{Ta})_2\text{O}_6(\text{OH})$

Buckfield?; Greenwood?; Newry? - Dunton Q; Rumford? - Black Mountain Q

Pyrochlore was the first member of its group to be discovered, but microlite is the only member of the pyrochlore group verified in Maine. Pyrochlore has also been reported presumably by collectors who mistook the hyphenated name microlite-pyrochlore to suggest that both members of a series are equally likely to occur at a locality.

Burr (1930) listed pyrochlore from **Buckfield**. No specimens known.

Verrill (1863) wrote of **Greenwood**: "At the locality in Greenwood that he had discovered a few years ago, the associated minerals were zircon, pyrochlore and magnetite, all in small crystals like the tin ore itself." True (1869) repeated the report of pyrochlore from Maine: "*Pyrochlore*. - Greenwood. This mineral, discovered by Prof. Verrill, is found in Albite, associated with crystals of Zircon, and is rare." The identification of this species at this early date was fraught with difficulties and the related species microlite was considered "discredited" until 1868 (King and Teixeira, 1993). (True's (1869) report was printed seven years after it was submitted.) Shepard (1835b) described microlite from Chesterfield, Massachusetts, but his chemical analyses totaled only 90%. The analysis of Wöhler (1826) for his pyrochlore totaled a more respectable 97%, but the mineral was thought to be a titanate and not a niobate. To add to the confusion, Shepard (1835a) described his microlite as being a niobate. When analyses showed pyrochlore to actually be a niobate, the rule of priority relegated Shepard's microlite to synonym status. All of the original microlite was to be called pyrochlore. In 1870, Shepard analyzed a new microlite from Haddam, Connecticut, prompted to do so by George Brush, and demonstrated that the

new microlite was actually a tantalate. Verrill's (1863) report had no option but to use the existing nomenclature. Although the name pyrochlore, from Maine, appeared in print without data, it has proved too virulent, until now, to discredit from Maine mineral lists.

Fraser (1930) wrote of the Dunton quarry, **Newry**: "Microlite is commonly present as well formed octahedrons in cleavelandite. The color varies from yellow to dark brown. In places the crystals are fairly large octahedrons, up to three-fourths of an inch in diameter. Spectroscopic analyses by Mr. Gedney have indicated the light yellow colored mineral is microlite and the dark brown mineral pyrochlore." No data were given and the method used would have been essentially qualitative and insufficient to prove the existence of pyrochlore. Holman (1935) apparently reiterated the pyrochlore listing. "Hatchettolite" from the Dunton quarry has yielded a microprobe analysis of about:

$(\text{Ca}_{.97},\text{Na}_{.48},\text{U}_{.27},\text{Pb}_{.01},\text{Bi}_{.0\text{X}})(\text{Ta}_{1.57},\text{Nb}_{.43})(\text{O},\text{OH})_7$

(Bart Cannon, personal communication, 1985).

pyrolusite?

MnO_2

Blue Hill?; Buckfield? - Bennett Q, Orchard Q; TC?; Castle Hill?; TE?; Greenwood?; Hodgdon? - Westford Hill P; Lubec? - Lubec Lead M; Mapleton? - Higgins P; Newry? - Dunton Q; Paris?; Rumford? - Black Mountain A, Elliot Q; Spider Lake quadrangle? - Munsungun Lake Formation; Sumner?; Thomaston? - Williams Q; Woodland?; T6[5?]R8?

Pyrolusite has been reported from many localities in Maine (e.g. Burr, 1930; Morrill et al. (1958); and Morrill and Hinckley (1959).) No verified samples of pyrolusite are known from Maine, though it seems unlikely that no specimens exist. Potter and Rossman (1979) made a survey of the worldwide identifications of black dendrites from granite pegmatites in addition to a great variety of other mineral environments. Based on their report and conversations with George Rossman (personal communication, 1987), **no pyrolusite has yet been found in a dendrite - anywhere in the world**. The earlier identification of manganese dendrites was probably made on the supposition that pyrolusite was the most common manganese oxide and therefore the safest name to apply to that material. By careful sampling and the use of infra-red analysis, the two prominent manganese cementing minerals in Maine streams were shown to be birnessite and nsutite by Potter and Rossman (1979). Although Potter and Rossman (1979) did not investigate any dendrites from Maine, on a worldwide basis they found coronadite, cryptomelane, hollandite, romanechite (from pegmatite), and todorokite (from pegmatite) - all as dendrites. Todorokite (q.v.),

cryptomelane (q.v.), and amorphous black manganese stains have been found in Maine pegmatites.

Studies of the Aroostook County manganese deposits have not yet indicated the presence of pyrolusite in any of the deposits.

The original Lubec Lead mine (vein 9), **Lubec** report (Holmes, 1861, citing unpublished report of N. S. Manross) only indicated: "The gangue of this vein consists of quartz and calcareous spar, the latter often containing large cavities partly filled with earthy oxide of manganese, a structure regarded as highly favorable to the richness of the vein."

The heavy black staining found in cleavelandite from the Dunton quarry, **Newry**, has proven to be amorphous and thus not a mineral (George Rossman, personal communication, 1987).

Hall (1970) noted of the Munsungun Lake Formation, **Spider Lake quadrangle**: "The rock typically breaks into rectangular fragments several inches across coated with pyrolusite."

PYROMORPHITE (Apatite Group)



Gouldsboro - *Gouldsboro M*; **Lenox?** - *no such locality name in Maine*; **Lubec** - *Lubec Lead M*; **Pembroke** - *Big Hill M*; **Stow** - *Colton Hill Q*

Good pyromorphite crystals have yet to be found in Maine. The pyromorphites from the various localities are found as olive-green to yellow-green resinous granular masses (1-2 mm) on milky quartz or microcline. At **Lubec** (Houghton, 1861) and the Upper Colton Hill quarry in **Stow** the pyromorphite is found with well crystallized wulfenite (q.v.). (Careful search might reveal pyromorphite crystals.) A few pyromorphite specimens with very tiny (fractions of a mm) crystals have been observed at the upper Colton Hill quarry (Pat Barker, personal communication, 1994).

The pyromorphite observed from the Gouldsborough mine, **Gouldsboro** (HU 123007), consists of almost granular "crystals" in patches (to 1 cm) on fractures in milky quartz with pyrite and bornite? and should not be confused with the abundant dark green epidote (included in the quartz) which occurs at this locality.

As early as 1844, Dana listed pyromorphite from **Lenox**, Maine and the listing was perpetuated through subsequent editions of his "System." There has never been a Lenox, Maine. Beck (1842) attributed pyromorphite to Lenox [sic; = Easthampton/Southampton], Massachusetts in his *Mineralogy of New York*, along with New York pyromorphite, and could have been the source from which Dana (1844) generated his erroneous pyromorphite listing if the handwritten state abbreviation "Ma." was confused with "Me." in extracting information for a locality list.

PYROPHANITE (Ilmenite Group)

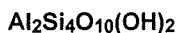


Newfield - *Straw Hill A*; **T9R3 WELS** - *Hovey Mountain P*; **TDR2 WELS** - *Maple Mountain P*

A single black blade (2 x 6 cm) of pyrophanite has been found in a pod (3 x 3 cm) of normal orange-flecked sunstone associated with a few minor grains of gray-blue sodalite (to 3 mm) from the Straw Hill area, **Newfield**.

Eilertsen (1952) listed pyrophanite from the Hovey Mountain-Maple Mountain district, **TDR2 WELS** and **T9R3 WELS**, without description. Pavlides and Milton (1962) confirmed the previous identification: "Pyrophanite was found in one veinlet and was identified by optical, spectrographic, and X-ray methods."

PYROPHYLLITE (Talc Group)



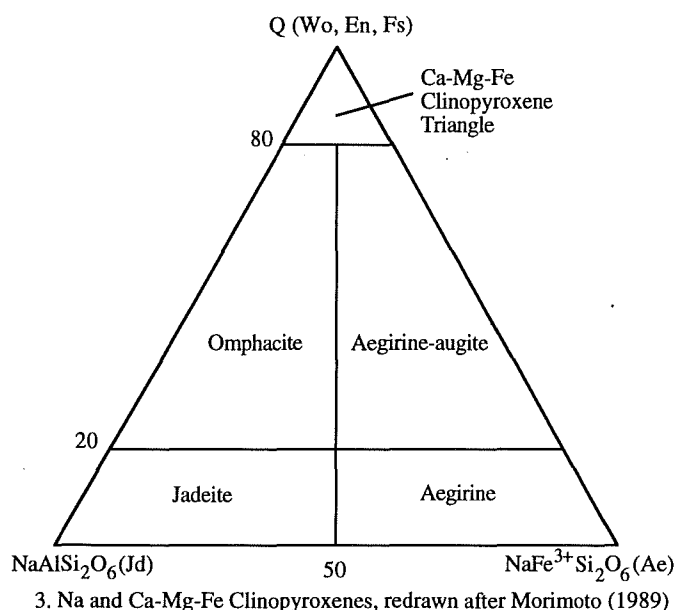
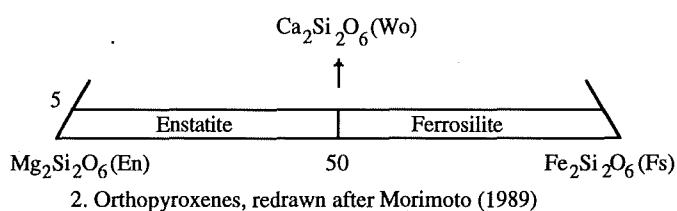
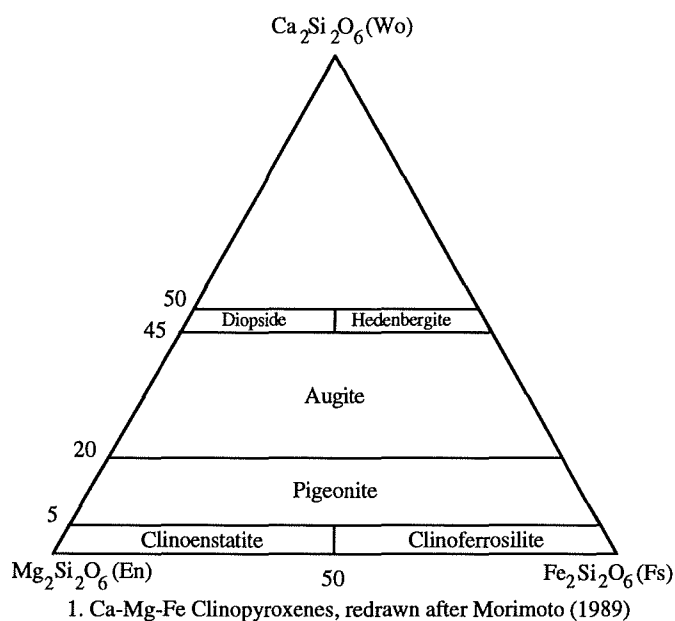
Carrabassett Valley - *Lexington batholith contact*; **Thomaston?**

Boone (1973) wrote of the Lexington batholith contact, **Carrabassett Valley**: "Cores of relict andalusite survive in many of the white mica 'shimmer-aggregate' pseudomorphs. In order to test whether the alteration of andalusite had proceeded stepwise, with hydration in advance of muscovitization, several radii across a large composite pseudomorph were explored by monitoring $K\ k_\alpha$ at points from the muscovite mantle inward toward the andalusite core. Muscovite is in direct contact with andalusite around most of the core's surface as examined in this section, but in several spots, $K\ k_\alpha$ counts diminished to background where optically, micaceous material is present. This indicates the presence of a layer-lattice aluminous phase which is probably pyrophyllite, as the counts for aluminum were slightly lower than for muscovite." The pyrophyllite was subsequently identified by X-ray diffraction (Gary Boone, personal communication, 1990).

A specimen labeled pyrophyllite from Thomaston exists (USNM# 0129156). Specimen not seen.

pyroxene - a group name including aegirine, aegirine-augite, augite, diopside, enstatite, ferrosilite, hedenbergite, pigeonite, and spodumene

Pyroxene minerals are abundant in Maine. There are orthorhombic pyroxenes (enstatite and ferrosilite) as well as the more abundant monoclinic pyroxenes. Pyroxenes should be characterized by having perfect cleavages at nearly right angles, but in practice chemical alteration of the mineral, as well as other factors, results in the mineral showing a splintery to fibrous cleavage surface. Pyroxenes, particularly diopside, can have a



well-developed parting whose smoothness might exceed the smoothness of the cleavage. The parting surface can be dull, but rarely is vitreous in luster.

Historically, mineral species have depended on the "50% rule" for their nomenclature boundaries, and Nickel (1992) wrote of the International Mineralogical Association's decision endorsing this rule. The recent report of the International Mineralogical Association's Subcommittee on Pyroxenes (Morimoto, 1989) has added certainty to what constitutes a *species* of the pyroxene group, but in many cases the species boundaries do not conform to traditional concepts. For example, augite has been considered to be a variety of diopside in which some of the calcium in the mineral was substituted by iron, magnesium, aluminum, etc. However, the "50% rule" cannot be applied rigorously to the large groups of pyroxenes that show wide ranges of coupled substitutions. This is particularly so when the minerals concerned are abundant and widespread, and have a historically established nomenclature in mineralogical and petrological circles.

Note: augite is now a species which can be iron-free or magnesium-free, even though it would be important petrologically to distinguish which portion of a series was observed: magnesian or ferroan augite, with the boundary for chemical modifier use being at the 50% mark of Fe:Mg. Pigeonite always represented an "anomaly" based on its optical and structural properties and always remained distinct from clinoenstatite. The new nomenclature is best expressed in diagrams.

PYRRHOTITE

FeS-Fe_{1-x}S

Acton - Boston-Acton M, Dirigo M; **Andover**; **Appleton**; **Auburn**; **Augusta**; **Bingham** - Wyman Dam excavation; **Blue Hill** - Arctic P, Douglass M, Mammoth M, Owen M, Saunders M (=Hinckley M), Stover Hill M, Twin Lead M, Victoria M, White Star M; **Brooksville** - Blodgett P, Perkins M, Tapley #1 M; **Brownfield**; **Bryant Pond quadrangle** - Berry Ledge and Patch Mountain Formations; "Byron schist"; **Buckfield** - Bennett Q, Orchard Q; **Carthage** - Saunders Farm P; **Concord** - Robinson M; Cutler quadrangle; **Ellsworth** - Brimmer P, Dunham P; **The Forks** - Black Narrows A; **Franklin** - Franklin M, Franklin Extension M; **Gardiner** - Iron Hill water tank locality; **Gorham** - quartz veins; **Katahdin Iron Works**; **Lebanon** - Towow Formation; **Linneus** - Drew Hill sulfide veins; Lucerne granite contact - **Carroll**, **Kossuth**, **Springfield**; Marie Pond; **Mayfield** - Mayfield Corner A; **Mexico** - U.S. Route #2 road cut; **Milbridge** - Cherryfield M; **Minot**; Moose River quadrangle; **Newfield** - Bergendahl P; **New Portland** - Wyman Farm A; **Newry** - pegmatite, Plumbago Mountain A; **Norway** - Crockett Ridge Q; **Penobscot** - Clyde Limeburner P, Hercules M, Penobscot M; **Peru** - Lobikis Q; **Portland** - Woodfords Q; **Phillips**; **Randolph**; **Raymond**; **Rockport** - Pleasant Mountain A, Riverside Q; **Rumford** - Goddard Ledge Q, Red Hill Q; Sangerville Formation - Patch Mountain Member; Smalls Falls Formation; **Sorrento** - Golden Circle M; **Square-**

town - gabbro-norite body; **Standish** - Whitney Q?; **Stoneham** - Cole Q, Lord Hill Q, Melrose Q; **Surry** - Campbell M; **Union** - Harriman P; **Warren** - Warren Nickel P; **Waterford** - Richardson P, Saunders Q; **Waterville Formation** - **Augusta**, **Palmyra**, **Sidney**, **Waterville**, **Winthrop**; **"Welden"**= **Weld?**; **Wesley** - Rollins M; **West Paris** - Perham Q; **Wilton** - U.S. Route #2 road cut; **Windham**; **Winter Harbor** - Iron Bound Island M; **York**

Pyrrhotite is an abundant mineral in Maine. It has a light brassy yellow to bronzy metallic luster, is usually magnetic, and rusts very easily. It forms a significant component in rusty schists exposed in western Maine (e.g. Smalls Falls Formation) and southern Maine (e.g. Towow Formation, **Lebanon**, Hussey, 1962). Moench and Boudette (1987) wrote: "Outcrops of the Smalls Falls [Formation] are characteristically rust encrusted; they produce an obnoxious sulfurous odor when broken." Guidotti and Cheney (1976) noted that the presence of pyrrhotite in the Smalls Falls Formation resulted in much of the iron being used up in the formation of pyrrhotite with consequentially iron-poor, magnesium-rich silicate associations (see also Henry and Guidotti, 1981). Additional pyrrhotite-bearing schists, at least locally, include the Billings Hill, Carrabassett, Hildreths, and Quimby Formations; and in the Smalls Falls Formation: "Sulfide minerals are mainly pyrite in areas of low-grade metamorphism and pyrrhotite at high grade" (Moench and Pankiwskyj, 1988). Wing (1959b) mapped the aeromagnetic signature of pyrrhotite in the Waterville Formation, **Sidney** and **Augusta**; and Osberg (1988) mapped the pyrrhotite-bearing unit from the **Manchester-Winthrop** area to the **Waterville** and **Palmyra** areas. Guidotti (1965a) noted pyrrhotite in the Berry Ledge and Patch Mountain Formations in the **Bryant Pond quadrangle**. Kulp et al. (1956) reported sulfur isotope values of pyrrhotite from pegmatites from **Newry**; **Red Hill**, **Rumford**; and **"Welden"** (= **Weld?**) as well as an unspecified occurrence on Plumbago Mountain, **Newry**. Kulp et al. (1956) wrote: "The metasediments associated with the Red Hill, Plumbago Mt., and Newry pegmatites are mica schists and gneisses and would contribute little sulfide derived from sedimentary sulfate. Thus it is not surprising that most of these samples show high S^{32}/S^{34} ratios as if derived primarily from sedimentary sulfide." Magmatic sulfur isotopic ratios were reported for Iron (= Ore) Mountain, **Katahdin Iron Works**; **Marie Pond**; and **Union**, as well. Wing (1959a) noted aeromagnetic anomalies which were partly correlated with pyrrhotite-bearing rocks: **Cedar Lake** - Nollesemic Lake area, **Hopkins Academy Grant** - **T3R9 NWP**; **Medford** - **Maxfield** Anomaly; and **Lincoln** - **Winn** Anomaly. Gates (1961) noted that pyrrhotite was "widespread throughout the Cutler and Moose River quadrangles." Guidotti (1965a), Creasy (1979), and others have noted small quantities of pyrrhotite in the Patch Mountain Member of the Sangerville Formation. Yates and Howd (1988) reported both hexagonal and monoclinic pyrrhotite from the Black Hawk mine, **Blue Hill**.

Forsyth (1955c) wrote of the Iron Hill road cut on U.S. Route #201, **Gardiner**: "The origin of the name Iron Hill may

be attributed to the presence of iron sulfides which cause heavy rust staining of the rocks and glacial drift in the area. Local residents report that attempts to mine the rock for iron ore were made during the 19th century... Examination of the rock showed the sulfide mineral to be pyrrhotite occurring as disseminated blebs with irregular shapes. In addition to the disseminated grains, the pyrrhotite also occurs in narrow veins. ... Sulfides are also found in minor quantity within the pegmatites, and marginal to these dikes, commonly are coarser than in the rest of the schist. Local silicification seems to have affected the schist and within these areas the pyrrhotite occurs in greater quantity. Graphite is present in the rock as fine disseminated grains and also as clusters within the pegmatites."

Kunz (1884c) indicated an early discovery of pyrrhotite in **Gorham**: "At Gorham, Me., on the shores of Sebago lake, about one year ago, some excavating was done for a road, and from the pile of rock thrown out in blasting a mass was selected by Mr. Hayden of Raymond, Me., who resides in the vicinity, who thought from the outward appearance and occurrence in it of pyrrhotite in crystals that it might contain something of interest." Locality now lost.

Doyle et al. (1961) noted of the sulfide-bearing dark gray phyllite and schist in contact with the Lucerne granite, **Carroll**, **Kossuth**, and **Springfield**: "Pyrrhotite and occasional chalcopryrite showings are confined to well defined zones within the unit, and are often sheared into lineations parallel to the strike."

Houston (1956) briefly wrote of the Black Narrows deposit, **East Moxie** and **The Forks**: "The mineralized phases of the peridotite contain as much as 20% sulphide. They are identical in every respect with those at Union, Maine. The pyrrhotite, pentlandite, and chalcopryrite resemble those at Union, but the associated alteration is more extensive and serpentine, magnetite, and chlorite cut the sulphides. Serpentine veinlets transect large masses of pyrrhotite in many cases partly filled with late magnetite..."

The pyrrhotite at the Katahdin Iron Works, **Katahdin Iron Works** was exploited as a source of iron and sulfur. Houston (1956) wrote: "Individual crystals [grains] of pyrrhotite range from 1.1 to 2 mm. in diameter, their sizes conforming largely to the grain size of the host rock. The grains are usually anhedral in outline with somewhat rounded contacts, but in some cases contacts between individual grains are extremely irregular. ... Pyrrhotite occurs predominantly as interstitial masses between the silicate minerals, but also in a great many other ways. Along the border of the deposit numerous rounded blebs of pyrrhotite lie within orthorhombic pyroxenes..., whereas in the center of the deposit, in sections containing chiefly sulphides[,] the orthopyroxene inclusions are partly rounded and replaced by the sulphides. Two areas were seen where pyrrhotite fills minute veinlets following cleavage cracks in olivine and pyroxene." Houston (1956) noted that the ore body was much oxidized and disintegrated with white veinlets of unidentified sulfates. The history of mining pyrrhotite iron ore has been summarized by Sawtell (1982, 1983, 1988).

Houston (1956) wrote of the Drew Hill sulfide deposit, **Linneus**: "At the southern border of the largest marble lens is a massive pyrite-pyrrhotite deposit. ... Pyrrhotite occurs chiefly as massive replacement in the host rock. Small euhedral crystals of pyrite are generally associated with the pyrrhotite." Houston (1956) mapped the locality in detail, while Pavlides (1971) mapped it in a generalized format. Kulp et al. (1956) wrote of sulfur isotope results: "The Drew Hill, Maine, pyrrhotite apparently was derived from rocks that were originally shales rich in sedimentary sulfide."

Jackson (1839) apparently reported pyrrhotite from **New Portland**: "From Kingfield, we went to New Portland, and on our way examined the estate of Mr. Thomas Wyman. The rocks are strongly charged with pyrites, which is magnetic, causing a powerful deflection of the magnetic needle."

Young (1962) made the following enigmatic statement regarding the Penobscot prospect, **Penobscot**: "The only sulfide mineral detected in either the wall rock or vein is pyrrhotite, occurring in thin veinlets and disseminated crystals." The report undoubtedly meant grains and not crystals.

Wentworth (1950) noted pyrrhotite associated with phlogopite and calcite from the Pleasant Mountain area, **Rockport**.

Maillot et al. (1949) reported trace amounts of pyrrhotite from a crushed sample of pegmatite from the Black Mountain quarry, **Rumford**.

Canney and Wing (1966) wrote of a gabbro-norite, **Squaretown** which contained pyrrhotite in concentrations below ore grade, but containing substantial cobalt and nickel.

Tabular crystals of pyrrhotite (1-4 cm) were found in **Standish**. The frequently doubly terminated crystals frozen in translucent to cloudy white quartz are probably among the most aesthetic morphological crystals found in the United States. An excellent specimen is figured by Pough (1953, 1960). This location is one of the great "lost" locations in Maine. Kunz (1885) wrote: "No new crystals [of andalusite] have been found at the Gorham, Maine, locality... Andalusite has been found on the slope of Mount Wiley, Standish, Maine, by Mr. Lucien Holmes of Standish; the crystals are fully one-quarter to three-eighths of

an inch in diameter and of a good flesh-pink color... While collecting on the Dresser farm, back of the Lucien Holmes farm, I found some crystals similar to the above, equally as transparent, associated with crystals of pyrrhotite in a quartz ledge. The locality associations being identical at the three places [of andalusite], although 6 miles apart, would lead to the inference that this mineral must occur in some abundance in this vicinity, and that these [are] only outcrops of the same rock... " Morrill et al. (1958) listed the Alfred Whitney mine, north of Steep Falls village, Standish as the pyrrhotite crystal locality as well as the source of gem andalusite. Philip Morrill wrote to Terry Szenics (November 17, 1974): "I believe this was near the shaft at Steep Falls but across the highway which would be 11 / 113 or 113. The shaft W of the highway produced gem andalusite, from which faceted stones came. ... I suspect this was the locality of the pyrrhotite xls - a rare one which was in such supply that you can find them pictured in Ward's Nat. Science catalog for several years in the 30's." In this letter, Morrill drew a rough sketch showing Steep Falls village, a barn on the west side of the road, and a shaft immediately north of the barn, and then a small bridge. Dillingham (1955b) devoted a paragraph to Standish localities. He did not mention pyrrhotite, but did say that gem andalusite came from a cellar excavation for Mr. B.B. Whitney. Pyrrhotite crystals in milky to gray quartz, which resemble the Standish material, have been labeled "Windham." Mount Wiley is not indicated on either the Buxton or Sebago Lake 15' USGS quadrangle maps. Pyrrhotite crystals have not been collected within living memory in Standish.

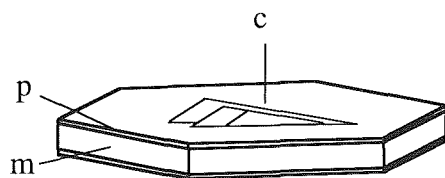
Pyrrhotite occurs as a deposit of potential economic value for its associated nickel mineralization at **Union** and **Warren**.

"Pyrrhotite occurs in massive zones where it is the chief constituent, in disseminated grains throughout the mafic and ultramafic rocks, interstitially to olivine grains, in veinlike masses in granite pegmatite, and within the schist bordering and enclosed by the ore bodies.

Pyrrhotite is typically anhedral with a recognizable basal parting. ... The pyrrhotite in these deposits is strongly anisotropic, but it lacks the strong pleochroism often characteristic of pyrrhotite. ... The more regular pyrrhotite exsolution lamellae, however, are identified as monoclinic pyrrhotite ... These distinct lamellae constitute 30 percent of the Harriman pyrrhotite and are virtually absent from the Warren pyrrhotite" (Rainville and Park, 1976).

Bastin (1908a) wrote of the Union pyrrhotite: "The analysis shows that it contains small amounts of nickel and cobalt, and constitutes 22.50 per cent. by weight of the whole rock."

Rounded bronzy pyrrhotite grains (to 7 mm) are found embedded in white calcite at a road cut along U. S. Route #2, **Wilton**.



Pyrrhotite, Standish

Q

QUARTZ (Silica Group)

SiO₂

Abbreviations

Ag = agate	P = pseudomorphs
Am = amethyst	PC = pseudocubic
B = blue quartz	RB = radiation burns
C = citrine	RQ = rose quartz
Ca = carnelian	RQXX = rose quartz crystals
Ch = chalcedony	Sc = scepter/parallel growth
H = hydrolite	SQ = smoky quartz
J = jasper	xx = crystals

Acton - Boston-Acton M (xx); **Addison** (Am); **Albany** - Bumpus Q (RQ), Coe Q (RQ), Donahue P (SQ), French Mountain (RQ), Johnson Q (xx,SQ), Kimball Ledge Q (RQ), Pingree Ledge Q (xx,Sc,SQ), Round Mountain P (RQ), Scribner Ledge Q (C,RQ,RB, SQ,xx), Stearns P (RQ,SQ), Wardwell Q (RB,RQ,SQ); **Alder Stream** - Alder Stream falls (J); **Auburn** - Greenlaw Q (Sc,SQ), Hatch Farm Q (SQ,C), Keith Q (SQ), Maine Feldspar Q (Sc,SQ,xx), Pulsifer Q (Sc,SQ), Wade Q (SQ); **Batchelders Grant** - Evans Notch Route #113 road cut (xx), Peabody Mountain A (RQ); **Bethel** - Hedgehog Mountain A (RQ); **Blue Hill** - Blue Hill Mountain A (xx), Long Island A (xx); **Boothbay Harbor** - Southport Island A; **Bowdoin** - Coombs Q (SQ), Rose Quartz Q (RQ); **Bowdoinham** (SQ); **Bridgton** - Knight Hill A (Am); **Brunswick** - Androscoggin River falls A (SQ), LaChance Q (RB,Sc); **Buckfield** - Bennett Q (C,Sc,SQ,xx), Bessey Q (SQ,H), Cummings Ledge Q (xx), Hedgehog Hill Q (Am), Westinghouse Q (SQ); **Bucksport** (B) - Snow M (xx); **Byron** (J); **TC** - Bailey Brook (Ag), South Arm A (J); **Camden** - Mount Megunticook A (xx); **Carrabassett Valley** - north Burnt Hill - Sugarloaf Mountain brooks (Am), Sugarloaf Mountain? (J); **Castle Hill** - Castle Hill A (J); **Chapman** - Edmunds Hill Andesite (J); **Cherryfield** - Diamond Ledge - Sprague Falls (xx); **Concord** - Robinson M (xx); **Cooper** - American Molybdenum M (Am); **Coplin** - Nash Stream (J); **Danville** - Quartz Q (xx); **Deer Isle** - Little Deer Isle A (xx); **Denmark** - Pleasant Mountain A (Am,SQ,xx); **Edgecomb** (Ch); **Eustis** - Dead River (J); **Freeport** - Taylor Q (RQ); **Friendship** - Martin Point A (xx); **Fryeburg** - East Fryeburg (SQ); **Georgetown** - Consolidated Q (RQ,SQ), Golding Q (SQ), Tourmaline P (C); **Gilead** - Peabody Mountain Q; **Grafton** - Morse Brook A (xx,Am,P); **Greenwood** - Beryllium Corporation Q (Am),

Diamond Ledge L (xx,Sc), Emmons Q (RQ,Sc,SQ,xx), Gross P (Sc), Harvard Q (Am,P,Sc,SQ,xx), West Hayes Ledge Q (xx,Sc), Heikkinen Q (RQ,SQ), Nubble Q (RB,RQ,SQ), Tamminen Q (PC,Sc,SQ,xx), Tamminen Senior P (RQ), Tiger Bill Q (xx), Waisanen Q (H,Sc,SQ,xx); **Guilford** - Rennet M (xx); **Hartford** - Ragged Jack Mountain area brook (Am); **Hebron** - Hibbs Q (RQ,RB,skeletal,SQ), Mount Rubellite Q (xx,Sc), Sanitarium Q (RQ), Streaked Mountain Beryl P (RQ); **Industry** - Lemon Stream A (J); **Jay**; **Jefferson**; **Jim Pond** - Jim Pond Formation (J); **Jonesboro** - Bodwell Q (xx,Am), Bodwell - Jonesboro Q (xx); **Kennebunk** (RQ); **Kennebunkport** - North Kennebunkport A (RQ), Cape Porpoise A (RQ); **Litchfield** - Oak Hill area (Am?); **Livermore** - (Am?), Route #4 road cut (xx); **Lovell** - Andrews Brook Pit (Am), Beryllium Corporation Q (xx), Ladies Delight Hill A (Am), McDaniels Hill (Am), McKeen Hill (xx,Am), Skillings Hill P (RQ); **Machias?** (Ch); **Machiasport** - Jasper Beach [no jasper found, red volcanic rocks there are jasper look-alikes]; **Marshfield** - Machias Q (Am), Marshfield Q (Am); **Mars Hill** - southwest Mars Hill A (J); **Mason** - New Meadows Mountain A (RQ), Peabody Mountain (xx,RQ); **Mexico** - U.S. Route #2 road cut (xx); **Minot** - LaFlamme Q (xx,RQ); **Mount Desert** - Allan Q (xx), Halls Quarry A (xx); **Mount Pleasant**; **Naples** (Am); **New Gloucester** - Granite quarry; **Newry** - Bell Pit (xx, PC), Broome P (RQXX), Dunton Q (Ch?,RQXX,SQ,xx), Martin P (xx), Nevel Q (RQXX,SQ,xx), Rose Quartz Crystal L (RQXX), Scotty Q (RQ,xx); **Norway** - BB #7 Q (RQ,SQ,xx), Tubbs Ledge Q (RQ); **Otisfield** (Am); **Oxbow** - Cupsuptic River Q (xx); **Paris** - Colby Ledge Q (RQ), Elm Hill Q (RQ), Hoopers Ledge Q (RB,RQ), Irish Q (RQ), Lower Hoopers Ledge P (xx, RQ), Mount Marie Q (Sc,SQ,xx), Mount Mica Q (PC,RQXX,SQ,xx), Paris Hill excavation (Am), Singepole Mountain P (RQ), Slattery Q (RB,RQ), Stearns Farm P (RQ,Sc), Swifts Crossing A (Am), Whispering Pines Q (C,RQ), Wright Farm A (xx); **Patten?** (Am); **Penobscot** - Penobscot M (xx), Annear M (xx); **Perry** - Loring Cove A (Ag,Am); **Peru** - Concord Pond Q (xx), Black Mountain Q (xx), Perry P (P); **Phippsburg** - Basin Q (xx,Am), Denny Reed Point L (Ch); **Poland** - Berry-Havey Q (P,Sc,SQ,xx); **Portland** - (Am?), Diamond Island A (xx); **Pownal** - Hinkley P (RQ), Tryon Farm P (RQ), Upper Tryon Mountain Q (RQ); **Rangeley** (Ag, Ca); **Rangeley Formation** (B); **Readfield** - Tallwood Inn road near Peacock Camp (xx); **Rumford** - Black Mountain Q (PC,RQ,SQ,xx), south Cranberry Bog A (RQ), Ellis River A (J), Goddard Ledge Q (= Ford Hill Q) (RQ,Sc,SQ), Red Hill Q (RQXX,SQ); **Saint George** - Clark Q (xx); **Saint John River** (Ca,Ch); **Salem**; **Skowhegan** - Kennebec River falls A (xx,RQ?); **South Berwick** - "Gold M" (xx); **South**

Portland - Danford Point A (B); **Spruce Top Greenstone (Ch)** - **TDR2 WELS, TER2 WELS, T9R3 WELS; Standish (RQ); Stoneham** - Blueberry Hill A (gemmy masses), Cole Q (RQ,SQ), Harndon Hill A? (Am), Lord Hill A? (Am), Lord Hill Q (Sc,SQ), McKean Mountain (SQ), McAllister Q (SQ - 50 kg), Melrose Q, Styles Mountain A (xx), Weymouth Hill A (xx); **Stonington** - New England Stone Industries Q (SQ); **Stow** - Barbour Q (Am,xx), Deer Hill Q (Am,Sc,xx), Eastman Q (Am,SQ,xx), Intergalactic Pit (Am,SQ,xx), Kimball P (Am), Nevel P (Am), Pine Hill A (Am), Upper Colton Hill Q (Am); **Stratton (J); Sullivan** - Sullivan and Waukeag M (B); **Sumner** - (J?), Barrett farm (Am), Heikkinen Q (xx); **Sweden** - Saltman Q (Am,xx); **Topsham** - Consolidated #1 Q, Leavitt Q (Sc), Railroad Q (RQ), Trenton Q (H,Sc,SQ,xx), Twin Pits (xx), William Willes #1 Q (Sc); **Turner** - North Turner (xx,feruginous); **Verona** - Empire M (B); **Vienna (RQ); Wales (C); Waterford** - Burnell Hill (xx,Am), Fullerton farm (RQ), Saunders farm (SQ), Strong farm (Am); **Waterville** - Crummetts Mills A (fulgurite); **Wayne (xx,RQ); Weld** - Tumble Down Mountain (J); **Wesley** - Rollins M; **West Paris** - Immonen #1 Q (H,RQ,xx), Perham Q (H,RQ,Sc,SQ,xx); **Wiscasset** - LaPoutre Q (xx,Am); **Woolwich** - U.S. Route #1 road cut (Am); **T5R7 WELS** - Sugarloaf Mountain A (J)

Quartz - Variety Rose Quartz Crystals

Newry - Broome P, Dunton Q, Nevel Q, Rose Quartz Crystal L; **Paris** - Mount Mica Q; **Rumford** - Red Hill Q

Rose quartz crystals were not known from anywhere in the world until they were found at the Mount Mica quarry, Paris during Dick Nevel's episode in mining (~1925; Nevel, personal communication to Charles Palache, 1927). (The so-called rose quartz crystals (Clifford Frondel, personal communication, 1989) of the Kinkle quarry, Bedford, New York are macrocrystalline masses (to 15 cm) of rose quartz which are sutured by discrete, straight grain boundaries that resemble crystal cross-sections.) No contemporary accounts exist other than Nevel's letter. Later, Howe (1948) wrote: "I have found the first rose quartz crystals..." The apparent original specimen, in the Museum of Science, Boston, consists of a lustrous ring of pale rose crystals (5-7 mm wide and 7 cm long) partly circling a smoky quartz crystal (15 cm). The crystals show innumerable "solution terraces," peculiar tapering toward the termination from the middle of the crystal which is asymmetrically developed, and striations which due to the other growth features are deeper than normal and have the effect of looking like "straight wrinkles." (The specimen has obviously faded from previous years of exhibition.) The overgrowth is reminiscent of, but distinct from, the ring of rose quartz crystals on cloudy to smoky quartz specimens found at the Sapucaia pegmatite, near Conselheiro Peñã, Minas Gerais, Brazil in the 1960's. Some tight rosette clusters (to 5 cm) have been found as "floaters" in gem pockets at the Mount Mica quarry. "Solution terraces" and other surface

irregularities, which characterize rose quartz from virtually all of the known world occurrences, are prominent on the Mount Mica specimens. Subsequent rose quartz crystal finds were made in the 1970's at Ilha da Lavra, on the Rio Jequitinhonha near Itinga and Taquaral, and in 1988 and subsequently at the Pitorra quarry, Linópolis County, and in several localities in Galileia, all in Minas Gerais, Brazil. Rose quartz crystals were also found in the 1960's at the Charles Davis quarry, North Groton, New Hampshire. **[Warning: rose quartz and amethyst quartz fade with extended exposure to sunlight.]**

The Dunton quarry, **Newry** was the second world locality for rose quartz crystals in 1928, but was the first locality in the world recorded in mineralogical literature (Fraser, 1930). The crystals were arranged in "fairy-ring" pattern with an outside ridge of excellent rose-colored crystals (to 1 cm) and an internal field composed of terminations only. The rings (to 1.5 x 4 cm) were not circular, but consisted of lobes which follow no recognizable pattern, resembling the shape of chalcedony roses from the western United States and Mexico. The matrix at the Dunton quarry consists of cloudy to smoky quartz crystal faces in green elbaite-bearing cleavelandite with occasional botryoidal hydroxyl-herderite, white botryoidal perhamite, gray lepidolite, and thin drusy films of clear to white quartz over the rose quartz. The luster of the rose quartz is low due to extremely minute multiple-growth surface markings. Crystals with coarse surface markings have a normal vitreous luster. Rose quartz crystal overgrowths on the terminations of smoky quartz crystals (to 3 x 5 cm) were found in cleavelandite.

The Nevel quarry and Rose Quartz Crystal locality, Newry were the subsequently known locations, respectively. Sampter (1949) wrote: "The rarest of prize crystals from Newry, or any place else, were found there this July. They were the largest rose quartz crystals known and remarkably deep red ones, too. The much visited Stanley Perham of Trap Corners, Me., has been given the sale of some of these crystals by the Whitehall Company of Keene, N.H., who do the mining. One perfect crystal is about 1/4" x 3/4" in size - no more glasses needed to see rose quartz crystallized." The locality may have been the Nevel quarry as that was the only rose quartz crystal area operating at that time. Nevel quarry rose quartz crystals are more than curiosities. The rosettes of 2-6 mm crystals can fill the interstitial cavities (to 10 cm) where quartz crystals (1-3 cm) have grown together. Free-standing triangular muscovite crystals (to 2 cm) in quartz vugs or spodumene cleavages embedded in the quartz matrix can be associated. A few small tan eosphorite crystals (to 2 mm) as well as colorless to tan cookeite crystal rosettes (to 2-3 mm) can be found sprinkled on the terminations of the quartz clusters. The Nevel quarry rose quartz crystals do not generally show terraced dissolution markings, but can have a thin skin of milky white quartz partly obscuring the rose color. The luster of these crystals is generally subvitreous. The arrangement of the Nevel quarry rose quartz crystals more closely resembles that of ordinary quartz crystals than other rose quartz crystal specimens in the world.

The several widely scattered prospect pits in the tree-covered Rose Quartz Crystal locality, Newry have been prolific producers of rose quartz crystals. (The Whitehall quarry, also near the summit of Mount Plumbago has not produced any rose quartz crystals or phosphates.) The clusters of rose quartz rarely exceed 5 x 5 cm while individual crystals have probably not exceeded 3 x 1 cm. In general, crystals are 5 mm or less and their clusters (to several cm) grew on cleavelandite with a wide variety of associated species including eosphorite, botryoidal hydroxylherderite, montebrasite, fluorapatite, carbonatian hydroxylapatite, roscherite, drusy white quartz, muscovite in outstanding crystals, etc. A rusty and/or black stain frequently coats the matrix. Inexperienced collectors have soaked the specimens in acid to remove the stains, but the associated rare minerals are dissolved or etched in the process. As there is such a large supply of rose quartz crystals from the locality, these collectors find out too late that the rare minerals sometimes command more interest. The luster of the rose quartz varies from vitreous to matte. The lower-luster crystals frequently have etched surfaces or thin drusy quartz coatings. Phantom crystals are common. The cores of many of the rose quartz crystals are cloudy with the outer zones being transparent pink or even clear. Growth terraces are very pronounced on most rose quartz crystals, and tapered or sceptor crystals are common. The sceptor overgrowths can be clear quartz or rose. Individual rose quartz crystals are usually highly distorted. Crystals can be flat and tapered, usually in "steps" along the crystal length. In association with the rose quartz crystals, Seaman (1975c) noted: "The cryptocrystalline variety of quartz, chalcedony, has occurred as pink, botryoidal masses..." The "chalcedony" is actually internally macrocrystalline, showing continuous conchoidal fracture, so the terminology is based on the specimen's similarity to chalcedony "desert roses" found in Mexico (the country) and some southeastern USA localities. Drusy rose quartz as well as drusy milky quartz can coat relatively smooth botryoids of rose quartz as a thin skin. The botryoidal rose quartz can be truly spherical (to 4 mm) and is unique for rose quartz. The botryoids show no evidence of even closely spaced terminations.

The Broome prospect, Newry produced a few patches (to 5 x 5 mm) of drusy rose quartz in albite-siderite matrix.

In 1950, Hurlbut reported that rose quartz "of amethystine" hue was found at the Red Hill quarry, **Rumford**. Transparent rose quartz crystals (to 6 mm) on albite and muscovite have been found in clusters (to 5 x 5 cm, HU collection). The color is very pale "hot pink" rather than "amethystine," and the crystals can have relatively normal shape or show step-wise tapering with dissolution terraces. Some Red Hill quarry rose quartz forms as free-standing translucent very pale pink crystals (to 1 cm) in parallel fractures in tan, slightly rusty-stained, microcline. The fracture surfaces can have small albite crystals (to 3 mm) as well as brown eosphorite crystals (to 3 mm) in small patches (to 2 cm). A brief mention of Red Hill quarry rose quartz crystals was made by Anonymous (1949a) and Cole (1952).

Quartz - Variety Massive Rose Quartz

Albany - Bumpus Q, Coe Q, French Mountain P, Kimball Ledge Q (Songo Pond Q), Round Mountain P, Scribner Ledge Q, Stearns P, Wardwell Q; **Batchelders Grant** - Peabody Mountain A; **Bethel** - Hedgehog Mountain A; **Bowdoin** - Rose Quartz Q; **Freeport** - Taylor Q; **Georgetown** - Consolidated Q; **Gilead** - Peabody Mountain Q; **Greenwood** - Emmons Q, Heikkinen Q, Nubble Q, Tamminen Senior P; **Hebron** - Hibbs Q, Sanitarium Q, Streaked Mountain Beryl P; **Kennebunk**; **Kennebunkport** - North Kennebunkport A, Cape Porpoise A; **Lakeville** - Getchell Mountain P; **Lovell** - Skillings Hill P; **Mason** - New Meadows Mountain A, Peabody Mountain; **Minot** - LaFlamme Q; **Newry** - Scotty Q; **Norway** - BB #7 Q, Tubbs Ledge Q; **Paris** - Colby Ledge Q, Elm Hill Q, Hoopers Ledge Q, Irish Q, Lower Hoopers Ledge P, Singepole Mountain P, Slattery Q, Stearns Farm P, Whispering Pines Q; **Pownal** - Hinkley P, Tryon Farm P, Upper Tryon Mountain Q; **Rumford** - Black Mountain Q, south Cranberry Bog A, Goddard Ledge Q (= Ford Hill Q); **Skowhegan** - Kennebec River falls A?; **Standish**; **Stoneham** - Cole Q; **Topsham** - power line cut L (Cathance Road), Railroad Q; **Vienna**; **Waterford** - Fullerton farm; **Wayne**; **West Paris** - Immonen #1 Q, Perham Q

Massive rose quartz has been found at a number of Maine pegmatites. However, localities which produce massive rose quartz do not seem to have rose quartz crystals and *vice versa*. Kunz (1885, and almost *verbatim*: 1892a) reported: "At Stow, Albany, Paris, and a number of other localities in Maine, the veins of quartz shade from white, transparent and opalescent, resembling hyaline quartz, often without any imperfections, through faintly tinted pink and salmon, into a rich rose color, thus forming a beautiful series of tints of color that have merit for a common gem or for ornamental stone work. Possibly as fine transparent opalescent rose quartzes as has ever been found were obtained, in pieces free from all flaws, of a fine rose-red with a beautiful milky opalescence 4 by 5 inches in size, at Round Mountain, Albany, Maine." Kunz (1892a) added: "... Specimens of this rose quartz, when cut into double cabochons, or sphere-shaped objects, distinctly show the asteria effect, similar to the star sapphire, if viewed by sunlight or artificial light, a peculiarity which has also been observed in specimens obtained from a number of other localities. ... A sphere 2 inches in diameter, a small dish, and other objects have been cut from this material."

The Bumpus quarry, **Albany** has yielded tons of rose quartz, some of which has been carved into statuettes and other works of art. Hedgehog Mountain (True, 1869), **Bethel** is reported to have rose quartz. Cameron et al. (1954) noted rose quartz with oligoclase, muscovite, and microcline from the Peabody Mountain area, **Batchelders Grant**. Rose quartz (masses to 25 cm) suitable for gem purposes and of the deepest rose red found anywhere (including Antsirabé, Madagascar, Malagasy; Sapucaia pegmatite, Minas Gerais, Brazil; etc.), has been found at the Hibbs quarry, **Hebron**, but in relatively small quantities.

Rose quartz from **Kennebunkport** has been found in pale chunks to 20 cm. Jackson (1838a) noted rose quartz from the Cape Porpoise area, Kennebunkport. The Whispering Pines quarry, **Paris** was a large producer of rose quartz, some being of faceting quality. Rose quartz has been found in pegmatite exposed along the shore of Southport Island, near the Newagen Inn, **Boothbay Harbor** (Arthur Hussey, personal communication, 1992).

Varying amounts of rose quartz have also come from the Scribner Ledge quarry, **Albany** (some with radiation "burns"[Faulkner, 1953a]) and the Black Mountain area (Gregory, 1968a), **Rumford**.

Doyle et al. (1961) reported of the Getchell Mountain prospect, **Lakeville**: "At one point along the northern contact of this granite with the sediments on Getchell Mountain a fairly large coarse grained pegmatite makes up the actual contact. ... The pegmatite appears to be made up mostly of large crystals of perthite and quartz and much of the quartz is rose colored."

Quartz - Variety Pseudocubic Quartz Crystals

Greenwood - Tamminen Q; **Newry** - Bell Pit; **Paris** - Mount Mica Q; **Rumford** - Black Mountain Q; **Stow** - Intergalactic Pit

Pseudocubic quartz crystals are actually quite common in the world. Most of the examples are developed only on one of the terminations. This habit of quartz is frequently seen in amethyst geodes from Uruguay, Mexico, and Brazil. Numerous occurrences of colorless pseudocubic quartz crystals exist. The important feature of Tamminen quarry, **Greenwood** pseudocubic clear quartz crystals is their doubly-terminated pseudocubic nature, which looks like a cube over all of the crystal and not just a portion of it. The habit occurs when the termination consists of only a three-faced rhombohedron and the other faces are small or can't be seen. Sampter (1949) imprecisely reported on pseudocubic quartz crystals: "Nestor Tamminen, at the foot of Noyes Mt., has opened some large new pockets on his property,

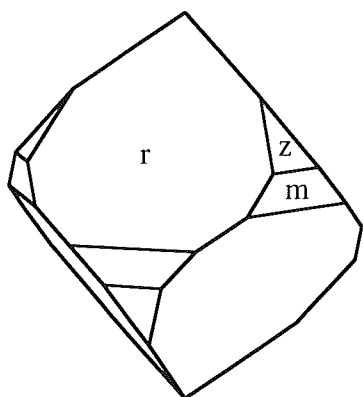
across the road from his house. They produce beautiful quartz crystals with double terminations, about 1" long and smaller, with a brilliance like and close similarity to the Herkimer 'diamonds'." Anonymous (1949b) noted: "A pocket had just been opened with clear quartz crystals imbedded in clay inside. The crystals were short with double terminations having a cubic aspect as compared with the elongated hexagonal prisms usually found in this area. Some had bubbles and were unusually brilliant, occurring in large numbers $\frac{1}{2}$ " to 1" long. Many were found in the clay dump by club members although the dump had already been gone over many times. Even Mr. Tamminen went over the dump again that day and found some more."

Good pseudocubic crystals from the Tamminen quarry were also found in 1960 (F. Perham, 1961) with a maximum dimension of 4.1 cm along the pseudocubic edge. Additional specimens were found in later mining events, both during feldspar mining and during collector-leased mining. Frank Perham (1961) wrote: "Literally hundreds of pockets have been discovered in the course of mining but rarely does any one pocket have many good quartz crystals. These crystals are unique in that rarely do you find a 'common' crystal with single termination and long prisms. The crystals tend to be doubly terminated with short prisms or to form in parallel groupings along the face of a larger crystal. Some very fine peduncled [pedunculated] crystals have also been found in various pockets. ... The pseudo-cubic quartz crystals are not actually cubic as the angle is not a right angle but 85 degrees 45 minutes. When the crystals are oriented properly it is easy to see all the faces and the side prisms even though they are very small with respect to the enlarged faces. Until one gets the proper orientation though, it is difficult to see anything but a generally cubic block." Pseudocubic quartz crystals also occur on matrix along with crystals of more familiar habit. (Note: pedunculated crystals are extreme scepters - thin shaft with large cap crystal. The term is borrowed from Botany and was a popular term among Maine mineral collectors in the 1940's and 1950's.)

The pseudocubic quartz crystals at the Bell pit, **Newry** and Black Mountain quarries, **Rumford** are generally 1-3 mm in siderite matrix. The color can be smoky.

A few large elongated "pseudocubic" quartz crystals have been found at Mount Mica quarry, **Paris**. In 1991, one crystal of ordinary translucent, uncolored quartz (about 1.5 x 6 cm) was recovered in two sections which formed a convincing rectangular prism (Phil McCrillis, personal communication, 1992).

As amethyst is frequently crystallographically simple on a worldwide basis, pseudocubic terminations are not rare, particularly at the Irai District, Rio Grande do Sul, Brazil and the San Eugenio District, Artigas, Uruguay. Most Maine amethysts show two sets of pyramidal faces, however, and are rarely pseudocubic. Thompson (1994) figured a pseudocubic amethyst crystal and wrote: "A couple of rare examples of stubby crystals with a 'pseudocubic' habit have also been found ...; they resemble the shape of the colorless quartzes from the Tamminen quarry in Greenwood, Maine (Perham [.] 1987 [a]). This odd habit results



Pseudocubic quartz, Tamminen Q, Greenwood

from the exaggerated development of alternate termination faces on both ends of the crystal, coupled with minimal prism faces, producing a shape that resembles a cube." The figured specimen was 3 cm in maximum dimension.

Quartz - Variety Amethyst

Addison - unspecified island; **Albany** - Songo Pond Q; **Bridgton** - "east of Knight Hill"; **Buckfield** - Hedgehog Hill Q; **Carrabassett Valley** - north Burnt Hill - Sugarloaf Mountain brooks; **Cooper** - American Molybdenum M; **Denmark** - Pleasant Mountain A; **Grafton** - Morse Brook A; **Greenwood** - Beryllium Corporation Q, Harvard Q; **Hartford** - Ragged Jack Mountain Brook L; **Jonesboro** - Bodwell Q; **Litchfield** - Oak Hill A?; **Livermore**; **Lovell** - Andrews Brook pit, Ladies Delight Hill A, McDaniels Hill A, McKean Hill L; **Marshfield** - Machias Q, Marshfield Q; **Mount Desert** - Halls Quarry village A; **Naples?** - Sebago Lake shore; **Newcastle-Damariscotta** - U.S. Route #1 road cut; **Paris** - Paris Hill water main excavation, Swifts Crossing A; **Patten?**; **Perry** - Loring Cove A; **Stoneham** - Harndon Hill L?, Lord Hill L; **Stow** - Barbour Q, Deer Hill A (Deer Hill Q, Eastman P, Intergalactic Pit, Kimball P, Nevel P), Pine Hill A, Upper Colton Hill Q, Wiley Mountain A?(=Willet Mountain A?); **Sumner** - Barrett farm A; **Sweden** - Saltman Q; **Topsham** - "Cathance quarries"; **Woolwich** - U.S. Route #1 road cut

Amethyst is well-known in Maine, but good specimens come from few of the localities. Some reports have been made concerning amethyst which are probably rose quartz, stained quartz, fluorite, etc. or specimens of such poor quality that the name amethyst is undeserved. Many amethyst locations consist of coarse, intergrown veins with no well-terminated crystals, or well-tumbled pebbles found in brooks. Some amethyst fades on continued exposure to sunlight and for this reason, many fine antique amethyst rings have faded stones in them. The bleaching action of sunlight is not necessarily complete and there might be no further fading after a certain point. Some extremely dark Uruguayan amethyst does not seem to be affected by sunlight. Most amethyst can be heated in a furnace to change the color to golden brown. Much so-called *citrine* has been artificially produced in this manner. The color change is irreversible.

The most historically famous amethyst location in Maine is the William Warren-George Howe find on the Warren farm, Pleasant Mountain, **Denmark**. Amethyst was found in the roots of an overturned tree in the early 1860's (William W. Warren, personal communication to Benjamin Shaub, 1958). Kunz (1895) wrote: "During 1894, Mr. George R. Howe, of Denmark, Me., has obtained many fine amethyst crystals, and has had a number of gems cut from them that were of a remarkably deep purple color. Single royal purple crystal points (to 20 cm) show a tapered prism with numerous multiple growth features. Clusters of several crystals are uncommon." Kunz (1899) further wrote: "Some extensive work was done in mining for amethyst

in the quartz vein at Denmark, Maine, and some beautiful specimens were obtained, many of gem value. Among them was a faultless polished [sic] brilliant crystal of the most intense purple, 5 inches high, 3 inches wide, 4 inches thick and equal to any crystal ever found at any known locality." (Despite the size of the operations suggested by Kunz (1899), Howe's "prospect" was actually only a digging for float specimens in soil.) Sterrett (1914) mentioned Howe and said: "These amethysts were rich dark purple and showed a strong garnet-red under artificial light, like the better Siberian amethysts." Dake et al. (1938) probably noted of Pleasant Mountain: "... and in Oxford County, Maine. The last-named locality has furnished some of the very finest amethysts known, but in limited quantity." Anonymous (1949a) noted: "Tiffany's in New York chose several of Mr. Howe's gems for showing in its Paris exposition and each won awards."

Morrill et al. (1958) reported of Pleasant Mountain amethyst: "One stone in Kaiser Wilhelm Estate appraised for \$10,000." The original source seems to be the *Boston Herald* (August 24, 1941) which said based on an interview with Howe: "He discovered the real rose quartz crystal[s] and later unearthed an almost perfect Regal Amethyst that he sold to Tiffany for \$850. The stone was exhibited in Europe and attracted the eye of the late Kaiser Wilhelm, who finally purchased it for \$10,000. Today it reposes with many other gems in the Kaiser's private collection at Potsdam and bears the tag - 'Royal Amethyst from Norway, Me.'" Later in the *Boston Herald* article, the Howe brooch is described with the indication that it contained what Howe admitted was: "... the best purple amethyst I ever got - weighed seven carats ..." If this were also the largest amethyst he ever had cut, the \$10,000 figure seems less reasonable. During the time of the "appraisal," amethyst was still a somewhat precious stone. The extensive South American amethyst deposits had yet to be significantly exploited for gem use, and thus the price of amethyst was high during the late nineteenth and early twentieth centuries. The size of the "\$10,000" stone, which may have been of record size for Maine, and perhaps from anywhere, is unreported. (Some of Howe's amethyst crystals were apparently acquired by Edward Wigglesworth and these specimens reside in the Museum of Science, Boston.) In perspective, the Pleasant Mountain amethyst crystals which survive to represent the find are not particularly fine by today's worldwide or American standards. Their fame rests partly with their historical utilization as a gem. Perhaps some specimens in private collections are of superior quality, as some of the early reports noted.

A unique smoky quartz crystal (about 7 cm) from the Harvard quarry, **Greenwood** has an amethyst exterior zone (Perham's of West Paris collection).

Dale (1907) reported of **Jonesboro**:

"Small cavities lined with crystals occur in granite. They are uncommon in the Maine quarries, but at the Bodwell Granite Company's quarry, near Jonesboro..., there are several about a foot in diameter, lined with quartz crystals and epidote. The center of some of these is filled with calcite (lime carbonate) in very obtuse rhombohedra

half an inch across. ... At the Machias Granite Company's quarry, near Marshfield..., there are several geodes, up to 6 inches in diameter, lined with crystals of feldspar and amethyst, with the central space filled with chlorite, epidote, and calcite.

Such cavities are attributed to bubbles of steam or gas that were in the rock while it was in a molten state, which gave room for the growth of crystals and later became filled with epidote and calcite."

It is unlikely that gas bubbles could have formed in this manner given the pressures on the granite at depth. The only modern evidence at the Bodwell quarry for such cavities suggests that the "geodes" were late-stage solution cavities formed along joint surfaces in the granite. Woodrow Thompson (personal communication, 1994) has observed very similar mineralization (with smoky quartz crystals instead of amethyst) in cavities at the New England Stone Industries granite quarry, located on Crotch Island in Stonington. The "geodes" in the Bodwell quarry probably were not spherical, but were perhaps more discoidal and were centered on fractures. No specimens known.

Deer Hill (also known as Big Deer Hill and erroneously as Little Deer Hill), White Mountain National Forest, **Stow** has produced amethyst in abundance. The prospects include the Deer Hill quarry, the Eastman prospect and Intergalactic Pit (both not part of the National Forest), the Nevel prospect, and the Kimball prospect. Kunz (1883b) first reported on Stow amethyst and later summarized (Kunz, 1892a; and almost *verbatim* in 1893): "Amethyst is found on Deer Hill, at Stow, Me., where there is a vein of amethystine quartz which has been traced fully one-quarter of a mile, and has furnished many thousands of crystals during the last twenty years, scarcely any of them, however, being of any gem value; but among some amethysts found during 1885 was one remarkable mass that yielded a gem weighing 25 carats, of deep purple color of the Siberian amethyst." The vitreous to frosted and etched Deer Hill quarry crystals (to 20 cm) are frequently color-zoned and have a beautiful red-purple color on the terminations and cloudy white prisms. Clusters (to 50 x 50 cm) of parallel growth amethyst on cloudy massive quartz were common at the Deer Hill quarry in the National Forest. Sericite frequently fills the interstitial spaces between crystal surface growths. Morrill (1969) and Thompson (1994) recounted the early history of Deer Hill, indicating that Dick Nevel, Orman McAllister, Phillips Cole, and Herbert Kimball were important "miners." Morrill (1969) further described an alexandrite effect where the mineral is "beautiful burgundy-red under daylight" and when viewed "under artificial light ... some become grey-blue, losing all purple." The amethyst from the various prospects can be almost indistinguishable. Several fine specimens are figured in color by White and Cook (1990). Perham (1958) stated: "A pocket of Amethyst 4 ft. wide, 42 inches deep and 7 feet long was opened at Deer Hill, Stow, Maine -- Eastman Ledge." Seaman (1975c) noted: "The beautiful variety of purple quartz, amethyst, has come principally from pegmatites at Deer Hill near Stowe [sic] where crystals to over six inches in diameter have been collected. Some amethyst crystals occur as scepter

crystals on the ends of milky quartz crystals at this locality as well." Ward (1978) also wrote on Deer Hill. The regulations concerning specimen collecting within the White Mountain National Forest can be obtained from rangers at the station in Bethel, Maine.

The Upper Colton Hill prospect, Stow has produced some small pale purple crystals of amethyst (to 10 cm). The nearby Barbour quarry has purple-gray amethyst in multiple-growth doubly-terminated clusters (to 10 x 30 cm). The terminations are frequently light salmon-brown due to turbidity and clayey inclusions. Some specimens of facetable reddish purple amethyst have been recovered at the Barbour quarry. The gemmy crystals are highly variable with transparent amethystine terminations on gray murky prisms which have a slightly etched satiny sheen. Usually the terminations are murky as well.

Meyer (1993a,b,c,d), Enright (1993), Matava (1993), and Associated Press (1993) issued newspaper reports on the amethyst discovery at the Intergalactic Pit, **Stow**. The Intergalactic Pit, within a stone's throw of the Eastman prospect, produced numerous purple-red to purple-blue amethyst crystals (to 20 x 10 x 10 cm) which were mostly singly terminated without matrix (Dennis Creaser, Jay Windover, and Gary Howard, personal communication, 1993). The amethyst occurred in cusped lenses (to 0.5 x 0.5 m) in highly sericitized microcline pegmatite. The amethyst varies in color from lightly tinged through royal purple. The crystals are generally bright vitreous in luster with some crystals showing indentations, irregular cross-sections, and tapering. The largest single crystal recovered from the 1993 season, which weighed about 5 kg and which had several royal purple zones, was christened the "Grape of Maine." About 1.1 metric tons of specimens were recovered in 1993, and many of these specimens yielded flawless amethyst gemstones (to 29.65 carats).

Thompson (1994) described amethyst from the Intergalactic Pit, Stow: "Individual amethyst pockets in the Intergalactic deposit usually vary from about 10 cm to nearly 1 meter in maximum diameter. ... Only a small percentage of the amethyst is a deep purple color; the choicest specimens have a reddish tinge that makes them very desirable for gem stock. ... Most of the Intergalactic crystals show color zonation. The deeper shades of purple commonly occur in the inner portions of the crystals, whereas the outer parts are pale smoky to almost colorless. ... The amethyst crystals are generally somewhat equant, being slightly longer than wide. Many of them range in length from 2 cm to 10 cm, although some reach 20 cm or more. The orientation of crystals in individual specimens varies from random to parallel. ... A couple of rare examples of stubby crystals with a 'pseudocubic' habit have also been found ..." The Intergalactic Pit amethyst occurs in several generations of growth. Frequently, the amethyst is found on a coarse druse of milky to cloudy quartz crystals (generally less than 1 cm). Color patterns are typical of worldwide amethyst with dark terminations that grade to only faint hints of color near the midsection of the crystals. Prisms of the amethyst are sometimes selectively coated by clayey musco-

vite (not kaolinite), and late generation parallel overgrowths of quartz are generally colorless to only faintly amethyst.

The amethyst from the Saltman quarry (also called Plumbago Amethyst quarry), **Sweden** was discovered in 1987 and was worked by the Plumbago Mining company for specimens. The crystals (to 15 cm) are a purple-lilac to deep reddish purple color and have vitreous luster. They sometimes occur in parallel growth. DeKoning (1989) reported on the discovery of the Sweden amethyst. Plates of crystals over one meter across were recovered. The entire production of specimens so far has been commercially recovered. The color is generally "bluer" than most of the other Maine amethyst, but specimens from the 1990 workings were of a deep royal purple, similar to the Pleasant Mountain amethyst. Individual crystals from the Plumbago prospect (up to 8 cm) have not yet been found in nearly the same size individual crystals as at Pleasant Mountain. The tips of the Sweden amethyst are frequently of flawless facetable grade. The more equidimensional crystals in tight clusters superficially resemble amethyst crystal clusters from Rio Grande do Sul, Brazil, but the matrix is composed of milky quartz rather than agate. Thompson (1990) wrote of the Saltman quarry specimens:

"Cavity walls and breccia plates in the fractured veins are encrusted with druses of small milky quartz crystals. These crystals are generally less than 1 cm in diameter, though a few are as large as 2.5 cm (1 in). Most of the amethyst crystals are planted on the drusy white quartz. However, there are many cavities in the pit area that lack amethyst. Specimens with deep purple amethyst clusters on a clean matrix of white crystals are very aesthetic..."

Many amethysts are perched on the edges of breccia plates and are doubly terminated. Some crystals, both individuals and clusters, show very little attachment and are almost *floaters*. Some of the amethyst crystals are over 2.5 cm (1 in) in diameter, and rare individuals exceed 5 cm (2 in).

The majority of the Sweden amethysts range in color from pale lilac to medium purple. Occasionally, crystals have been found that are so deeply colored as to appear nearly black. Crystals from one distinctive pocket are dark purple and unusually lustrous, with micro-hematite(?) inclusions that give them a sparkle like sunstone."

About 3 to 3.5 metric tons of specimens have been produced so far from the Plumbago Pit (Philip McCrillis, personal communication, 1993).

Putnam and Perham (1968) wrote of **Waterford, West Paris, Paris, and Poland**:

"Good amethyst is said to have been found in the Black Guard region in Waterford on the right hand side of the road in a field near some apple trees. Seen any? ...

West Paris: Amethyst has been reportedly seen during road work operations on Stearns Hill on the road leading to the Henry Stone Farm.

Paris Hill: Amethyst was found in the main street of Paris Hill so there may be more around the hill. ...

Poland: Amethyst has been reported from the west side of the summit Springs Hill in Poland. Are there any new finds?

Paris: When Alton Bradford was a boy, his father took him from Norway to a brook near Swift's Crossing in Paris. There in the bottom of the brook was a seam of amethyst crystals that averaged perhaps to be one-half inch thick and 1 inch long."

Quartz - Variety Quartz Pseudomorphs

Grafton - Morse Brook A; Greenwood - Harvard Q; Peru - Perry P; Poland - Berry-Havey Q

Quartz pseudomorphs from Maine are not currently common, but during various mining events, several localities produced interesting specimens deserving attention from the pseudomorph collector. Only one locality here mentioned, the Morse Brook locality, Grafton, is not a granite pegmatite occurrence. Most of the occurrences are actually epimorphs, but as these epimorphs are usually hollow, few will question their listing here.

Grafton, Maine

Clear to cloudy quartz crystals were found in a vein across Morse Brook, **Grafton**. The quartz was sometimes associated with barite and rarely formed cavernous pseudomorphs after barite (to 6 cm). The Morse Brook quartz crystals (to 7 cm) were found in a few large clusters (to 20 cm), many of which had an iron stain, and the surfaces of the crystals were frequently lightly etched. Davis (1948) indicated some quartz pseudomorphs after barite had been found at the Morse Brook locality, Grafton: "On some of these same plates there were - at some time in the past - Barite crystals up to one inch square and an eighth inch thick. A coating of tiny quartz crystals had covered all but one of the sides of these barite crystals. One of the large flat surfaces was left uncovered. Later the Barite crystals dissolved leaving the quartz crystal coverings." Only several of these quartz epimorphs exist.

Greenwood, Maine

Quartz epimorphs after an unknown mineral have long been known from Noyes Mountain, at the locality now called the Harvard quarry, **Greenwood**. The specimens are generally cabinet-size (to 20 cm) and consist of wedge-shaped crystals tightly coated by short prismatic quartz crystals (generally to 2 x 1 mm) forming a uniform carpet on the unknown host crystals. The hollow, wedge-shaped epimorphs usually have a similar internal coating of quartz crystals. The location was first found by George L. "Shavey" Noyes in the late 1890's and was first written about by Warren (1898):

Pseudomorphs after Phenacite from Greenwood, Maine

... The crystals are remarkable for their size, and are evidently pseudomorphs, as the faces are rough, in places pitted, and in the depressions perfectly developed quartz crystals are visible. A thin section, when examined under the microscope, showed that the material consisted of quartz and a mineral with a foliated or mica-like structure. The color of the crystals is white with a slight greenish cast. It is evident that the crystals were originally attached, and they had been broken from the matrix, so that they thus presented only a portion of the crystal faces, and although the habit differs from that of phenacites which have been described, the characteristic forms and the peculiar symmetry of the crystals render it almost certain that they must be pseudomorphs after that rare mineral. ...

The development of the faces is shown in Fig. 3, which represents the smaller crystals weighing 2 lbs., and measuring $4\frac{1}{2}$ inches in diameter, and Fig. 4, representing a crystal 12 inches in diameter, and weighing 28 lbs. If the faces had been symmetrically developed in about the proportions represented by these two partial crystals, the complete form would appear like Fig. 5, which differs from previously described crystals of phenacite, in that the μ , s and s_1 faces are unusually prominent, while, when prismatic forms are developed, generally the prism of the second order a is prominent instead of m .

Owing to the rough character of the faces, only approximate measurements could be made with the contact goniometer...

A determination of the bases was made on a portion of material which was decomposed by hydrofluoric and sulphuric acids ...

The high percentage of water and alumina, and low percentage of alkalis, probably indicate the presence of cookeite, which has been observed as a secondary mineral on other specimens from the locality. Careful tests were made for beryllium with negative results.

3. Supposed Pseudomorphs after Topaz from Greenwood, Maine

In connection with the pseudomorphs of quartz just described, there occur other pseudomorphs of quartz after a prismatic, and probably an orthorhombic mineral. The crystals are prisms about 4 inches in length, having an angle about like the prism m , 110° , of topaz, and are terminated by basal planes. It seems most probable that they are pseudomorphs after topaz, but the original material has been wholly removed, and the crystals now present the appearance of a shell of quartz, with the points of innumerable crystals projecting outward, while within they are cavernous, and the sides of the cavities are lined with small quartz crystals, and rounded prominences of cookeite."

The missing parts of the above quote include an angle table and a tabulated chemical analysis which totaled 27 weight percent and which assigned the remainder of the specimen to silica, calculated by difference. One specimen which is still preserved from the above study appears to be an etched microcline crystal showing faces nearly equal to Warren's (1898) figure three. The illustrations were certainly idealized, although it was suggested that the pseudomorphs were after phenakite as a close match was made from measured angles of the unknown compared to

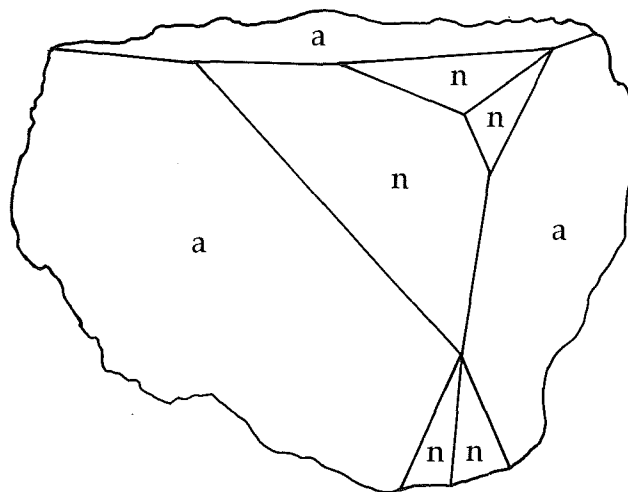
phenakite data from von Koksharov (1857). [An earlier Yale mineralogist, Yeates (1890a), similarly reported phenakite as unreplaced crystals, based on a crystallographic study of specimens from the Mount Rubellite quarry, Hebron, Maine, but had to retract the identification (Yeates, 1890b) in favor of fluorapatite. He said: "The unusual flat habit of these apatite crystals is well worthy of note." Fluorapatite and phenakite have similar crystallographic angles in a few of their common forms.] The Greenwood pseudomorphs after "phenakite" also may have been after Hebron-style fluorapatite, while the "topaz" may have been albite variety valencianite or zygadite (a platy habit of valencianite). The Noyes Mountain quarry was reopened by the geology department of Harvard University in 1923, more or less, and has from that time been called the Harvard quarry.

Some "isometric" pseudomorphs were reported with specimen diameters up to 30 cm and a weight of 13 kg. Palache and Landes (1925) wrote:

Quartz Pseudomorphs

"The quartz pseudomorphs taken from the Greenwood ledge in numerous specimens by Mr. Noyes when the large pockets were first opened are among the most interesting minerals which it yielded. They are of two types and both were described by Warren [1898], the one as a pseudomorph after phenacite, the other as after topaz. It was largely in the hope of solving the riddle of their nature that ownership of the Greenwood ledge was secured for the Harvard Museum and the later excavation there carried on. Many new specimens of both types were then secured but none approaching the beauty of the early groups; nor was the hope of finally determining their nature fulfilled although a new interpretation is offered on a later page.

According to Mr. Noyes the large pocket ... was completely encrusted either with quartz crystals or with the hollow pseudomorphs or both. ... Whatever the primary mineral may have been it was certainly



Quartz pseudomorph, Harvard Q, Greenwood
(redrawn from Richmond and Gonyer, 1938)

developed in very great abundance in all the cavernous parts of the ledge.

The two types of quartz pseudomorphs, one due to replacement and the other to incrustation, also differ from each other crystallographically. Two minerals, then, played the part of host. No traces other than external form remain of either of these original minerals, but some of the pseudomorphs contain cleavelandite, which was evidently replacing the missing minerals. ... It is evident that the original minerals were associated together and preceded cleavelandite in formation.

Examples of the replacement type of pseudomorph ... will be discussed first. These are composed of fine grained quartz and cookeite with an occasional remnant of cleavelandite. Crystal faces are plentiful and definite. Five specimens of this type of pseudomorph have been found ...

The form is a cube, with each corner truncated by three faces of the trapezohedron (211). The angles check as closely as could be expected when one considers the rough surfaces involved. ...

The smallest cube among these pseudomorphs is two inches, the largest is nine. The latter specimen contained three of these nine-inch cube faces, with the corner formed by their junction truncated by three smaller trapezohedron faces. Other trapezohedron faces marked their corners.

Under the impression that the form was rhombohedral Warren [1898] described the original mineral as phenacite, but the definite isometric character of the pseudomorph rules out this mineral. ...

The second type of pseudomorph resulted from incrustation by drusy quartz, followed by the solution and removal of the host. ... Some are hollow, others are partially filled with later quartz or earlier cleavelandite. The form is prismatic, terminated bluntly by faces at ninety degrees to the axis of elongation. The end faces, giving the cross-section of the form, are sometimes diamond shaped, at other times six-sided. The apparent orthorhombic symmetry in many of the forms suggested to Warren that the original mineral was topaz ...

Other specimens, however, appear to have but one plane of symmetry, and that at right angles to the axis of elongation. If that is true the pseudomorphs are monoclinic, and consist of side pinacoid, base, and positive and negative orthodome. ...

However, even with the eye, a rather wide divergence of angles may be noted. ...

The suggestion is made that the host for the incrustation was heulandite, elongated parallel to the *b* axis. ...

Another possibility is bertrandite... Still a third possibility is feldspar, in elongated crystals with side pinacoid, base, and negative orthodomies."

Palache and Landes (1925) gave reasons for and against identifying the isometric-appearing mineral as analcime and the other mineral as being heulandite. In a footnote, they substituted pollucite for analcime as a better interpretation of those specimens. They further wrote in the footnote that they wished to emphasize the possible bertrandite suggestion. In recent years, many collectors have begun to support the third possibility suggested by Palache and Landes (1925) that the wedge-shaped pseudomorphs were albite. New prospecting at the Harvard

quarry in 1993 (Frank Perham, personal communication, 1993) failed to reveal any new quartz pseudomorphs such as those which had been found in the 1890's or the 1920's.

Peru, Maine

Kunz (1888a) noted of the Perry prospect, **Peru**: "In 1887, at the spodumene locality at Peru, Maine, which has furnished tons of that material for commercial purposes, there were found some crystals in which the original spodumene had been almost entirely replaced by white quartz, with the exception of a white core of crystallized albite. These crystals are remarkable for the sharpness of the striated prismatic faces; the terminations are not so distinct. The surface of the crystals is covered with a coating of damourite." The Perry prospect is a lost location and none of these pseudomorphs are known.

Poland, Maine

Hollow fine-grained quartz replacements of corrugated fluorapatite crystals (to 1+ cm) have been found on cleavelandite at the Berry-Havey quarry, **Poland**. The pseudomorphs are not unlike the Harvard quarry pseudomorphs and form groupings to 5 x 8 cm. One good specimen is known.

General Quartz Descriptions

The remainder of quartz localities can be treated as a group. The area of the Alder Stream falls, **Alder Stream** has produced bright red jasper with specular hematite veinlets (Lander, 1954). Jasper, sometimes in bright red-orange to brownish red boulders (to 1 m), is found in virtually all of the streams immediately south of **Jim Pond** and **Alder Stream** (Earl Meyer, personal communication, 1990). Nash Stream, **Coplin** is a particularly good locality with jasper boulders. (The occurrence has been traced in Jim Pond (Burroughs, 1979; Boudette, 1982) and forms part of the basal unit of the Jim Pond Formation which discontinuously parallels the Squirtgun fault.) Kunz (1885, and similarly 1892a) reported: "Red jasper is found on Sugar Loaf Mountain, Maine ..." The particular hill of this name was likely in **Carrabassett Valley**. The Dead River bed, **Eustis** has medium red to red-brown jasper boulders in it.

Jackson (1837a) reported on a fine-grained volcanic rock which he loosely called jasper:

"Two miles west from Buck's Harbor, we visited a place, to which I gave the name, last year, of Jasper Head, on account of a beautiful variety of ribbon jasper, found there in abundance. The whole promontory consists of this mineral, and the shore is covered with its pebbles, which have been rounded and polished by the sea. Huge blocks, which have fallen from the cliff, lie in confusion upon the beach, and some of

them are upwards of 10 feet in length, and four or five feet in thickness. On examining this rock, it will be seen that the stripes of red, brown, green and blue, which it presents, are the original lines of stratification; and it appears probable that this jasper originated in the semifusion of regular strata of slate and sandstone. The jasper is overlaid and underlaid by trap-rocks, which, from evidence before presented, you will be satisfied, had an igneous origin; and there is no improbability in the supposition, that such a powerful mass of melted rocks, might have induced the changes in question."

Many lapidaries have collected "jasper" pebbles from Jasper Beach, **Machiasport**, but the red rocks are actually volcanic pebbles, not the jasper variety of quartz.

Mount Apatite, **Auburn** is famous for its multiple-growth smoky quartz crystals. The largest and best crystals came from the Greenlaw quarry and Maine Feldspar quarry. Kunz (1897) reported that several tons of crystals were found from a single pocket and elaborated (Kunz, 1898): "Mr. T. F. Lamb, of Portland, Maine, states that 3 tons of smoky quartz crystals were mined on the Joshua Littlefield farm in Auburn, Maine. This locality is only a few rods from the well-known G. C. Hatch tourmaline locality." However, Kunz (1904a) added: "Since 1897 numerous pockets of smoky quartz have been found on the Littlefield Farm, at Mount Apatite, Auburn, Me. Several tons of crystals in all have been obtained. One exceptionally perfect crystal weighing 12 pounds was found imbedded on the edges of a mass of cleavelandite, a short distance from the farm of A. S. Berry [Poland], in a deposit of large quartz crystals, feldspar, and gem tourmalines, of which more than 150 were obtained. A perfect 3-inch ball was cut from a smoky-quartz crystal found at the deposit, and is now in the collection of E. R. Chadbourne, of Lewiston, Me." (The sphere is now in the Northeastern University geology department.) The Pulsifer quarry, Auburn did not produce many significant quartz specimens. However, small quartz crystals of a variety of habits were described by Wolff and Palache (1902a,b). The characteristic quartz from the Pulsifer quarry consists of a milky quartz overgrowth on smoky to cloudy quartz crystals (1-8 cm) and is usually associated with purple apatite, cookeite, etc. A few multiple-growth smoky quartz crystals (to 15+ cm) were found at the Pulsifer quarry. A few Pulsifer quarry milky-overgrowth quartz crystals show a somewhat skeletal shape with very tapering slender apices. The resulting crystals have a cross-section which resembles a "snowflake" with a spiked termination. Lucas (1936) illustrated a 115 kg quartz crystal from Auburn [Pulsifer quarry?].

The LaChance quarry, **Brunswick** has produced some interesting "radiation burns" (to 1 cm across) in faintly cloudy transparent to translucent smoky quartz. (The origin of the radiation does not need to be from uranium minerals. Potassium is naturally radioactive and Reinitz and Rossman (1988) have shown that the current radiation levels in the Himalaya pegmatite, San Diego County, California are more than adequate to account for the darkening of color in tourmalines over the history

of that deposit. The substitution of aluminum for silicon in quartz creates a susceptibility for smoky development by potassium's nuclear radiation.) The "burns" show up as dark smoky, irregular to circular patches which sometimes overlap, but generally are individual spots in the quartz. Similar "radiation burns" have been found at the Wardwell quarry and the Scribner Ledge quarry, **Albany**; Nubble quarry, **Greenwood**; Hibbs quarry, **Hebron**; LaFlamme quarry, **Minot**; Hoopers Ledge quarry and Slattery quarry, **Paris**. Sometimes, the "radiation burns" in the Albany pegmatites are developed in rose quartz which has some smoky wisps as well as the irregular to circular smoky patches.

The LaChance quarry, Brunswick has produced clear to cloudy scepter crystals (to 7 cm). Very fine masses of relatively clear quartz are found at the LaChance quarry. Local legend holds that the source of the quartz for the production of the giant reflecting lens of the Mount Palomar, California telescope came from this quarry, and this is partly corroborated by Cameron et al. (1954).

The second largest Maine quartz crystal came from the famous quartz pockets at the Bennett quarry, **Buckfield**. The crystal was pictured by Zodac (1929). The milky, doubly-terminated crystal was composed of several crystals in close parallel position and was 91 cm long by 61 cm. (Parallel growth quartz crystal clusters are well-known from the quarry.) The crystal was estimated at 227-272 kilograms and the pocket was estimated at 6 x 2 x 2.5 m. (Stan Perham [1966] noted that this huge quartz crystal is now in a cemetery in South Acton, Massachusetts. The crystal is actually located in the Woodlawn Cemetery in "North" Acton.) A larger quartz crystal which had a dark smoky color was found at the Lord Hill quarry, **Stoneham**. The 261 kg crystal was 119 x 43 cm. It had a distorted termination and was also illustrated in a publication (Pollack, 1966). Smoky quartz crystals (generally 5-15 cm) from the Lord Hill quarry are usually etched or lightly frosted and occasionally sceptered. Kunz (1892a) reported of some quartz specimens: "In 1884, a fine, clear mass, weighing over 6 pounds, with clear spaces several inches across, was found on Blueberry Hill, Stoneham, Me., and a broken crystal that weighed over 100 pounds and a crystal over 4 inches long and 2 across, very clear in parts, were found near Mount Pleasant [Pleasant Mountain, Denmark?], Oxford County, Me., and a fine crystal at Minot, Me." Zodac (1929) noted the large milky quartz crystal from the Bennett quarry, Buckfield:

"This crystal was found in one of the largest pockets ever opened in the Paul Bennett quarry at Buckfield, Maine. The pocket was about twenty feet long, nine feet wide and from five to eight feet high. It was lined throughout with fine quartz crystals, many of them ranging from a foot to eighteen inches in length and from six to ten inches in diameter, for the most part milky-white in color. ...

The crystal illustrated is thirty-six inches high, twenty-four inches over all in diameter and weighs in the neighborhood of 500 to 600 pounds. It is doubly terminated and for the most part is a beautiful

translucent milky-white color with the middle of the crystal showing some transparent spots of smoky quartz. It was found five years ago."

A well-known habit of the quartz from the Bennett quarry, Buckfield are the "flattened" quartz crystals (to 10 x 10 x 1 cm). In reality, the "flattened" crystals are healed shards formed during late-stage energetic churning of the crystal pocket contents due to the dynamic action of the entrapped, resurgently "boiling" aqueous fluids. The larger cloudy quartz crystals are chipped, flaked, etc. and the broken surface begins to develop vicinal crystal faces due to regrowth, while the original crystal surfaces present the normal smooth development. Frequently, the shards are curved due to conchoidal fracture, but the curve is composed of numerous faces. Occasionally, small shards will be attached to the "flattened" crystals and have recrystallized into crystals attached to the main crystal. Similar "flattened" quartz crystals are found at Lord Hill, Stoneham; Tamminen quarry, Greenwood; Hibbs quarry, Hebron; Trenton quarry, Topsham; and Mount Mica quarry, Paris. Cloud (1934) wrote of the Tamminen quarry, **Greenwood**: "At this locality were found some of the most interesting mineralogical specimens of the trip. Complete hexagonal quartz crystals, 25 centimeters long and 10 centimeters wide, were so flattened as to be as thin as an ordinary book cover; small crystals of parallel growth were numerous along the sides of the large flat ones."

Landes (1925) wrote of quartz from the Bennett quarry, Buckfield, but identical massive quartz has been found at the Mount Mica quarry, Paris:

"Even the most massive specimens are extremely porous as the crystals do not fit together very closely. These large quartz aggregates, consisting of a multitude of small individuals, are pink and yellowish in color, due to presence of flakes of cookeite throughout the mass. ...

Sometimes the quartz crystals ... project in parallel groups, from thin shelves. The latter are likewise parallel to each other and are usually composed of finer-grained quartz. They may also contain cookeite, especially toward the center of the slab."

Putnam and Perham (1968) wrote of **Township C**: "Colored agate that is very lovely and jasper have been reported from Bailey Brook at South Arm. Have you ever seen any?"

Boucot et al. (1964) noted of the Edmunds Hill Andesite, **Chapman** and the andesite on Castle Hill, **Castle Hill**: "Red jasper irregularly veins the andesitic breccia."

Pavlidis and Milton (1962) wrote of the Spruce Top greenstone, **TDR2 WELS**, **TER2 WELS**, and **T3R9 WELS**: "In many rocks, amygdules filled chiefly with chlorite enclose either pyrite, epidote, quartz, or chalcedony. Pyrite occurs mostly along peripheral parts of chloritic amygdules and chalcedony forms the marginal lining of at least one amygdule whose core is filled with chlorite."

Smoky quartz is particularly abundant in the coastal Maine pegmatites. Specific mention can be made of the nearly black

massive smoky quartz from the Consolidated quarry, **Georgetown**. The nearby Tourmaline prospect, Georgetown has produced some genuine medium to pale citrine crystals (to 5 x 5 x 8 cm) (Ray Woodman, personal communication, 1992).

Sceptered quartz crystals are not scarce in Maine, but a well-known prolific scepter location has been the Diamond Ledge locality, **Greenwood** which has generally been operated by collectors using hand tools. The 1-2 cm clear quartz scepters, as well as the much more common normal quartz crystals (to 15 cm), have been acquired in 20 x 20 cm plates of clear to milky crystals. The crystals vary from water clear with smooth faces through milky with translucent tips and usually have extreme multiple-growth features on the prisms producing a coarse roughness.

Excellent smoky quartz on cloudy quartz scepters were found in the hydroxyl-herderite pockets at the Waisanen quarry, Greenwood. The lustrous smoky crystals (to 15 cm) form a parallel-position cluster of several crystals implanted on the base crystal. Similar crystals were found at the Tamminen quarry and Emmons quarry, Greenwood.

Landes (1925) described Harvard quarry, Greenwood specimens: "Crystals vary in length from one to thirty centimeters. The large crystals are usually milky, the smaller ones clear or smoky. ... Others, of truly spectacular appearance, consist of a parallel aggregate of smoky or milky quartz crystals... These parallel groups may be frozen onto massive quartz of the pocket wall, or they may cluster on a single large quartz crystal. In the latter case crystallographic directions in the individuals of the aggregate are parallel to similar directions in the host. In some instances the large crystal is incompletely developed on one side, and a multitude of smaller crystals have so arranged themselves as to tend to complete the crystal form. ... One slab two feet long is covered by a host of small parallel quartz crystals. Those on the outside are smoky, but farther in they become milky." Dauphiné-style (or La Gardette-style) twinning is a common feature in quartz, but is usually inconspicuous. The Harvard quarry clear quartz crystals (to 5 mm) which are found in cleavelandite with cookeite sometimes show two crystals in parallel growth and a notch between the two terminations can be seen separating small triangular "z" faces sloping to an intersection with large "r" faces. This twinning at this locality is only visible using a microscope.

New finds (Dennis Gross, Duane Leavitt, personal communication, 1993) at the West Hayes Ledge quarry, Greenwood produced abundant, extremely sceptered, multiply-grown clear to smoky quartz crystals (to 20 x 20 cm). The first generation crystals (to 10 cm) tend to be cloudy and slender while the second generation crystals are much glassier with abundant, sometimes branching, multiply terminated cloudy to smoky quartz crystals.

A few pockets at the Hibbs quarry, **Hebron** produced some complex quartz crystals (to 7 cm) with slightly cloudy cores overgrown by transparent outer layers. The Hibbs quarry quartz crystals can have skeletal faces (to 4 mm below the projected

normal surface) and frequently are bounded by the surface of the cloudy core. Some white to tan clay can be trapped at the core/clear quartz interface.

Mount Rubellite quarry, Hebron has produced clear quartz scepters (to 7 cm) on quartz, cookeite, and cleavelandite matrix.

Jackson (1838a) reported of **Kennebunkport**: "On the road from the Port to Kennebunk village occur a great number of dykes... Some very curious reticulated veins of blue quartz occur in the mica-slate on this road, and were probably formed at the time, when the neighboring dyke was thrown up."

Large clusters (35 x 25 cm) of milky to cloudy quartz crystals come from an unspecified locality in **Lovell**. Individual lustrous, well formed crystals (to 10 x 10 x 10 cm) were found.

Gregory (1900) noted of southern summit of the Mars Hill area, **Mars Hill**: "As one climbs higher and over thick beds of arkose, another outcrop of igneous rock is seen at the base of a long talus slope. This is a second diabase dike, or perhaps a flow, of unknown width and extent, which attracts the attention of any observer because of the chunks of bright-red jasper included in it."

A large number of cloudy to pale smoky quartz crystals (to 15 cm) were found in the quartz vein that produced the thin-bladed ankerite crystals in the road cut on U.S. Route #2, **Mexico**. The crystals varied from vitreous to matte luster, and the faces varied from smooth through parallel-growth texture. Frew (1957) briefly described the occurrence.

Scepter smoky quartz and clear quartz is found overgrown on cloudy quartz crystals at the Mount Marie quarry, **Paris**. One exceptional transparent, lustrous doubly-terminated smoky quartz crystal (6 x 3 cm) was found overgrown on a cloudy quartz crystal (2 x 1 cm). Another type consists of symmetrical crystals (to 7 x 7 cm) with a large set of rhombohedral faces in combination with a set of "negative" rhombohedral faces about one-third the former and with skeletal indentations along their intersections as well as "tunnels" etched out of the side of the larger terminal faces. Multiple parallel-growth quartz crystal plates (to 20 cm) are characteristic of the Mount Marie quarry.

Shepard (1830) described quartz crystals at the Mount Mica quarry, **Paris**:

"The crystallized Quartz, it has already been mentioned, is of two kinds, - the brown or smoky, and the common Quartz; between which, notwithstanding they were formed in the same crystalline vault, there are such remarkable differences both in the modifications which they offer and in other respects, as clearly to evince, that the crystallization of the one, was subsequent to that of the other. The brown Quartz is much clearer and better crystallized; and its crystals are singularly characterized by the alternating re-appearance of the prismatic faces, after the pyramidal faces have begun to form. A fragment of a crystal measuring two inches and a half across its prismatic faces shews [sic] these alternations, repeated for a great number of times, and forming steps in some places, one eighth of an inch in depth. Moreover, these crystals are entirely free from any penetrating minerals; while the white

crystals show nothing of the above peculiarity in their structure, - being uniformly tabular in their shape. Besides, the larger ones are wanting in that perfection of fracture and tendency to a pyramidal termination, (except at one extremity [sic],) which characterize the smoky Quartz; and are every where penetrated by crystals of Tourmaline and often by Feldspar and Talc [cookeite]. Farther, I possess one crystal of brown Quartz, having a crystal of the other variety attached to it, but between the two, notwithstanding the coincidence of their prismatic axes, (one crystal being placed directly upon the summit of the other,) a perfect line of demarkation can be traced. From these observations, I am led to infer, that the brown Quartz was first deposited from solution, and surrounded the walls of the granitic cavity with its crystals; and that the Tourmaline crystallized next, to which succeeded the Talc and Feldspar; and that, finally, the white Quartz was deposited around the other substances."

Parallel-growth smoky quartz is frequently seen as an overgrowth on milky quartz crystal cores. These crystals can be up to 20 cm.

Seaman (1975c) noted citrine at the Whispering Pines quarry, **Paris** as well as the Scribner Ledge quarry, **Albany** and the Bennett quarry, **Buckfield**. Citrine is not common in **Maine** and much so-called citrine is mostly a pale smoky quartz.

Kunz (1885) noted an unusual specimen from **Paris**: "Mr. Samuel R. Carter has in his cabinet cut specimens of pieces of bluish quartz filled with small acicular crystals of indicolite, somewhat resembling rutile in quartz, with the exception of the blue color. These were found in pieces over 1 inch square at the famous tourmaline locality at Mount Mica, **Paris, Maine**." Skeletal and parallel-growth quartz crystals (to 10 cm) are well-known from the Mount Mica quarry. Seven large multiple-growth quartz crystals (to 50 kg) were found in one pocket and were called "The Seven Dwarves" (Duane Leavitt, personal communication, 1992).

Putnam and Perham (1968) noted of **Paris**: "Quartz Crystals in a fairly wide vein were found by Raymond A. Dean about a mile above the Wright Farm in back of **Paris Hill**."

The Penobscot mine, **Penobscot** has been known for its quartz crystals (MMJ, May 7, 1880): "We acknowledge the receipt from Rev. Samuel Annear of a large box of specimens from the Penobscot mine. The quartz crystals are very beautiful. The shaft is now 36 ft. in depth." It was later reported (MMJ, September 9, 1881): "Rev. Samuel Annear is receiving numerous visitors at his charming 'crystal cottage' in North Penobscot. Tourists sojourning in that vicinity should not fail to visit this interesting retreat. The crystals are always beautiful and the garden is now in its best attire. The place is unique in its beauty and attractions." Christ (1989) illustrated a partly crystallized plate (about 30 x 50 cm) from the Annear Mine (specimen from a lodge fireplace).

Chalcedony from the Denny Reed Point area, **Phippsburg** is found in cavities in a quartz vein. The attractive botryoids of the chalcedony can be translucent and over 1 cm across. Display

specimens 15 x 20 cm have been recovered. The color of the chalcedony varies from uniform milky white through uniform tan at the locality. No staining is evident. These specimens are found in minor late fault zones characterized by fault breccia (Arthur Hussey, personal communication, 1992).

The Berry-Havey quarry, **Poland** produced a few smoky scepter overgrowths on milky quartz crystals (to 8 cm) as well as plates (to 20 cm) of multiple-growth quartz.

Noyes (1930) noted of Diamond Island, **Portland**: "We operate on the side of the big hill and find schistose slate rocks, all filled with veins of quartz mostly in very small crystals but very clear."

A peculiar greasy, fine granular, gray-green mineral (prase?) from Rangeley has been called quartz (HH collection).

Moench and Pankiwskyj (1988) noted of the Rangeley Formation exposed over a large portion of western Maine: "Conglomerate of the body contains a wide variety of plutonic, volcanic, and sedimentary boulders and cobbles, which include a distinctive granite rock containing *blue quartz* from sources identified north of the area." The *blue quartz* formed small grains (to 5 mm±) which were undoubtedly milky and barely perceptible. This example might serve for the various reports in Maine for blue quartz. Morrill and Hinckley (1959) wrote of the Empire mine, **Verona**: "Famous for blue Quartz cabochon material (Scarce)." Neither McKinley (1939) nor Dake et al. (1938) mentioned blue quartz from Verona. Leadbetter (1963) listed blue quartz from Bucksport. Blue quartz was noted from the Sullivan and Waukeag mine, **Sullivan** (MMJ, January 28, 1881). Arthur Hussey (personal communication, 1992) wrote: "Blue quartz is generally taken to indicate a volcanic parent of the metamorphic rocks that contain it. The Cushing Formation, particularly at Danford Cove, South Portland, and at several localities in Portland and Harpswell is characteristically a light gray fine grained granular volcanic rock with relict crystal fragments of plagioclase and blue quartz. The rocks are interpreted to have been originally rhyolitic to rhodacitic crystal tuffs (Hussey, 1971a, 1985). The blue color of [this] quartz, I have been led to understand, is due to finely disseminated rutile grains."

Large clusters of lustrous, milky quartz crystals (to 30 cm) with multiple growth prism zones come from the Concord Pond prospect, **Peru**.

Cole (1952) wrote of the Goddard Ledge quarry, **Rumford**: "In one of the larger pockets, the Whitehall people found a beautiful pedunculated group of smoky quartz crystals, but this was the exception."

Herbert Haven wrote in his diary August 11, 1935 (Morrill, 1966) of **South Berwick**: "We went to Old Gold Mine on King's Mt. So. Berwick, Me. It was operated in 1920 and assayed \$10 per ton. A vein of gold and other minerals was found. \$1000 was spent in blasting. There are nice quartz crystals there."

Pollack (1966) reported of **Stoneham**: "In November 1965, an extremely large and fine terminated, Smoky Quartz crystal was found at the Lord Hill Mine in Stoneham, Maine. This

tremendous crystal weighed 574 pounds (261 kg), was 47 inches long and 17 inches in diameter [119 x 43 cm] and was found loose in a pocket along with numerous smaller smoky quartz crystals. ... A check of records indicates that this crystal is the largest single, terminated and smoky quartz crystal ever to be found in the eastern United States..." The accompanying photograph in the article showed the crystal was quite irregular. Buckfield produced an earlier crystal of similar size. (Dake et al. (1938) indicated that a quartz crystal from Grafton, New Hampshire was 6½ feet long and 1½ feet in diameter and weighed 2,913 pounds [198 x 46 cm; 1324 kg].) Lord Hill quarry smoky quartz crystals are generally frosted, often extremely, and can have a milky cast on their exterior. Sceptered crystals (to 20 cm) are not rare and many specimens show a peculiar overgrowth which transcends being sceptered and instead are so grown as to suggest being wrapped in a geometrical sheath which is too small for the crystal and the core crystal is exposed along much of the prism length. Additionally, doubly-terminated crystals are common, but the crystals frequently are thicker at one end. Smaller crystals frequently jut from the side of a main crystal. Deep, corrugated striations are not uncommon and many crystals are coated by a hard, fine-grained muscovite coating. Highly prized crystals (to 30 cm) have one or more adjacent surfaces coated by drusy phenakite crystals. Many of the smoky quartz crystals have gemmy cores.

The pockets which produced the gem beryl crystals at the Trenton quarry, **Topsham** also produced some excellent doubly terminated smoky quartz crystals (to 30 cm) with parallel growth faces. Numerous fluid inclusions are present in Trenton quarry quartz crystals (Arthur Hussey, personal communication, 1992). A second Topsham locality with gem pockets, the Fisher quarry, produced no terminated pocket beryl crystals or any consequential smoky quartz crystals.

Exceptional transparent and flawless tapering quartz crystals (to 12 cm) with unusual deep "horizontal" striations have been found in the dumps of the northernmost of the Twin Pits just one hundred meters north of the Swamp #1 quarry. Multiple growth quartz crystals (to 15 cm) are found at the Consolidated #1 quarry, Topsham and just across the road to the west in the water-filled Leavitt quarry.

Excellent transparent, lustrous quartz crystals (to 8 cm), some with vermiform clinocllore inclusions, are found in veins at the Cupsuptic River road metal quarry, **Oxbow**.

Bayley (1892a) described a fulgurite from Crummetts Mills area, **Waterville**.

Perham and Putnam (1968) wrote of **West Paris**: "Many bubble-bearing specimens of quartz crystals have been taken from the Bell #1 Mine [Perham quarry] at West Paris." Smoky quartz crystals with several scepter growth periods also came from the Perham quarry (see cover, *Rocks and Minerals*, #282 by Benjamin Shaub). Some multiple-growth quartz crystal specimens from the Perham quarry show selective smoky color zoning along the intersections of crystal faces.

Jackson (1838a) noted of **T5R7 WELS** and nearby areas:

"Jasper, a precious stone, is also found abundantly in the State, in beds always in contact with trap rocks. On Sugar Loaf Mountain, upon the Eastern bank of the Seboois river, there is a bed of this mineral, 10 feet wide, cutting through the mountain, in contact with a huge trap-dyke to which it owes its origin. Immense quantities of boulders, or rounded masses of jasper, also occur scattered in diluvial soil, and are also found in the bed of the Aroostook and St. John Rivers.

Chalcedony and carnelian are also found in globes, or hollow spherical [sic] masses in the amygdaloidal trap rocks, and also as boulders, in the St. John river."

quicksilver? = native mercury

Denmark - Mount Pleasant A

An unusual material was reported from **Denmark** (MMJ, September 10, 1880): "Quicksilver has been discovered on Mount Pleasant on land owned by Miss Almeda Warren of Denmark. - [*Portland Transcript*. " No specimens known. It was not stated if the material was native quicksilver or if quicksilver-bearing ores were supposedly found.

R

RAMMELSBERGITE

NiAs₂

Union - Harriman P

Rammelsbergite was identified among polished sections of the metallic minerals found at the Harriman prospect, **Union** (Rainville and Park, 1976): "Niccolite is locally abundant in pegmatites and is commonly rimmed by rammelsbergite, which demonstrates a response to local changes in arsenic composition of the residual ore fluids."

REDDINGITE (Reddingite Group)

Mn²⁺(Mn²⁺,Fe²⁺)₂(H₂O)₃(PO₄)₂

Auburn? - Maine Feldspar Q; **Buckfield** - Bennett Q; **Greenwood** - Emmons Q; **Newry?** - Dunton Q; **Poland** - Berry-Havey Q; **Rumford?** - Black Mountain Q, Red Hill Q; **Stoneham?** - Cole Q, Lord Hill Q

Reddingite is a relatively rare phosphate. Many of the so-called reddingite localities in the world are actually localities for the iron-rich member of the series, phosphoferrite: North Groton, New Hampshire; Glendale, South Dakota; etc. Reddingite is found in reaction and replacement zones that, at one time, consisted of lithiophilite or manganese-rich primary phosphates, but some very late-stage manganese-rich assemblages can result after iron became depleted due to oxidation. Due to the easily altered nature of phosphates, specimens which remain exposed on a quarry dump quickly become oxidized and coated with heavy black and brown stains.

Morrill et al. (1958) listed reddingite from the Maine Feldspar quarry, **Auburn**. No specimens known.

Reddingite was found in considerable quantity during the 1920's mining at the Bennett quarry in **Buckfield**. The Bennett quarry, reddingite was found as dark red to dark red-brown veinlets of highly intergrown crystals usually without good crystal shape, which cut large masses (to 25 cm) of pink to pink-brown lithiophilite. Landes (1925) gave optical data for the mineral and reported: "Reddingite, a rose pink to reddish brown mineral, crystallizes in octahedroids of the orthorhombic system. It is usually granular, and ranks with rhodochrosite as one of the commonest minerals in Class III. It may be distinguished from that mineral by its lack of cleavage." Associated species include

fairfieldite, eosphorite, rhodochrosite and an unknown red manganese phosphate (q.v.).

Reddingite occurs as small (1 mm and less) rounded bipyramidal crystals in etched cavities in lithiophilite from the Emmons quarry, **Greenwood**. The reddingite can appear almost granular while abundantly lining small vugs (to 1 cm). When the mineral is clear to light orange-brown, there are relatively few associated phosphates, but as darker, more oxidized material grades into landesite (q.v.), additional associations are present including: rhodochrosite, stewartite, hureaulite, eosphorite, fairfieldite, jahnsite-(MnMnMn), etc. The reddingite can form masses with tiny, closely-spaced etched "slits" which can have granular botryoidal mitridatite lining the openings. Gray translucent fairfieldite crystals (to 4 mm) can be present which may have rockbridgeite twins (to 1 mm) implanted on them. Fine-grained, etched glassy, red-brown triplite can be found replacing some of the reddingite, and minor strunzite has been observed in reddingite vugs.

Fraser (1930) apparently collected the only reddingite ever found at the Dunton quarry, **Newry**: "On one specimen a reddish brown mineral was observed as a radial fibrous deposit on herderite. The optical properties of this mineral were near those given for reddingite and the mineral gave a good microchemical test for phosphorus. From these data it was concluded that the mineral was reddingite." The identification may have been in error and may have been made on an iron-rich "roscherite" which has refractive indices not far removed from those of some reddingite. "Roscherite" was not known from Newry at the time, but was recognized in 1934 (Holman, 1935). "Roscherite" does form radial deposits on hydroxyl-herderite, while reddingite is more commonly found in direct replacement of lithiophilite, etc. (Phosphoferrite (q.v.) was listed in the Bjareby collection catalog, but the specimen was not located.)

The Berry-Havey quarry, **Poland** reddingite varies in color from red through red-orange to dark red and is translucent. Fresh crystals are generally the lighter colored. Individual crystals reach up to 2 mm and are simple bipyramids, sometimes with a "wavy" or "terraced" surface. The Poland reddingite is usually associated with lithiophilite, dickinsonite, rhodochrosite, eosphorite, fairfieldite, and an apatite. Berman and Gonyer (1930) provided chemical and optical data and brief descriptive information. Wolfe (1940) used Berry-Havey quarry material to determine the unit cell constants of the species. Some very pale pink reddingite has been mistaken for rhodochrosite and *vice versa*. The oxidation of "reddingite" can lead to the formation of landesite (q.v.). In light of the ordering scheme found in lan-

desite, there are interesting implications as to the correct nomenclature of the Berry-Havey quarry material (Paul Moore, personal communication, 1990).

Reddingite was listed from **Rumford** by Burr (1930), but not by Bailey (1930), Verrow (1941), nor Morrill et al. (1958). The locality was ascribed to the Black Mountain quarry by Thompson et al. (1988) and Francis et al. (1993) and questioned by Thompson et al. (1991). No specimens known.

A specimen of "phosphoferrite" was listed in the Bjareby collection from **Stoneham**, but the specimen was not located. Given the manganese-rich nature of the Lord Hill quarry secondary phosphates, the mineral may have been reddingite.

retinalite (Serpentine Group) - a gem variety of antigorite

Alder Stream, Eustis, Jim Pond

Retinalite and bowenite (q.v.) are yellow-green translucent varieties of antigorite. Williamsite is a dark green to blue-green gemmy variety of antigorite. Beautiful retinalite specimens have been found in float and stream boulders and small woods outcrops at **Eustis, Jim Pond** and **Alder Stream** (Lander, 1955; S. Perham, 1963b). The retinalite is variable in color even in a single specimen, ranging from yellow-green through darker shades of such as olive-green, avocado-green, etc. The mineral is hard for serpentine ($H=3\frac{1}{2}$) and has an oily luster. Translucent areas can be 10 or more centimeters across. Veinlets of opaque antigorite or clinochrysotile as well as inclusions of chromite, etc. can mar the material for gem use.

RHODOCHROSITE (Calcite Group)

(Mn,Fe)CO₃

Auburn - Keith (= Towne) Q; **Buckfield** - Bennett Q; **Castle Hill** - Dudley P; **Deer Isle** - Deer Isle M; **TDR2 WELS** - Maple Mountain P; **Franklin**; **Gouldsboro** - Gouldsboro M; **Greenwood** - Emmons Q; **Hancock** - Elliot M; **Hebron** - Mount Rubellite Q; **Houlton** - Hovey Hill A; **Mapleton** - Higgins P; **New Sweden** - Ostlund M; **Newry** - Bell Pit, Dunton Q; **Paris** - Mount Mica Q; **Pembroke**; **Poland** - Berry-Havey Q; **Portland** - Fort Gorges A; **Rumford** - Black Mountain Q; **Stockholm**; **Topsham**; **Woodstock**; **T3R9 WELS** - Henderson Hill P, Hovey Mountain P

Tannish pink to rose-orange scalenohedral rhodochrosite crystals (to 3+ cm) as well as pink complex rhombohedral crystals (to 1+ cm) have been found at the Bennett quarry, **Buckfield** usually replacing lithiophilite in pegmatite. Secondary phosphates such as eosphorite, fairfieldite, hureaulite, reddingite, etc. can be associated. Landes (1925) reported:

"Small veins of rhodochrosite cut through the minerals of Class III. These are obviously later than the massive rhodochrosite and

phosphate minerals of that class. In many instances the earlier minerals have been removed by solution and dike-like forms are the result. These isolated veins are roughly parallel to each other except for an occasional vein which intersects the others at a low angle.

Deposition of rhodochrosite continued during the period of solution of the neighboring minerals and as a result the projecting veins are lined with small pink rhodochrosite crystals, showing that ascending hot waters dissolved and redeposited rhodochrosite over a relatively long period. ...

Ground water activity at Buckfield produced a third generation of rhodochrosite. In Class III this mineral appeared in masses, in Class IV in veins and druses, and in Class V in minute bristles or quills projecting out from the surfaces of earlier minerals. These much elongated crystals vary in color from white to bright yellow. ...

The commonest primary minerals coated are rhodochrosite and reddingite. One small crystal of rhodochrosite has a pompadour of white secondary bristles. These project upward from about the top of a steep rhombohedron on the primary crystal. The secondary fibers are parallel in crystallographic orientation to the host.

These white or yellow quills of rhodochrosite are without doubt supergene in origin. They were deposited even after the manganite. In one specimen a somewhat spherical mass of manganite is covered with secondary rhodochrosite fibers like spines on a burr."

Gemmy to translucent rhodochrosite crystals (to 4 x 3 cm) were found at the Bennett quarry in the 1992 field season and might be the largest rhodochrosite crystals from a granite pegmatite anywhere in the world (Ron Holden, personal communication, 1992). The rhodochrosite crystals were terminated by steep smooth rhombohedral in combination with etched scalenohedral faces. One large crystal (about 22 x 15 x 10 mm) was found on minor rhodochrosite matrix while the "twin peaks," a parallel growth crystal pair, is 20 x 20 x 20 mm (Jim Mann, personal communication, 1994). Small black smoky quartz quartzoids (to several mm) and some minute earthy coatings of yellow to tan francolite (variety of fluorapatite) occur with the rhodochrosite. Rhodochrosite replacing polyhedral lithiophilite (to 3 cm) has been found embedded in Bennett quarry pollucite.

The rhodochrosite from the silver mines of Hancock County, consists of pale pink cleavages to several centimeters. It is uncertain if the Deer Isle mine, **Deer Isle** rhodochrosite is correctly identified or if it is a pale pink massive manganian calcite.

Rhodochrosite from the Emmons quarry, **Greenwood** can be found as pink cleavages (to several cm) cutting lithiophilite masses. Rhodochrosite hosting abundant secondary phosphates (stewartite, jahnsite-(MnMnMn), bermanite, etc.) can be nearly colorless and have nearly acicular steep scalenohedral habit. The closely spaced crystals can completely line a vug in granular pale pink rhodochrosite.

Rhodochrosite cleavages (to 1 cm), sometimes intergrown with löllingite grains (to 7 mm), are found as a corrosion rim on fine-grained nearly porcellanous montebrasite (to 7 cm) from Mount Rubellite quarry, **Hebron**.

The Bell pit, **Newry** rhodochrosite is sometimes found as pale pink to almost colorless complexly faceted crystals (less than 1 mm) overgrown on the tips of siderite terminations in scepter-like growth. Very rarely, a milky pink simple rhombohedron of rhodochrosite in scepter growth on siderite has been found. Also from the Bell Pit, coarse (to 1+ cm) cleavages have rarely been observed in contact with tannish brown granular to crystallized siderite. Secondary phosphates can be associated: eosphorite, strunzite, fluorapatite, etc. The rhodochrosite of the Bell Pit is also found in masses with cleavages up to 2 cm across and varies from pink to orange-red in color. Within the masses (up to 10 cm), crystal faces and, occasionally, complete rhodochrosite crystals project into interstitial voids and cavities. The crystals are rarely larger than 3-4 mm. The habit is generally acute rhombohedral.

Rhodochrosite from the Dunton quarry, Newry is found in vugs in siderite with quartz crystals in blue tourmaline eyes. The pale pink rhodochrosite is botryoidal (to 2 mm), but can have an irregular "bumpy" shape.

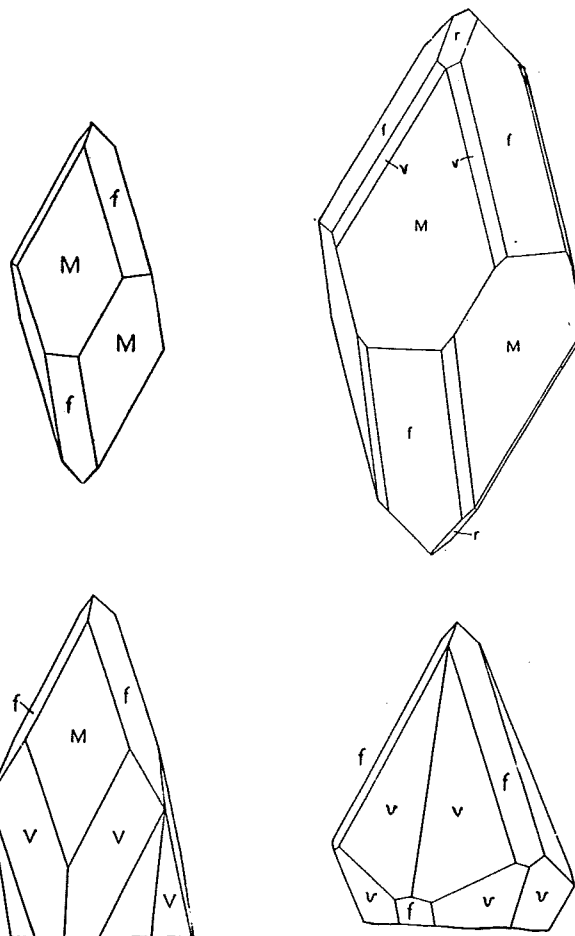
Rhodochrosite crystals from the Mount Mica quarry, **Paris** can be steeply rhombohedral with so-called "dog's-tooth" habit (to 4 mm). The rhodochrosite formed elongated lenses (to 7 cm) in cleavelandite-quartz matrix with blue massive elbaite (not necessarily in "eyes") and incidental species such as massive cassiterite (to 1+ cm). The rhodochrosite crystals can have a dusty but glimmering coating of hydroxylapatite and rounded transparent hydroxylapatite crystals that are doubly terminated (to 2 mm) or bunched in white sprays of acicular crystals (to 1 mm). Eosphorite prisms can be intergrown with the rhodochrosite, but may be so light in color as to be indistinguishable from it.

Berry-Havey quarry, **Poland** rhodochrosite is pink scalenohedral (to 5 mm) and can have a "fibrous" to corrugated appearance. Berman and Gonyer (1930) reported on its crystallography. The rhodochrosite replaces lithiophilite and can be found in 12 cm cleavage masses in quartz.

Rhodochrosite veinlets (to several mm) occur in ledges with manganiferous rock (which may correlate with the Wilson Cove Member of the Cushing Formation) near Fort Gorges, **Portland** (Arthur Hussey, personal communication, 1992).

Verrow (1941) noted of Black Mountain quarry, **Rumford**: "*Rhodochrosite* - Associated with triphylite as an alteration product derived from the latter." No specimens known.

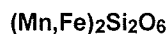
Rhodochrosite is not always found in crystals in Maine. The Aroostook County occurrences on Hovey Mountain, **T3R9 WELS** and Maple Mountain, **TDR2 WELS** contain massive and fine-grained particles dispersed through the manganiferous layers of the deposits there. Pavlides and Milton (1962) reported: "Ferroan rhodochrosite, with N_0 (index of refraction of the ordinary ray) commonly greater than 1.790, is relatively abundant in the hematitic manganese deposits of Maple and Hovey Mountains. Minor amounts of magnesium and calcium in varying ratio are also present in the carbonate. Commonly, two or more carbonates may be intimately associated in one specimen,



Rhodochrosite, Berry-Havey Q, Poland
(from Berman and Gonyer, 1930)

as can be discerned from their relative differences in indices of refraction in thin sections. The carbonate occurs as more or less impure concentrations either in lamellae or pods. ... It is also intimately disseminated in hematite- and braunite-rich laminae. Carbonate-rich laminae in the banded hematite ironstone are more readily leached at the bedrock surface than in the other laminae, and banded hematite ironstone with such laminae hence tend to have a finely ribbed appearance in outcrop."

RHODONITE (Pyroxenoid Group)



Blue Hill - Black Hawk M; Blue Hill Bay, Blue Hill mountain L;
Deer Isle - Deer Isle M, Little Deer Isle A; **TDR2 WELS** - Maple Mountain P; **Rumford?** - Black Mountain A; **T3R9 WELS** - Hovey Mountain P

No crystals of rhodonite are known from Maine. Jackson (1838a) noted of Blue Hill, **Blue Hill**: "This rock contains a considerable quantity of oxide of manganese disseminated in it,

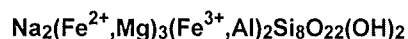
and on examining farther upon the S.E. side of the mountain, we discovered a huge bed of the gray silicate of manganese, which is fifteen feet wide, and runs E.N.E. and W.S.W. cutting through the mountain side." Kunz (1892a) wrote of Blue Hill that: "Rhodonite... has been found in an extensive bed at Blue Hill Bay, Me." Weeks (1895) wrote: "At Blue Hill, in Hancock County, Me., there has occasionally been mined what is termed a silicate of manganese. It occurs in a vein 15 feet wide. The hill is a mass of contorted gneiss rock, the manganese running through it east-northeast by west-southwest. Its chief use has been as a flux at the furnace of the Katahdin Iron Works." Forsyth (1953) reported rhodonite from Blue Hill, Blue Hill: "A small deposit of manganiferous hornfelsic schist occurs about 500 feet east of the summit of Blue Hill. ... The manganese bearing mineral is pink rhodonite which occurs in irregular subhorizontal veins about 1½ inches thick and also in fine grained clusters associated with garnet. The rock surrounding the pink bands is massive and dense, and although the minerals are too small for megascopic identification, a positive manganese reaction was obtained in a carbonate bead test." A Blue Hill rhodonite cabochon is in the Smithsonian Institution's gem collection. Rhodonite occurs as pale pink fine-grained contorted veinlets (to several cm thick) in silicate gangue at the Black Hawk mine, Blue Hill (Hugh Durgin, personal communication, 1993).

The best Maine rhodonite occurrence is now found in the inter-tidal area near Dunham's Point, **Deer Isle**. The Deer Isle silver mine dump was graded over for house construction, but a quantity of material was dumped onto the beach. The rhodonite is pale pink and fine-grained. Acord (1976) noted that rhodonite was a scarce constituent of the beach rock on Little Deer Isle, **Deer Isle** near "Eaton's Lobster Pound Restaurant." No specimens available for study.

Morrill et al. (1958) indicated rhodonite had been reported from **Rumford**, and Seaman (1975d) indicated an occurrence on Black Mountain. No suitable deposit known.

Rhodonite from Hovey Mountain, **T3R9 WELS** and Maple Mountain, **TDR2 WELS** Aroostook County consists of fine-grained particles in pink interlacing veinlets dispersed in the manganiferous banded hematite ironstone ore. Pavlides and Milton (1962) provided a description of this mineral: "The rhodonite in veinlets is readily recognizable by its distinct rose-pink color and its hardness. In thin sections it shows a well-developed cleavage and high birefringence."

RIEBECKITE (Amphibole Group)



Agamenticus Complex - **Berwick, Wells, York; Baring granite** - **Alexander, Baileyville, Baring, Calais, Meddybemps; Cashes Ledge; Chapman Sandstone - T10R3 WELS; Charlotte granite - Charlotte, Meddybemps; Gardiner - locality C; Meddybemps granite - Alexander, Charlotte, Cooper, Meddybemps; Tunk**

Lake pluton - Cherryfield, Franklin, Gouldsboro, Sullivan, T7SD, T10SD; York - paisanite dike, Spouting Rock A, York Beach granite

The reports of riebeckite in Maine have almost all been based on thin sections of rock examined microscopically. The mineral is frequently found as reaction zones around, or inclusions in, other amphiboles.

Ludman and Hill (1990) wrote of riebeckite in granite from **Alexander, Baileyville, Baring, Calais, Charlotte, Cooper, Meddybemps**: "The amphibole in most Baring granite thin sections is common green hornblende, but in some cases an alkali amphibole (deep blue-green pleochroism) occurs instead. ... The predominance in the Meddybemps and Charlotte granites of intensely blue-green amphibole (riebeckite or arfvedsonite), instead of hornblende, and its presence in some samples of the Baring granite, suggest that these three bodies are alkali granites."

Cashes Ledge (42° 54' N, 68° 56' W) provided a host of unusual mineral reports for Maine from a single grab sample broken from a submarine ledge. "Strikingly pleochroic *riebeckite*, varying from deep blue or black to light yellow-brown, occurs principally in sheaf-like aggregates of very thin needles 0.1 - 0.5 mm. long. The aggregates are clustered in several areas in the slide, where they are associated with hornblende, aegirite, iron-rich olivine, astrophyllite, aenigmatite(?), and quartz. Riebeckite also forms larger crystals, one of which is 0.1 x 0.4 mm. and is in contact with hornblende, aegirite, quartz, and aenigmatite(?)" (Toulmin, 1957).

The alkali syenite ("granite") from the Agamenticus Complex, **Berwick, Wells, and York** has bright blue needles of riebeckite as small patches in or at the margins of avocado to olive-green pleochroic arfvedsonite grains (to 3 mm)(Wandke, 1922a; Hussey, 1962). Wandke (1922a) further noted of a paisanite dike: "A single example of this type of dike was found near the crest of a hill just north of 'Scotland,' York, Maine. The minerals present are quartz, albite, microcline, microperthite, aegirite, riebeckite, arfvedsonite, zoisite, and an undetermined titaniferous mineral [aenigmatite?], brown in color and platy in habit." Brooks (1990) wrote of the riebeckite of the Agamenticus Complex, while Haff (1939) wrote of riebeckite granite and riebeckite microgranite dikes exposed near York Beach, York and elsewhere:

"The primary minerals in the granite are microcline, soda microcline, cryptoperthite, albite, oligoclase, quartz, riebeckite, and aegirinaugite. Accessory magnetite, zircon, apatite, sphene, rutile, and cassiterite[!] occur with an unusual amount of fluorite. ... Riebeckite is the most abundant ferromagnesian constituent in what is here considered the normal rock, and it is always associated with some aegirinaugite, with which it is often intergrown. In some places the riebeckite replaces the aegirinaugite along the (110) cleavages.

The riebeckite has intense absorption which makes definite determination of its optical properties difficult. ... In sections parallel to (100)

the riebeckite often shows a mottled distribution of light-blue patches which traverse the crystal apparently without any regard to cleavage. ...

The riebeckite is conspicuous because of its dark blue color, its prismatic development, and the size (many greater than 4 mm.) and crude parallelism of the elongate crystals."

Karner (1974) said of the hornblende-aegirine augite granite exposed on the margins of the Tunk Lake pluton, **Cherryfield, Franklin, Gouldsboro, Sullivan, T7SD, and T10SD**: "Calcic hornblende, probably containing significant sodium and ferric iron, occurs as subhedral to euhedral grains from 2 to 3 mm long with cores of aegirine augite. Perthite occurs as subhedral grains from 1 to 2 cm long, and quartz, as anhedral grains from 1/4 to 1/2 cm in diameter. Riebeckite and a reddish-colored biotite (probably astrophyllite) are common in small amounts."

Riebeckite from the nepheline syenite from locality C, north of Spears Corner, **Gardiner** has been called osannite (q.v.) by Daly (1918). Leake (1978) reported that correctly identified osannite is equivalent to riebeckite.

Boucot et al. (1964) wrote of the Chapman Sandstone, **T10R3 WELS**: "... at various places between Hedgehog Mountain and Squapan Lake... Zircon is common, and one sample contained a dark blue amphibole, possibly riebeckite."

ripidolite (Chlorite Group) = clinocllore

Cutler - *Cutler diabase, Little River Formation*; **Sapling** - *Indian Pond A*

Gates (1961) wrote of the Cutler diabase and the Little River Formation basaltic rocks, **Cutler**: "The very pale interstitial ripidolite found in the least altered diabases commonly, on metamorphism, turns a slightly darker green, assumes the anomalous blue interference colors of penninite (although the optic angle and N_0 index remain the same as in the ripidolite), and becomes indistinguishable from the chlorite replacing plagioclase and pyroxene. In most of the altered rocks chlorite is ubiquitous, occurring as vesicle fillings, as massive replacements of pyroxene and albite..."

Boone et al. (1989) wrote of the Indian Pond area, **Sapling**: "... it appears the chlorites are ripidolitic, and have a wide range of atomic ratios of Mg/Mg+Fe+Mn from ~ 0.2 to 0.8." These ratios span the chlorite series from chamosite through clinocllore.

ROBERTSITE (Mitridatite Group)

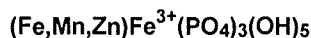


Greenwood - *Emmons Q*

Dark red to dark red-purple robertsite botryoids with pink to tan strengite (less than 1 mm) and with lilac drusy phospho-

siderite in vugs in fluorapatite-quartz matrix has been found at the Emmons quarry, **Greenwood** (Gene Bearss, personal communication, 1992). The robertsite can be found on an avocado-green earthy matrix of mitridatite along with tiny brown jahnsite-(MnMnMn) crystals (less than 1 mm).

ROCKBRIDGEITE



Greenwood - *Emmons Q*; **Newry** - *Bell Pit, Dunton Q, Nevel Q*; **Poland** - *Berry-Havey Q*; **Rumford** - *Black Mountain Q, Red Hill Q*; **Standish** - *Oak Hill P*

Rockbridgeite is a late-stage phosphate found in small cavities in crystallized siderite. The black, lustrous crystals are generally simple rectangular prisms (1 mm or less) grown on siderite crystals. The rockbridgeite crystals sometimes are splayed in a "bow-tie" group. Alternatively, rockbridgeite can form black intergrown, botryoidal clusters which show a radially fibrous to platy interior arrangement of cleavages. Dufrenite is a scarce green to black botryoidal phosphate. It was presumed to be common until Frondel (1949) and Lindberg (Smith) (1949) showed that material called dufrenite was actually a relatively diverse group of similar-appearing minerals, including what became rockbridgeite.

Bell Pit, **Newry** rockbridgeite (EDAX chemical analysis, this study) forms drusy to almost individually visible rockbrigeite crystals (using 40X magnification) lining vugs in siderite with strunzite and quartzoids (to 2 mm).

The rockbridgeite of the Dunton quarry, **Newry** is found in the siderite/rhodochrosite enclosed in the blue tourmaline eyes in cleavelandite. The rockbridgeite forms black, almost smooth botryoids (to 3 mm) placed on mitridatite and diadochite coated carbonate. Cross-sections of the botryoids show a greenish black color and radially disposed cleavages. Additionally, tiny black rockbridgeite "dots" (much less than 1 mm) are found with laueite and beraunite on diadochite botryoids in the blue tourmaline eyes and siderite. Tiny unidentified brown needle crystals (schoonerite?) (much less than 1 mm) are sometimes found associated with the rockbridgeite.

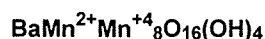
A specimen of rockbridgeite from the Nevel quarry, **Newry** consists of black botryoids (to 1 mm) which usually have an earthy surface, but which sometimes have brownish red internal reflections, associated with tan laueite crystals (much less than 1 mm), in a vug in quartz lined by olive mitridatite (Bjareby #522).

Pinkish brown rhombohedral siderite/ rhodochrosite crystals (to 2 mm) from the Berry-Havey quarry, **Poland** are stained by earthy olive-green mitridatite and have small (less than 1 mm) black rockbridgeite "bow tie" clusters of crystals which have green tips. Short transparent (about 1 mm) quartz crystals are present.

Slightly zincian rockbridgeite (EDAX chemical analysis, this study) occurs at the Red Hill quarry group, **Rumford**. The rockbridgeite is black with a dark green earthy streak and forms botryoids (to 1 mm) which can be associated with phosphophyllite, jahnsite-(CaMnFe), beraunite, strunzite, etc. in muscovite and microcline matrix. Rockbridgeite was reported from the Black Mountain quarry by Thompson et al. (1989, 1991) and Francis et al. (1993), but examination of the only specimen suggests it is mislabeled and is actually from the Red Hill quarry group.

Doloff (1936) wrote of "dufrenite" from the Oak Hill prospect, **Standish**: "It occurs in cavities within triphylite, and where the process of alteration has gone on long enough, the dufrenite alone remains. It is typified by botryoidal-like masses in tiny columns, has an olive green to leek-green color, a light green streak, and a hardness of about 4 on Moh's [sic] scale. It is usually associated with other vari-colored products of the alteration of the primary phosphates."

romanechite?

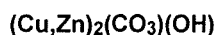


Bethel?; **Blue Hill?**; **Buckfield?** - *Bennett Q; TC?*; **Castle Hill?**; **Dover-Foxcroft?**; **Gardiner?**; **Hebron?**; **Hodgdon?** - *Westford Hill area; Linneus?* - *Stewart M; Lubec - Lubec Lead M; Mapleton - Higgins P; Newry?* - *Dunton Q, Scotty Q; New Sweden?* - *Ostlund farm P; Oxford?*; **Paris?**; **Penobscot?** - *Annear M; Phillips?*; **Rumford?** - *Black Mountain Q; Skowhegan?*; **South Berwick?**; **Sumner?**; **Topsham?**; **Winslow?** - *Winslow Tin M; T3R7 WELS?*; **T6R8 WELS?**; **T8R7 WELS?**

So few correctly identified psilomelane specimens were reported worldwide that the name was dropped in favor of the newer name romanechite. Romanechite is still used so indiscriminately that it is uncertain if this mineral is found in Maine. No X-rayed or chemically analyzed specimens are known from the state. Specimens of black and brownish black botryoids and stains from the Dunton quarry, **Newry** have been studied by Paul Moore (personal communication, 1973) and George Rossmann (personal communication, 1987) who found todorokite and a non-crystalline material, respectively. Resinous black botryoids from the Berry-Havey quarry, Poland have proven to be cryptomelane (this study). Many of the listings of Morrill and Hinckley (1959) and Morrill et al. (1958) probably refer to black "manganese" stains of unknown character. The only scientific report of Maine romanechite was made for the Bennett quarry, **Buckfield** (Landes, 1925): "Hard, black botryoidal crusts coating rhodochrosite proved to be psilomelane. The mineral is limited in its occurrence to the zone of weathering and even there it is quite subordinate to manganite, with which it is associated." No data given. Wells (1891) reported psilomelane from the Mount Rubellite quarry, Hebron. Psilomelane was translated to

equal romanechite(?) by Thompson et al. (1989, 1991) and as unqualified romanechite by Francis et al. (1993) without substantiation, but this species has not been verified from either the Black Mountain quarry, **Rumford** or the Bennett quarry, Buckfield.

ROSASITE



Brooksville - Callahan M

Rosasite was reported from the Callahan mine, **Brooksville** without description (Gregory, 1969). Rosasite forms light blue radially fibrous botryoids (to 3 mm) in clusters (to 1 cm) (Gardiner Gregory, personal communication, 1990). The crystals of rosasite are virtually touching to form a solid botryoidal surface, but the aggregates have a "fuzzy" appearance. Botryoids can be grouped individually, side-by-side, or one on top of another. Reticulated cerussite, with anglesite, hemimorphite, etc. can be associated. The mineral is found in veinlet surfaces in talcose schist matrix.

ROSCHERITE (Roscherite Group)



Buckfield? - Bennett Q

Roscherite was investigated by Lindberg (1958) who showed there was a wide chemical variation in the mineral. Ferraiolo (1982) distinguished between three different chemical variants: iron-rich, manganese-rich, and magnesium-rich, respectively. Zanzaziite (q.v.) is a magnesium-rich member of the roscherite group which has been recently named (Leavens et al., 1990).

Morrill et al. (1958) reported roscherite from the Bennett quarry, **Buckfield**, but no verified specimens are known. Some olive-brown platy crystals (to 1 mm) are found in subparallel vugs in massive rhodochrosite from the Bennett quarry. These crystals have been presumed to be roscherite. Specimen unavailable for study. Chemical analyses of other Maine roscherites indicate that they represent a new member of the group (see unknown mineral #3). A formal description is pending.

rose quartz - see description under quartz

rubellite (Tourmaline Group) = varietal name for red to pink tourmaline, usually elbaite

ruby silver?

Franklin - *Franklin Extension M*; **Sullivan** - *Sullivan M*

Ruby silver has been reported from several silver mines in Maine, but the reports are undoubtedly spurious and may have been represented by specimens from Nevada, etc. Freshly exposed massive ruby silver can be dark raspberry red to almost grape red-purple and appear black at first glance. Exposure of ruby silver to sunlight can darken the mineral to black.

A promotional article reported of the Franklin Extension mine, **Franklin** (MMJ, May 14, 1880): "This property is looking wonderfully well, showing at the surface a considerable quantity of gray copper, and also native and ruby silver." No specimens known.

Ruby silver from the Sullivan mine, **Sullivan** was reported by Kempton (1879) as well as (MMJ, January 28, 1881): "Mr. Geo. E. Harrington and a party of Boston gentlemen passed through Bangor Monday evening on their return trip to Sullivan. Mr. Harrington showed us a very magnificent specimen of Sullivan ore covered with ruby silver." It was later reported (MMJ, July 1, 1881): "The vein matter of the Sullivan lode is mostly quartz, much of which is tinted with chlorite, heavily charged with fine sulphurets of iron, and carrying, near the surface, argentiferous galena, zinc blende, sulphuret of copper and native silver. ... Ruby and native silver are found in greater quantities, minute particles of telluride of gold are occasionally visible, while the sulphurets are of finer grade and chlorides or horn silver and antimonial silver have made their first appearance at the mine." No specimens known. (the late Philip Foster (personal communication, 1965), a noted systematic collector from Dover, New Hampshire, looked for any specimens of Maine ruby silver for over 40 years without success.)

RUTHERFORDINE

UO_2CO_3

Newry - *Dunton Q*

Rutherfordine from the Dunton quarry, **Newry**: "... seems to have formed by the action of carbonated surface waters on hydrated lead uranyl oxides resulting from the alteration of uraninite crystals" (Fron del, 1956). No specimen of rutherfordine was located at Harvard University from Fron del's studies (1956, 1958c; Fron del and Meyrowitz, 1956). Worldwide rutherfordine is very pale yellow to almost white and consists of tiny (less than 1 mm) needle crystals and mats. The matrix can be uraninite itself, or it is sometimes interlayered in muscovite. (Rutherfordine is easily soluble in dilute acids with the evolution of carbon dioxide bubbles. This test is best done while viewing the material through the microscope. A needle can be used to pick up the suspected material and place it into a droplet of acid.)

RUTILE (Rutile Group)

TiO_2

Albany - *Songo Pond Q*; *Allsbury Formation slates* - **Hersey**, **Merrill**, **Moro**, **Mount Chase**, **Patten**; **Bethel**; **Blue Hill** - *Black Hawk M*; **Dedham** - *Brown Q*; **East Moxie** - *Black Narrows*; **Farmington** - *Sangerville Formation*; **The Forks** - *Black Narrows*, *Hill Q*; *Gulf of Maine*; **Kennebunk**; **Linneus** - *Drew Hill sulfide veins*; **Litchfield** - *Oak Hill boulder*; **Monmouth**; **Monson** - *Pond Q*; **Newry** - *heavy-mineral soil survey*; **North Haven** - *Southern Harbor A*; **Paris** - *Mount Mica Q*; *Rangeley Formation* - **Byron, TD**; **Rumford?** - *Black Mountain Q*; **Saint George** - *Clark Island Q*; *Smalls Falls Formation*; **Topsham** - *Consolidated #2 Q*; *Umbagog granodiorite* - **Magalloway**, **Upton**; **Union** - *Harriman P*; **Warren** - *Warren Nickel P*, *Starrett P?*; **Waterford**; **Woodstock** - *Koskala P*

Dale et al. (1906, 1914) reported that rutile is a common accessory mineral found in slate and phyllite and listed many minor occurrences. Rutile is an accessory in many rock types: e.g., Boone (1955) reported rutile as a common accessory of the fine-grained schists (Sangerville Formation) in **Farmington**. Smith (1923) and Burr (1939a) also reported a number of rutile occurrences.

Large (to 2 cm) v-twinning wrought-iron black rutile crystals have been found at the Songo Pond quarry, **Albany** (Jim Mann, personal communication, 1993). Some of the crystals are crudely formed while the largest twin has coarse surface corrugations of parallel growth rutile crystals. The core of the crystal is niobium- and tantalum-bearing while the surface crystals have a lower niobium and tantalum content (chemical analysis, this study).

Hitchcock (1862b) reported from **Bethel**: "Rutile in lengthened prismatic crystals." No specimens known.

Ekren and Frischknecht (1967) wrote of the Allsbury Formation slate, **Hersey**, **Merrill**, **Moro**, **Mount Chase**, and **Patten**: "Thin sections of three dark-gray and black slates from conductive belts reveal that the principal mineral is quartz; chlorite, sericite, and carbon occur in lesser amounts. Rutile (verified by X-ray) is abundant as tiny needles."

Black first and second-order bipyramidal rutile crystals (to 1 mm) are found embedded in muscovite-impregnated milky quartz at the Black Hawk mine, **Blue Hill**. The mineral varies in a few cases from untwinned acicular crystals (to 2 mm) in small quartz crystal vugs, to brown or black "twisted" vertically striated unteminated crystals (to 2 mm) embedded in milky quartz, to black elongated crystals with irregular first-order bipyramids with first and second-order prisms.

Smith (1923) reported of the Brown Granite quarry, **Dedham**: "The rock consists, in descending order of abundance, of potash feldspar (orthoclase and microcline), smoky quartz, soda-lime feldspar (oligoclase), and black mica (biotite), together with accessory zircon, apatite, and secondary magnetite and chlorite.

The quartz contains needles of rutile." Smith (1923) was more specific of the granite of the Clark Island quarry, **Saint George**: "The quartz contains hairlike crystals of rutile."

Valentine and Commeau (1989) reported on fabulous quantities of rutile in the clay and silt fractions of Gulf of Maine sediments.

Smith (1901) wrote of the North Haven Greenstone "just west of the head of Southern Harbor," **North Haven**: "Some of the sections contain considerable quantities of fine needles of rutile, .005 to .01 mm. in length, golden yellow in color."

Sweeney and Salvato (1976) listed rutile from the Mount Mica quarry, **Paris** without substantiation. No specimens known.

Bailey (1893) reported of the Black Mountain quarry, **Rumford**: "Rutile (small brown crystals)," but the absence of confirmed rutile should be noted for this locality. The mineral was likely manganotantalite, which can very much mimic rutile in appearance.

"Rutile takes the place of ilmenite as the Ti oxide phase in the sulfide-rich units like the Smalls Falls Formation" (Charles Guidotti, personal communication, 1991).

The Consolidated #2 quarry, **Topsham** has produced a few specimens of black rutile needles (to 1 mm) (King, 1992a,

1993a,b). The rutile typically occurs as flat mats of crystals with triangular twinning, or 60° "V's" in vugs in etched albite, sericite and bipyramidal anatase. Brown bladed brookite crystals are associated.

In **Union** and **Warren**: "Rutile occurs as a decomposition product of ilmenite and as fine needles in quartz. Although much of the decomposition of ilmenite to rutile appears rather irregular, there is a tendency for rutile to form along grain boundaries, within fractures, or along crystallographic directions of ilmenite... A myrmekitic intergrowth of chalcopyrite and rutile is commonly observed in altered ilmenite grains" (Rainville and Park, 1976).

Dark orange twinned rutile crystals (to 5 mm) are found epitaxially oriented on large hematite crystals (to 1.5 cm) (HU unnumbered) from an unspecified area, **Waterford**. It has been presumed that the ilmenite and rutile had occurred in veins within a "granite."

Dark gray-lavender untwinned rutile needles (to 2 mm) are found in vugs in chamosite and microcline pegmatite at the Koskala prospect, **Woodstock**.

Lapham (1882) noted rutile among Nathan Perry's list of the minerals of Woodstock.

S

SAFFLORITE

CoAs₂

Brooksville - *Callahan M (= Harborside M)*

Park and Bastille (1973) reported safflorite without description as a "subordinate" part of the ore at the Callahan mine, Harborside, **Brooksville**. The safflorite undoubtedly was found as microscopic silvery metallic grains embedded in sulfide matrix. The list of species reported by Park and Bastille (1973) included: pyrite, chalcopyrite, sphalerite, galena, cubanite, pyrrhotite, mackinawite, chalcocite, marcasite, valeriite, arsenopyrite, and bismuth. Bouley and Hodder (1984) described the main ore and its intergrowths from the Callahan mine, but cited only some of the rarer minerals reported by Park and Bastille (1973), leaving the reader the impression that the lack of discussion meant that the assemblage of rare minerals, including safflorite, was not observed by them.

sagenite = reticulated rutile needles

Rangeley Formation - **Byron, TD**; *Umbagog granodiorite* - **Magalloway, Upton**

Sagenite is a textural term indicating reticulated rutile needles and rods, usually as inclusions of microscopic size.

Guidotti (1974) wrote of the Rangeley Formation, **Byron** and **TD**: "Minor chlorite, present in a few specimens from the l. s. [lower sillimanite] zone has anomalous blue colors (this demonstrates low Mg/Fe, as confirmed by several probe analyses), inclusions of sagenitic rutile, and gradational relations with biotite plates, suggesting a retrograde origin for this chlorite."

Green (1964) noticed sagenite in the Umbagog granodiorite, **Magalloway** and **Upton**: "In some specimens [biotite] is partly replaced by green chlorite and sagenitic rutile."

sahlite (Pyroxene Group) = ferroan diopside

Bethel; **Cornish** - *Route #5 road cut? Berry Ledge?*; **Parsonsfield**; **Rumford** - *Rumford Falls A, Rumford Point A*

Sahlite is a synonym for diopside. It was first reported in Maine by Jackson (1837a, 1838a, 1839) at the Rumford Falls area and Rumford Point area, **Rumford** and the report undoubtedly was made on dark green cleavages frozen in rock. Bouvé

(1867), discussing mineral occurrences in Maine and elsewhere, explained: "The Pyroxene is in some cases of the variety Sahlite, and in some instances Pargasite and Scapolite accompany the other named minerals."

Fisher (1941) wrote of **Cornish**: "Six miles south of Cornish ... lime-silicate gneiss, with abundant epidote, sahlite, and diopside, and well-developed crystals of vesuvianite and brown garnet, crops out along the Limerick-Cornish highway in an area mapped as Berwick [Formation] by Katz."

SAMARSKITE-(Y)

(Y,Ce,Pb)(Nb,Ta,Ti)₂O₆

Freeport?; **Topsham** - *Consolidated #2 Q, East Standpipe Hill P, Russell Brothers Q, Square Pit, Standpipe Hill Q, Swamp #1 Q, William Willes #3 Q, Yedlin locality*

Samarskite has been labeled on a specimen (Bjareby #4550) as coming from **Freeport**. The specimen is identical to the Yedlin locality, Topsham specimens. No other specimens are known, so this specimen was perhaps purchased in Freeport and incorrectly labeled.

Standpipe Hill and nearby areas in **Topsham** are the only places that samarskite-(Y) has been verified for, so far, in Maine. Due to the mutual proximity of these small quarries and prospects, the specimens known are essentially identical and one description will suffice for all. It is inappropriate, however, to label specimens simply *Standpipe Hill* rather than using the individual quarry names, when they are known. The mineral is relatively abundant and is usually found in prismatic, rectangular crystals to about 1-2 cm. (The crystal shape is reminiscent of a thick, traditional picket fence lath.) The crystals are frozen in reddish brown stained microcline along the margins of biotite cleavages and are revealed when the feldspar is cracked open. Yedlin (1942) pointed out: "The feldspar in the vicinity of the monazite and samarskite loses its vitreous lustre and becomes a bit chalklike, dropping about 1 degree in hardness."

A thin earthy red-brown film generally coats the crystals, which are resinous dark brownish black to black in their centers. Samarskite-(Y) has a smooth conchoidal fracture and is very brittle. Additional associated minerals include almandine crystals (to 2 cm), prismatic red-brown monazite-(Ce) crystals (to 3.5 x 2.5 cm), and, rarely, long needles of allanite (to 3 x 0.2 cm). The largest samarskite-(Y) crystals (to 5 cm) from the area come from the East Standpipe Hill quarry (actually two small pros-

pects) about 100 meters east of the standpipe (water tower). The so-called Yedlin locality (also called the samarskite locality) on the lower western slope of Standpipe Hill was named because Neal Yedlin (1942) wrote about the small quarry there. It was a prolific producer of samarskite-(Y). (The mineral name is pronounced "sam - ars - kite - why".) Stern (1950) verified the identity of Topsham samarskite (HU#92510). Lane (1937) reported a chemical analysis by Gonyer on a sample from "near the standpipe on top of the hill."

sanidine (Feldspar Group) = disordered K-feldspar

Monticello - Sugar Loaf hill A; **T5R9 WELS** - Traveler Mountain A; **York** - Cape Neddick gabbro

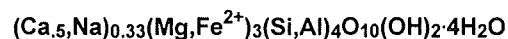
Sanidine is a type of K-feldspar which has a great degree of elemental disorder. The disorder in the distribution of chemical constituents can be caused by high heat, rapid growth, etc. Barth (1969) noted: "Orthoclase as a name may be used for any monoclinic K-feldspar including sanidine." Barth (1969) apparently based his statement on the work of Wright and Stewart (1968) who distinguished a continuous variation in disorder from orthoclase to sanidine even though Wright and Stewart (1968) designated "High Sanidine," "Low Sanidine," and orthoclase proper.

Pavlidis et al. (1965) reported sanidine as phenocrysts in felsites, mostly rhyolite, on eastern Sugar Loaf, **Monticello**.

Woodard (1968) noted the presence of high sanidine and anorthoclase in the Cape Neddick gabbro, **York** and in its contact zone in the Kittery Formation.

Neuman and Rankin (1980) noted that sanidine, the disordered variety of microcline, occurred as phenocrysts in several samples of the Traveler Rhyolite, in the Traveler Mountain area, **T5R9 WELS**.

SAPONITE (Smectite Group)



Edmunds - Whiting Bay shore; **Edmunds and Leighton Formations** - **Charlotte**, **Jonesport**, **Pembroke**; **Pembroke** - U.S. Route #1 road cuts; **Perry** - Gin Cove A, Loring Cove A

Gates and Moench (1981) reported saponite as an alteration of olivine in a Whiting Bay shore outcrop of basalt east of Little Mountain, **Edmunds**, as well as in basalt in a U.S. Route #1 road cut north of Oak Hill and in a diabase dike in a U.S. Route #1 road cut near the Pennamaquan River and Crow Brook (both in **Pembroke**).

Light gray-green clayey saponite lines amygdulites filled by calcite and zeolites, as well as pseudomorphs of phenocrysts, in basalt at the Gin Cove and Loring Cove areas, **Perry**. Hinckley (1953) noted: "One of these minerals, of which I sent you only a small portion of a nodule, has recently aroused my interest

because of its peculiar behavior. When found it was olive-green and very soft - almost like a lump of cheese. It filled cavities in basalt, and was found below the high tide line on the shore (at Perry). By the time I had sent it to you it had become hard enough so that it could barely be scratched by finger nail; but otherwise its appearance had not changed. Two weeks ago I discovered that my specimens had all turned chalky white. Since I wanted to have some of this material in the original form, I went to the place this is found and again located some rock containing these nodules. I trimmed down a few specimens and laid them on a rock... In a few minutes... I was greatly surprised to find the first lot had already turned hard and become chalky white on the surface. ... I finally managed to get several rocks home, but thus far I can find no way to preserve them in the natural state in which they occur other than by keeping them under water. ... First of all, is the mineral serpentine? Or is it saponite?" In an editorial comment, *Zodiac* added (Hinckley, 1953): "It seems only too evident that Mr. Hinckley's mineral is saponite..." Dillingham (1955a) found additional saponite. The basalt member of the Perry Formation outcrops between Lewis and Gleason Coves, Perry. Gates and Moench (1981) wrote: "One altered sample ... from the interior of a sill is coarse grained and composed of albite to sodic oligoclase, prehnite, sunbursts of vividly pleochroic blue-green to straw-yellow pumpellyite (showing anomalous interference colors), epidote, deep-green chlorite, magnetite, augite, a few spots of calcite, and sparse saponite possibly after olivine."

Gates and Moench (1981) wrote of the Edmunds and Leighton Formations exposed in **Pembroke** and **Charlotte**, and irregularly exposed to **Jonesport**: "Some basalts of the Edmunds and Leighton Formations have sparse phenocrysts of clinopyroxene as well. Olivine is uncommon, but sparse pseudomorphs of saponite(?) after small euhedral phenocrysts of olivine were found in two flows from the Edmunds Formation. ... Amygdulites composed variously of chlorite, quartz, calcite, and epidote are common, particularly at the base and tops of flows."

saussurite = alteration of plagioclase by a member of the epidote group

Cutler - volcanic rocks; **Dennys Formation** (Washington County) - andesite dike; **Flagstaff Lake pluton** - **Coplin**, **Dallas**, **Davis**, **Eustis**, **Jim Pond**, **Lang**, **Rangeley**, **Stetsontown**, **Tim Pond**; **Moosehead Lake A**; **Patch Mountain Member of the Sangerville Formation and Berry Ledge Formation** - **Greenwood**, **Norway**; **York** - Cape Neddick A

Saussurite is an alteration of plagioclase which consists of a mixture of epidote + albite + calcite.

Gates (1961) wrote of the extensive alteration of volcanic rocks in the **Cutler** area, including basalt, volcanic agglomerates, tuffaceous breccias, keratophyre, etc. The alteration of the rocks is expressed by the abundant and highly conspicuous formation of epidote. The replacement of plagioclase by epidote results in a mixture called saussurite. In several cases, Gates (1961) calls

this replacement process epidotization and in other cases saussuritization.

Gates and Moench (1981) noted: "The andesite dike that intrudes the Dennys Formation, has euhedral phenocrysts of saussuritized plagioclase, and epidote pseudomorphous after phenocrysts of pyroxene(?). ... The basaltic andesite at Mount Tom, like most basalt and the basaltic andesite in the Eastport Formation, is porphyritic. Saussuritized phenocrysts of labradorite are set in an intergranular matrix of small euhedral feldspar laths, epidote grains, chlorite, and abundant magnetite."

Boudette (1991) reported saussurite in the Flagstaff Lake pluton gabbro and troctolite, **Coplin, Dallas, Davis, Eustis, Jim Pond, Lang, Rangeley, Stetsontown, Tim Pond**: "... common saussuritization and sericitization of plagioclase; almost half the rocks contain variable but minor amounts of clinozoisite, epidote, chlorite, and ferrocarbonate."

Guidotti (1965a) noted of the Patch Mountain Formation (now a member of the Sangerville Formation), **Greenwood and Norway**: "Zoisite is locally present in small amounts and appears to be an alteration of the calcic plagioclase." Regarding the Berry Ledge Formation: "The relations of zoisite suggest that it may be a retrograde product of calcic plagioclase." In one instance, Guidotti (1965a) described the alteration in the word reaction: "Ca-plagioclase -- saussurite + calcite".

Hurley and Thompson (1950) noted of Silurian-Devonian rocks west of the Moosehead Lake area: "All of these rocks altered, ... The ferromagnesian minerals are largely altered to chlorite and the plagioclase to a conspicuous saussurite."

Haff (1939) noted saussuritized dikes from Cape Neddick, **York**: "In less severely altered lamprophyres, residual areas of turbid, zoisitized plagioclase and irregularly dispersed prismatic hornblende and altered augite are seen." While "zoisitized" may have been used in a specific way to reserve saussurite for restricted usage, the process of saussuritization was clearly indicated and Haff (1939) wrote of diabase in York: "Some, usually the more fine grained, have been nearly completely saussuritized with the preservation of only occasional remnants of the original mesostasis."

scapolite group - see marialite and meionite

Casco - Chute P; **Cornish** - Berry Ledge, Day Hill P; *diabasic and basaltic dikes* - **Easton, Fort Fairfield, Mars Hill, Presque Isle; Fairfield; Greenwood** - *pegmatite contacts*; **Minot** - *Pitts-Tenney P*; **Newfield; Norway; Parsonsfield; scapolite isograd** - **China, Windsor**

Scapolite has been reported from a variety of locations as a component in metamorphic rocks. Most of the specimen locations will be discussed under the species meionite and marialite. Guidotti (1965a) noted in the Patch Mountain Formation (now a member of the Sangerville Formation), **Greenwood and Norway**: "Scapolite is common in some sections and its fresh, clean appearance suggests that it is primary." In the Berry Ledge

Formation: "A few specimens have scapolite and/or microcline in notable amounts."

Ferry (1976) mapped a scapolite isograd in **Fairfield**: "The scapolite isograd is probably limited to the zone around the biotite granodiorite, because the granodiorite magma was hot enough to produce scapolite in its contact aureole whereas the quartz monzonite was not." Ferry (1976) reported that the composition of the scapolite was meionite with $Ca/(Ca+Na) \approx 0.75$.

Pavlidis (1978) noted scapolite(?) in diabasic and basaltic dikes in **Easton, Fort Fairfield, Mars Hill, and Presque Isle**.

SCHAFARZIKITE

FeSb₂O₄

Linneus - *Drew Hill sulfide veins*

Schafarzikite is a rare mineral and Linneus might be the third or fourth known locality of the species in the world. Schafarzikite in powdery red coatings occurs intergrown with red powdery metastibnite coating fractures in fine-grained stibnite in the sulfide-bearing veins on Drew Hill, **Linneus**. The combination has been mistaken for kermesite. Associated minerals include yellow powdery coatings of valentinite intermixed with kaolinite and occasional tiny (1 mm and less), nearly colorless sulfur crystals.

SCHEELITE (Scheelite Group)

CaWO₄

Blue Hill - *Blue Hill Falls, Long Island area, Trio M*; **Byron** - *East Branch Swift River A*; **Cooper** - *American Molybdenum Company M, Calais Mining Company M*; **Cornish** - *Berry Ledge L, Day Hill A, Pease Mountain A*; **TD** - *Mountain Brook A*; **Farmington** - *calc-silicate rock, Route #2 road cut*; **Franklin?**; **Greenwood** - *Tamminen Q*; **Newfield** - *Davis Farm M, Piper Hill P*; **Norway**; **Paris** - *Mount Mica A*; **Parsonsfield** - *Wiggin Mountain A*; **Phippsburg** - *The Basin L*; **Porter** - *Porter Lead M*; **Raymond** - *Camp Hinds A*; **Roxbury** - *Partridge Peak A*; **Sanford** - *Webster P, Goodall Farm L*; **Upton** - *unnamed hill*; **T10SD** - *Catherine Hill Q*

Scheelite is an inconspicuous mineral. In most cases, it can pass for milky to smoky quartz or other similar-appearing minerals and is rarely crystallized. The high specific gravity of the mineral frequently goes undetected, due to the usual small grain size compared with the matrix. Scheelite usually strongly fluoresces blue-white under short-wave ultraviolet light, but can grade to cream-yellow. Scheelite is virtually always non-fluorescent under long-wave ultraviolet light. Fluorescence color alone can not distinguish scheelite from powellite as their "characteristic" colors can overlap.

Bipyramidal gray, matte-lustered scheelite crystals (to 4 mm) are found in vugs in pegmatitic granite from Long Island, Blue Hill Bay, **Blue Hill**. The vugs are lined with Carlsbad twinned and etched microcline crystals (to 4 mm), bladed albite crystals (to 3 mm), pseudohexagonal muscovite crystals (to 3 mm), clear, etched slightly smoky quartz crystals (to 3 mm), etched purple fluorite grains, and tiny clinocllore crystals (to 1 mm), along with clear to yellowish brown beryl crystals (to 2 mm) frozen in matrix. Hinckley (1966) wrote of the scheelite on Long Island: "... one mine was located near the north end of this island ... chalcopryrite, pyrite, arsenopyrite, and apatite have been reported... Scheelite crystals and molybdenite have been obtained as micromount specimens."

Byron scheelite deposits have been described (Trefethen et al., 1955): "Traces of scheelite have been found associated with small zoned lenticular bodies of quartz, diopside, garnet, and iron sulfide in the bed of the Swift River near the town line separating Houghton from TWP[]D. These lenses or pods consistently bear a zonal structure but the sequence of zoning may vary. They are more commonly found parallel to the foliation of a staurolite-garnet schist in which the twinned porphyroblasts of staurolite are marginally or completely altered to chlorite. The pods vary in length from six inches to eight feet and are much more massive than the surrounding schist. ... A half inch grain of scheelite was found on the Swift River in the core of one of these pods about 1/8 mile above its confluence with Mott Stream. About 1/2 mile further upstream a larger amount of scheelite is present in a similar type of rock, but occurs as fine disseminated grains ranging from pinpoint size to 3/8 inch across. This mineral also occurs in this outcrop as a 1/8 inch vein cross cutting the pod at a high angle. An assay made on material from this locality revealed a tungsten content of 0.26% which is quite a bit below the commercial grade of ore." A second locality in Byron was also described: "The site is approximately 1/2 mile up the second south flowing tributary above the mouth of the East Branch of the Swift River..." however, no scheelite was found in place there - only loose drift boulders containing scheelite. Additional scheelite localities mentioned included Mountain Brook, **TD** and Partridge Peak A, **Roxbury**. (Note: milky white scheelite can be found in black sand concentrates in gold pans.)

Scheelite from the Day Hill locality, **Cornish** is scarce. Trefethen et al. (1955) visited the locality and found only one mass (5 cm across) in calc-silicate rock. A well-formed, white, 2.5 cm bipyramidal crystal was found in calcite in a calc-silicate boulder from a rock fence nearby. Some scheelite has been found from pinpoint size upwards at Berry Ledge, Cornish along Route #5. Pease Mountain was also described by Trefethen et al. (1955): "The skarn rock appears to be a thin dip slope erosional remnant being only 3 to 5 feet thick at the most resting on top of a quartzose gneiss. The skarn rock can be followed for about 75 feet along the strike ... parallel to the mountain side and for about 30 feet down the dip. ... Present in the skarn rock are typical skarn minerals such as diopside, grossularite garnet (both massive and euhedral forms), and crystals of idocrase. Scheelite occurs as

disseminated crystals a fraction of an inch in diameter. Most specimens showed at least a trace of scheelite." Carpenter (1951a) first noted the locality.

Farmington has several scheelite occurrences: "The first of these is approximately two miles north of Farmington Falls on the West Farmington - Farmington Falls road, and the second one mile north of Farmington on Route Two. At the first locality, the scheelite occurs as minute grains disseminated sparsely in the lime silicate rock. At the second locality, the scheelite is associated with one inch veins of coarser grained calcite and zoisite" (Trefethen et al., 1955).

Tamminen (1952) reported of the Tamminen quarry, **Greenwood**: "Some of the new minerals we have found are scheelite and vesuvianite next to the contact on the south wall..."

Trefethen et al. (1955) reported on minor scheelite occurrences on the northern slope of Piper Hill, **Newfield** as well as the Davis Farm silver mine, near Shady Knook [sic], Newfield.

Seaman (1975d) reported scheelite from the Mount Mica area, **Paris** and though the article featured pegmatites, the scheelite was undoubtedly from the contact zone with the country rocks.

Scheelite from The Basin locality, **Phippsburg** is massive (to several centimeters) and cream white. It is intergrown with quartz, calcite, pyrite, diopside, grossular, etc.

Scheelite crystals and grains (to 5 x 7 cm) are found at the Webster prospect, **Sanford** as well as the 200 meter prospect and is found in notable quantities at the 600 meter prospect. The scheelite varies from milky white to cloudy gray masses to occasionally rounded crude bipyramidal crystals (to 2 cm). The Sanford scheelite fluoresces blue-white to cream-colored in short-wave ultraviolet light and is non-fluorescent in long-wave ultraviolet light.

Moench and Pankiwskyj (1988) noted scheelite in Ordovician calc-silicate rocks from the southwestern summit area of a hill north of Cedar Brook and immediately west of East B Hill, **Upton**.

Vitreous clear to cloudy bipyramidal scheelite crystals (to 3 mm) are found in vugs in tan-stained albite with clinocllore at the Catherine Hill molybdenite quarry, **T10SD**. The locality was noticed by Hess (1917).

schiller spar - should = enstatite; see zoisite

Newry

SCHOEPITE / METASCHOEPITE

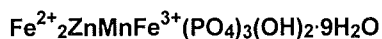
$\text{UO}_3 \cdot 2\text{H}_2\text{O} / \text{UO}_3 \cdot 2 \cdot x\text{H}_2\text{O}$

Poland - *Berry-Havey Q*

At the Berry-Havey quarry, **Poland**, bright resinous milky yellow to translucent amber schoepite/metaschoepite forms pseudomorphs after cubic to cubo-octahedral uraninite crystals

(to 3 mm) embedded in cleavelandite or green manganian fluorapatite. The resinous yellow schoepite frequently has a black core of relict uraninite. Schoepite is pronounced as though it was spelled "scoopite."

SCHOONERITE



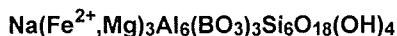
Newry - Bell Pit, Dunton Q, Nevel Q

Fibrous to splintery, salmon-brown schoonerite needles in matted jackstraw clusters (to 2 mm) identical in appearance to some schoonerite from the Palermo #1 quarry, Groton, New Hampshire are found in sphalerite-bearing crystallized tan to brown siderite from the Bell Pit, **Newry**.

Dunton quarry, Newry schoonerite occurs as orange-pink to light orange-brown matted clusters of fibrous crystals (to 0.1 mm) in vugs in fairfieldite in blue elbaite eyes. (Newry locations verified by chemical analysis and XRD)

Schoonerite from the Nevel quarry, Newry occurs as tiny (to 0.5 mm) jackstraw thin-bladed pearly brown crystals in vugs in otherwise tightly foliated white fairfieldite and minor vivianite in quartz matrix.

SCHORL (Tourmaline Group)



Albany - Bumpus Q, Donahue P, Johnson Q, Pingree Ledge Q, Scribner Ledge Q, Songo Pond Q, Stearns P, Wardwell Q; **Auburn** - Greenlaw Q, Maine Feldspar Q, Pulsifer Q; **Augusta** - China Road Granite Q; **Bowdoin** - Coombs Q; **Bowdoinham** - West Booker Q; **Brunswick** - LaChance Q; **Buckfield** - Bennett Q, Bessey Q, General Electric Q, Westinghouse Q; **Byron**; **Calais** - U. S. Route #1 road cut Red Beach; **TD** - Bemis Stream P; **TE**; **Falmouth**; **Farmingdale** - tourmaline granite; **Farmingington**; **Freeport** - Taylor Q; **Georgetown** - Consolidated Q; **Greenwood** - Emmons Q, Eagle Point (Patch Mountain), Harvard Q, Heikkinen Q, Mustonen Ledge P, Nubble Q, Tamminen Q, Tiger Bill Q, Waisanen Q; **Hallowell**; **Hartford** - Ragged Jack Mountain L; **Hebron** - Hibbs Q, Mount Rubellite Q; **Leeds**; **Lewiston** - Cloutier Q; **Lisbon**; **Litchfield** - Dennis Hill A; **Mason**; **Mechanic Falls**; **Mexico** - Gogan P; **Minot** - LaFlamme Q, Sturtevant Q; **Monmouth**; **Mount Vernon**; **Newry** - Dunton Q, , Martin P, Nevel Q, Scotty Q; **North Yarmouth**; **Norway** - BB # 7 Q, Tubbs Ledge P; **Orland** - Route #175 road cut; **Oxford**; **Paris** - Hoopers Ledge Q, Lower Hoopers Ledge P, Mount Marie Q, Mount Mica Q, No. 4 Hill P, Slattery Q, Whispering Pines Q; **Peru**; **Phippsburg** - Popham Beach A, Thomas Q; **Poland** - Berry-Havey Q; **Portland** - Rocky Hill-Municipal Q, Woodfords Q; **Pownal** - Hinckley P, Lower Tryon Mountain Q, Upper Tryon Mountain Q; **Rumford** - Black Mountain Q, Goddard Ledge Q (= Ford Hill Q), Red Hill Q; **Sanford?**; **Stoneham** - Barbour P

(= Melrose Farm outcrop), Lord Hill Q; **Topsham** - Consolidated #1 Q, Fisher Q, Porcupine Hill Q, power line L, Tarbox's Q; **Vienna**; **Waterford**; **Wayne**; **West Bath**; **West Paris** - Perham Q; **Windham** - Foster Corner A; **Woodstock** - Koskela P; **Woolwich** - Trott Cove Q

Schorl crystals are widely available in small quantities in Maine's pegmatites. Schorl is not generally found in schists. Massive schorl is found at virtually every Maine pegmatite, but terminations make the crystal. Crystal sections to 35 cm are known. Bastin (1910) explained: "Much of the tourmaline of pegmatite deposits is black and opaque and looks much like shiny anthracite coal, though it is much harder. This variety contains iron, is without commercial value, and must be carefully separated from feldspar in mining. ... Black tourmaline is only locally abundant and can be easily avoided in quarrying." Iron minerals in general greatly diminish the quality of feldspar for ceramic uses. Bastin (1910) reported schorl crystal sections of large size: 61-91x30 cm from **Georgetown** and 13x30 cm from **Auburn**. Schaller (1912b) reported on schorl from Auburn, and Ward (1932) presented new optical data for schorls from Auburn, Hebron, Newry, Oxford, Paris, and Stoneham. Riggs (1889) reported chemical analyses of schorls from Black Mountain, **Rumford** and Mount Mica, **Paris**. Some dark indicolite crystals could be schorl as well as some greenish black tourmaline.

Early Mount Apatite area, **Auburn** triangular schorl crystals (to 5 x 2 cm) were found in quartz seams (to 7 cm). The schorl crystals were lustrous and symmetrical and had numerous fine striations along the length of the crystals. The crystals were frequently closely spaced, but not touching, and grew in a flat planar pattern.

Schorl crystals (to several cm) are found in aplite at the Bennett quarry, **Buckfield**. Poorly formed schorl crystals (to 2 cm), with poikilitic quartz, are nearly homogeneously distributed in the Bennett quarry aplite. Particularly large schorl crystals (to 10 x 7 cm) came from the General Electric quarry, Buckfield.

The U. S. Route #1 road cut in Red Beach, **Calais** produced interesting schorl crystals (to 5 mm) frozen in brick-red microcline and greenish yellow muscovite granite. The prismatic crystals had both first- and second-order prisms, small first-order pyramids as other unidentified pyramids as well as "c" pedions. The "c" pedions had conspicuous triangular striations.

Sharp schorl crystals (to 4 cm) are found embedded in almandine-albite-schorl matrix at the Harvard quarry, **Greenwood**. The almandine crystals (to 1 cm) are also well-formed.

Schorl at the Nubble quarry, Greenwood is scarce, but very fine lustrous, smooth, and symmetrical crystals were found (to 8 cm). The crystals show simple positive pyramids along with first- and second-order prisms.

Emmons quarry, Greenwood schorl occurs abundantly as elongated black crystals (to 15 x 5 cm) without rational faces. The often irregularly tapered crystals are multifaced, frequently with a satiny luster indicating light etching, and look as though they were "whittled" or hand-hewn. Additional Emmons quarry

schorl in albite pegmatite can consist of these tapering shapes which abruptly end at their widest point and then continue as closely spaced spindly extensions (to 7 x 0.8 cm) encased in quartz. These closely spaced "pendants" resemble the dangling rods on wind chimes.

Sampter (1946) wrote of Greenwood: "Bought the large, perfect black tourmaline crystal from Matti Waisanen, which I have admired in his house for several years. It is about 1 foot long, by 5 inches in diameter and unusually hard and solid for a Maine black tourmaline and is a complete unbroken crystal, with perfect sides and one perfect termination." Neil Wintringham (personal communication, 1992) reported: "The Sampter schorl went eventually to Joseph D'Agostino of the New Jersey Mineral Society." The whereabouts of this specimen is unknown. The discovery locality was apparently the Mustonen Ledge prospect on Noyes Mountain (Neil Wintringham, Nestor Tamminen, personal communication, 1992).

Eagle Point on Patch Mountain, Greenwood has produced excellent schorl crystals (to 5 cm) in gray quartz seams.

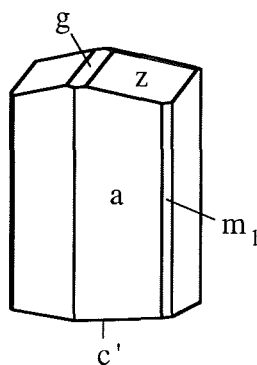
Small blocky schorl crystals (chemical analysis and XRD, this study) are found as rare 3-4 mm crystals with nepheline, albite, cancrinite, etc. at Dennis Hill, **Litchfield**.

Doubly-terminated schorl crystals (1-2 cm) have been found frozen in aplite at the Nevel quarry, **Newry**.

Perkins (1934) wrote of schorl from **Orland**: "Highway No.175 leading south from Orland passes through the eastern extension of the Mt. Waldo granite mass. About four miles south of Orland vill[age]. Fresh exposures of the granite appear in a roadside cut near the top of a small hill. One joint surface shows a splendid development of black tourmaline suns. Each cluster being from three to six inches in diameter. In general appearance and characteristic they closely resemble the Rocky Hill, Portland occurrence of the same mineral."

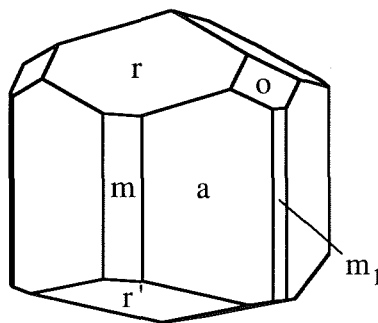
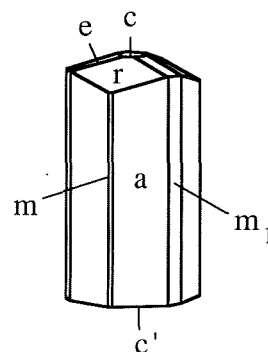
Mount Mica quarry, **Paris**, produced abundant schorl, but few terminated crystals. Terminated crystals show about equally developed first- and second-order pyramids and prisms giving very attractive complexly formed crystals. This material shows dark brownish green internal reflections. The crystals were found frozen in quartz-muscovite matrix. Bastin (1911) reported: "Black tourmaline or schorl, which is the most abundant iron-bearing mineral present at the quarry, occurs in prismatic crystals, mostly compound, many of which are a foot in length and 4 to 5 inches in diameter. A few having a length of 2½ feet were seen by the writer, and one 4 feet in length is described by Hamlin [1895]." A few well-terminated schorl crystals (to 8 cm) were found frozen in quartz at the Mount Marie quarries, **Paris**. The Whispering Pines quarry, **Paris** has produced some exceptional schorl crystals frozen in quartz. One particularly enormous crystal (to 20 x 7 x 7 cm) is known. Schorl crystals (to 15 x 4 cm) occur in quartz and microcline matrix at the Number 4 Hill quarry, **Paris**.

Joint surfaces in granite from the Rocky Hill quarry (Municipal quarry), **Portland** can have closely spaced "suns" of acicular schorl (to 7 cm in diameter).

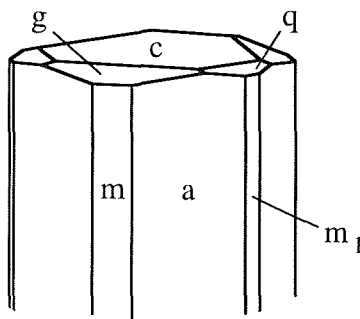
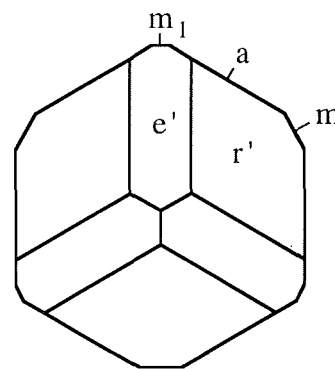


Tryon Farm P, Pownal

Mount Marie Q, Paris



Mount Mica Q, Paris

View along $[00\bar{1}]$,
Mount Mica Q, Paris

Barbour P, Stoneham

Schorl

The largest terminated schorl crystal (16 x 16 x 16 cm) from Maine is probably from the Porcupine Hill quarry, **Topsham** (HU 92331). The crystal is free of matrix and has a "c" face and relatively small pyramid faces. The prism is deeply striated along its length. Wheeler and Wheeler (1878) noted of tourmaline in Topsham: "Large masses are found at Rocky Hill. Fine, large, perfect hemimorphic crystals are found at Tarbox's quarry, Topsham. Brown tourmaline is found at New Meadows, near the railroad bridge."

An excellent brilliant terminated schorl crystal (to 5 x 1 cm) in granulated smoky quartz apparently came from the Eddie Koskela Farm quarry on a tributary of Bog Brook several hundred meters south of the Koskela road, **Woodstock** (Neil Wintringham, personal communication, 1992).

schorlite = obsolete spelling of schorl

schrötterite = a mixture

Greenwood? - *Harvard Q*

Schrötterite is an ill-defined clayey alteration of microcline. The original schrötterite has proved to be a mixture of halloysite and variscite. The specimen so labeled from the Harvard quarry, **Greenwood** (HU collection) appears to be a sericite replacement of microcline.

SCOLECITE (Zeolite Group)

$\text{CaAl}_2\text{Si}_3\text{O}_{10}\cdot 3\text{H}_2\text{O}$

Windham - *Mallison Falls A*

Snow white, flat-lying, radial groups (to 5 mm) of scolecite occur lining fractures in biotite-quartz gneiss at the Mallison Falls area, **Windham**.

SCORODITE

$\text{Fe}^{3+}\text{AsO}_4\cdot 2\text{H}_2\text{O}$

Georgetown - *Consolidated Q*; **Greenwood** - *Emmons Q*; **Hebron?** - *Hibbs Q*; **Hollis** - *Hollis Center road cut*; **Minot?** - *LaFlamme Q*; **Moose River?** - *Heald Pond A*; **Paris** - *Mount Mica Q*; **Standish** - *Oak Hill road cut, Breakheart Hill A*; **T12R8 WELS** - *Bald Mountain A*

Though many scorodite occurrences are listed for Maine, few verified specimens are known. Most so-called scorodite specimens appear to be thin yellow damourite coatings on löllingite or arsenopyrite. The damourite would be somewhat "sectile" rather than crystalline to earthy.

Morong (1990) wrote of the Consolidated quarry, **Georgetown**: "Scorodite as occasional pale-green scoriaceous crusts on löllingite."

Scorodite occurs as thin gray-green films and stains on löllingite plates in cleavelandite at the Emmons quarry, **Greenwood**.

Morrill et al. (1958) listed scorodite from the LaFlamme quarry, **Minot**. No specimens known.

Herbert Haven noted in his diary for July 30, 1938 (Morrill, 1966): "On Omas Ellis' place on Heald Pond, north of Jackman [**Moose River**], algae ironstone is found as well as scorodite - a brown and green alteration of arsenopyrite and [is] an iron arsenate."

Pale gray resinous to dull coatings and botryoids in vugs in löllingite and albite from the Mount Mica quarry, **Paris** have proved (this study) to be scorodite. Yellow-green damourite can be associated.

Dolloff (1936) reported scorodite as an alteration of löllingite from Breakheart Hill pegmatite and a road cut on Oak Hill, **Standish**: "This ... is found associated with löllingite. This is particularly noted in surface exposures where the appearance of a black rusty area indicates the presence of underlying löllingite." The criteria expressed better fit limonite. Dolloff (1930) noted scorodite as an alteration from a Hollis Center road cut, **Hollis**. No specimens seen.

SCORZALITE (Lazulite Group)

$(\text{Fe,Mg})\text{Al}_2(\text{PO}_4)_2(\text{OH})_2$

Newry - *Bell Pit, Nevel Q, Scotty Q?*

Scorzalite occurs as deep cobalt blue dots (to 1 mm) embedded in intergranular contacts of siderite along with quartz matrix from the Bell Pit and Nevel quarry, **Newry** (chemical analysis, this study).

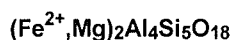
Robin's egg-blue coatings on albite from the Scotty quarry, **Newry** have been identified by collectors as scorzalite, but no tests have been made and specimens are currently unavailable.

sericite (Mica Group) = fine-grained muscovite

Alder Stream; **Brooksville** - *Cape Rosier A*; **Calais** - *Bodwell Q*; **Lincoln Sill** - *Appleton, Liberty*; **Lovell**; **Onawa pluton** - *Elliotville, Willimantic, T7R9 NWP*

Sericite is a useful varietal name which signifies a white to creamy colored fine-grained muscovite alteration or deposit in a mineral vein, etc. Trefethen (1937), Philbrick (1936), Jackson (1953), and Dale (1907) used sericite as a varietal name implying late-stage or post-genetic alterations of early minerals in the rocks they discussed. Morrill et al. (1958) noted sericite from **Alder Stream**.

SEKANINAITE (Cordierite Group)



Upper Cupsuptic - *Cupsuptic pluton contact*; **York** - *Kittery Formation*

Sekaninaite is the member of the cordierite series where $\text{MgO}/\{\text{FeO} + \text{MgO}\} < 0.5$. Harwood and Larson (1969) reported analyses of suspected contaminated "cordierite" samples from "location 2" in a contact-metamorphosed isolated block of the Hurricane Mountain Formation surrounded by the Cupsuptic pluton, **Upper Cupsuptic**. They reported, in general, that the "cordierite" formed metacrysts to 3 mm in the contact-metamorphosed pelitic rocks. The recognition of this species is tentative given the authors' uncertainty of the analyses which showed ratios just over the sekaninaite boundary from cordierite ($\text{MgO}/\{\text{FeO} + \text{MgO}\} = 0.47$ and 0.48).

Woodard (1968) noted sekaninaite compositions of a cordierite group mineral in the contact zone of the Cape Neddick gabbro within the Kittery Formation, **York**: "... large variation in the immediate wall rock, with individual beds showing hercynite within 1 foot of contact, cordierite (40 mol. per cent $\text{Mg}_2\text{Al}_4\text{Si}_5\text{O}_{18}$) within 5 feet of contact, olivine [fayalite?] within 1 foot of contact, and late poikiloblastic brown hornblende within 1 foot of contact ..." Woodard (1968) indicated highest iron compositions near both sides of this contact.

selenite = transparent crystallized gypsum

serpentine group - see antigorite and clinochrysotile

SERPIERITE



Brooksville - *Cape Rosier M*

Pale greenish-blue feathery to silky serpierite crystals (less than 1 mm) in compact clusters (to 3 mm) were found on talcose matrix with smithsonite, brochantite, and linarite at the Cape Rosier mine, **Brooksville**.

sicklerite - see purpurite

SIDERITE (Calcite Group)



Auburn - *Maine Feldspar Q*; **Blue Hill** - *Black Hawk M*; **Denmark** - *Pleasant Mountain A*; **Greenwood** - *Emmons Q*; **Jim Pond**; **Madison** - *Merchant Q*; **Milton**; **Mount Katahdin Township** - *Traveler Rhyolite*; **Newry** - *Bell Pit, Dunton Q, Nevel Q, Rose Quartz Crystal L*; **Old Orchard Beach**; **Paris** - *Mount Mica*

Q; **Pembroke** - *Big Hill M*; **Peru**; **Poland** - *Berry-Havey Q*; **Rockport** - *Riverside Q*; **Rumford** - *Black Mountain Q, Elliot Q (= North Rumford Q), Goddard Ledge Q (= Ford Hill Q), Red Hill Q*; **Stoneham** - *Cole Q, Lord Hill Q*; **West Paris** - *Perham Q*; **Windham**; **Winthrop**; **T6R8 WELS** - *Mattagamon Lake gate-house area*

Siderite is more widespread in Maine than previously realized. It is found in small amounts in pegmatites, vesicles in volcanic rocks, and intergrown with sulfides in metalliferous ore deposits. The importance that can be placed on siderite is the influence that one of its components, CO_2 , has on increasing the fluidity of a rock- or ore-forming fluid, and the intensifying influence it might have on the corrosive nature of these fluids.

Pegmatites, for example, which have abundant secondary phosphates, usually have crystallized carbonates: siderite, rhodochrosite, etc., suggesting not only an aqueous-driven corrosion-oxidation sequence, but also a carbonate-aided one as well. The giant triphylite crystals of New Hampshire pegmatites, at the Palermo #1 quarry and other localities, show extensive replacement and corrosion by fluids which precipitated siderite. Similar phenomena are seen at the Big Chief quarry and other localities in the Black Hills of South Dakota; the Hagendorf Süd pegmatite in Bavaria, Germany; and the Galileia district pegmatites in Minas Gerais, Brazil, etc. While hand-specimens of rare pegmatite minerals are frequently distinctive enough to help identify the assemblage's source or origin, siderite-secondary phosphate assemblages are remarkably similar around the world. In Maine, siderite replacement units are rarely greater than 10 cm in maximum dimension.

The Siderite Assemblage in Granite Pegmatites

Siderite is well represented as masses (to 10 cm) in quartz and feldspar matrix in many granite pegmatites. The siderite represents the high carbon dioxide activity present in late stage corrosive fluids in the pegmatite. The siderite in Maine pegmatites is usually manganoan. It frequently contains secondary phosphates formed through the corrosion of early phosphates such as triphylite, fluorapatite, and montebrasite. The phosphate recombines with elements available in the late-stage fluids and a large number of secondary minerals can form, including those which are characteristic of the so-called "siderite assemblage" (though rhodochrosite can also be the host): augelite, autunite/meta-autunite, beraunite, bermanite, beryllonite, brazilianite, crandallite, diadochite, dickinsonite, earlshannonite, eleanorite, eosphorite, evansite, fairfieldite, fluorapatite, gainesite group, goyazite, hureaulite, hydroxylapatite, hydroxyl-hercynite, jahnsite group, kosnarite, landesite, laueite, ludlamite, mangangordonite, mitridatite, montebrasite, moraesite, perhamite, phosphophyllite, reddingite, rockbridgeite, roscherite group, stewartite, strengite, strunzite group, switzerite/metaswitzerite, torbernite/metatorbernite, triplite, vivianite, wardite, whitlockite, whitmoreite, etc. as well as non-phosphates

such as bertrandite, chalcopyrite, fluorite, pyrite, quartz, todorokite, etc.

The siderite assemblages at the Bell pit, **Newry**; Dunton quarry, **Newry**; Black Mountain quarries, **Rumford**; Red Hill quarry, **Rumford**; Mount Mica quarry, **Paris**; Emmons quarry, **Greenwood**; Lord Hill quarry, **Stoneham**; and other localities have been the source matrix for many of the highly sought-after secondary pegmatite phosphates in Maine. Most of the siderite crystallizes as normal rhombohedra, but some localities have nearly pseudocubic siderite crystals. The Bell Pit, **Newry** is well-known for its extraordinary tan, steeply scalenohedral siderite crystals (to 25+ mm) found in quartz vugs.

Isolated siderite crystals are scarce in Maine pegmatites. At the Maine Feldspar quarry, **Auburn**, reddish to chocolate brown platy siderite crystals (to 1 x 1 x 0.3 cm) are found grown across vugs in blocky albite. Individual green to blue elbaite crystals (to 0.8 x 0.2 x 0.2 cm) can occur in the vugs as well.

Light golden brown transparent, but frosted, rhombohedral siderite crystals (to 2 mm) with "c" pinacoidal terminations are found on clean or limonite-stained cubo-octahedral pyrite crystals (to 6 mm) sometimes with muscovite, chalcopyrite, galena, etc. from the Black Hawk mine, **Blue Hill**. The siderite crystals sometimes appear pseudo-octahedral. The siderite also forms globular clusters (to several mm).

Small rhombohedral crystals (to 5mm) of dark brown siderite occur with smoky quartz and amethyst crystals, liningmiarolitic cavities in igneous rock on Pleasant Mountain, **Dennmark** (Woodrow Thompson, personal communication, 1994).

The Merchant slate quarry in East Madison, **Madison** contains veinlets of brownish-red pearly siderite cleavages that cut across the slate along with quartz in veins (generally 1-3 cm). Simple rhombohedral crystals to 3 mm have been observed here.

The Traveler Rhyolite in Baxter State Park, **Mount Katahdin Township** contains shallow rhombohedral siderite crystals of dark brown color (to 3 mm) in vesicles. Vugs in cherty-appearing matrix from an outcrop near the Mattagamon Lake gatehouse, **T6R8 WELS**, contain mahogany-brown low-angle rhombohedra of siderite, with ridges through the middle of the rhombohedral faces, suggesting twinning and giving the specimens a crinkled appearance.

Martin (1965) wrote of Bell Pit, **Newry** siderite: "Siderite xls in very distinct scalenohedral form were bountiful. These xls, in matrix, varied in size from $\frac{1}{2}$ inch to a minuteness that was discernable only by viewing through a 40x microscope. Color varied from colorless to a dark brown. There were also variations in crystallization from scalenohedral to rhombohedral." The steep scalenohedral siderite crystals (to 1+ cm) from the Bell Pit rank among the best of their kind from anywhere. Frank Perham (1965) wrote of the Bell Pit: "Siderite crystals, most of which were long scalenohedrons, and in some instances attaining a length of one inch and a maximum diameter of one eighth inch. Other forms of Siderite crystals were found, the most common of which were the stubby, blocky crystals found in vugs filled with a black sooty material." Many times, the Bell Pit siderite

consists of blocky, simple to complex, rhombohedra with tan to brown color, rarely mint green. The green siderite has relatively "normal" composition (chemical analysis, this study).

Martin (1965) noted of the Dunton quarry, **Newry**: "The typical crystallization of the siderite found at the Dunton pegmatite has almost always been rhombohedral and tabular hexagonal. In many instances botryoidal rhodochrosite is found associated with the siderite." Pseudo-hexagonal siderite crystals are also found at Black Mountain quarry, **Rumford**. A complex rhombohedral siderite crystal with "c" pinacoid was found at the Ridge #1 pegmatite quarry, Red Hill, **Rumford** (Robinson and King, 1993a,b).

siderophyllite? (Mica Group)

Litchfield - Dennis Hill A

Barker (1965) wrote of Dennis Hill, **Litchfield**: "This biotite satisfies Foster's redefinition of lepidomelane (1960, p. 31) as characterized by high Fe^{2+} and Fe^{3+} and by very low octahedral Al and Mg content, and analogous to siderophyllite (as defined herein) but containing Fe^{3+} in place of Al." Barker (1965) based his comments on a chemical analysis by Clarke (1886c) which indeed seemed to be the ferric and hydroxyl analog of siderophyllite. Clarke (1889), however, reported another analysis of the mica which could be assigned to the hydroxyl analog of siderophyllite, that was not considered by Barker (1965). The unacceptable formulas which can be derived from these old analyses suggest that the mica needs further investigation. It will be included under annite (see biotite series) until the problem is resolved. The mica or the analyses reported are variable.

SILLIMANITE (Aluminosilicate Group)

Al_2SiO_5

Alexander - Breakneck Mountain A; **Bangor?**; **Beaver Cove** - Burnt Jacket Mountain A; **Bethel** quadrangle - **Bethel**, **Gilead**, **Mason**; **Brunswick**; **Bucksport**; **Byron** - Hedgehog Hill A; **TC** - Black Brook A; **Camden** - Camden Hills A; **Errol** quadrangle igneous rock contacts - **Lincoln Plantation**, **Magalloway**, **Upton**; **Flagstaff Lake pluton**; **Garland?**; **Gorham** - Warren mill canal; **Greenwood** - Immonen Q, Witt Hill P; **Harpwell** - Harpswell Neck A, Orrs Island A; **Kennebago Lake quadrangle** - **Elephants Head**, **Redington**, and **Spider Lake pluton contacts**; **Littleton Formation** - **Andover North Surplus**, **TC**, **Newry**, **Riley**; **Monmouth**; **Moxie pluton contact** - **Beaver Cove**, **Big Squaw**, **Greenville**, **Little Squaw**, **Squaretown**; **North Yarmouth** - "south of post office"; **Old Speck Mountain quadrangle**; **Onawa pluton contact** - **Elliotsville**, **Willimantic**, **T7R9 NWP**; **Orington** - **Kings Mountain A**; **Paris** - **Mount Mica A**; **Phippsburg** - **Small Point A**; **Pocomoonshine Gabbro-Diorite contact** - **Alexan-**

der, Crawford, Princeton, Plantation 21; Rumford - U. S. Route #2 excavation; Sangerville Formation - Livermore, Livermore Falls; Sebago batholith northern contact zone (includes effects of numerous other intrusive rocks) - e.g. Albany, Bethel, Buckfield, Greenwood, Hanover, Livermore, Livermore Falls, Norway, Paris, Rumford, Sabattus, Stoneham, Turner, Watford, etc.; Sidney - Route #23 road metal quarry; Standish; Sumner - Biron Q; Old Speck Mountain/Oquossoc/Rangeley/Rumford quadrangles - Andover North Surplus, Byron, TC, TD, TE, Rangeley Plantation; Waldoboro; Wales - Minwah Hill A; Warren - Megunticook Formation, railroad station area, Starrett property, Vaughan Neck A; Waterville - Sidney Road - road cut; Weld - Mount Blue A; Windham; Winthrop - Horsehoe Island A; Woodstock - Mollyockett Mountain A; Woolwich - U. S. Route #1 road cut; Yarmouth

Sillimanite is an aluminosilicate which is indicative of high temperature metamorphic conditions. It is usually white to cream-colored and fibrous. Most specimens require microscopic examination to verify the presence of the mineral. Boudette (1991), Forsyth (1955a), Larrabee (1964), Green (1964), Espenshade and Boudette (1964), Pankiowskyj (1965), Warner and Pankiowskyj (1965), Guidotti (1965a, 1968a,b, 1970, 1974), Guidotti et al. (1975), Moench (1971), Hussey (1971a, 1983, 1988), Osberg et al. (1985), and Moench and Pankiowskyj (1988) provided generalized and specific geologic maps and discussions of portions of Maine with sillimanite and sillimanite + K-feldspar isograds. Sillimanite grade metamorphism is a consistent feature near contacts with intrusive plutonic rocks in Maine. Large regions of Maine north of the Sebago batholith from the New Hampshire border to Lewiston, and to the north up to the Azischohos and Flagstaff Lakes regions, are sillimanite-bearing due to various intrusive rocks. Not all towns with sillimanite are listed. Fibrolite is the original name for this species, but has been superseded by the name sillimanite.

Ludman and Hill (1990) wrote of Alexander: "Sillimanite first occurs as fibrolite, but commonly forms prisms 1-3 mm long in the higher grade rocks and migmatites. Most of these coarse crystals are gray, but many, particularly on and south of Breakneck Mountain, are pale green in hand specimen."

Philbrick (1940) noted sillimanite in the Squaw Mountain intrusion (later called the Moxie pluton), Beaver Cove and Big Squaw. Espenshade and Boudette (1967) discussed the formation of sillimanite in the Moxie pluton contact zone: "Sillimanite and cordierite occur at many places in a zone as much as several thousand feet wide adjacent to the Moxie pluton, but they seem to be absent at some places near the contact of the pluton (Espenshade and Boudette, 1964). ... Grain size is commonly about one-half mm in diameter, but may be as much as 2 mm in hornfels near or adjacent to the intrusions. ... Andalusite, sillimanite, and cordierite occur in varying amounts in the hornfels, and any or all of these minerals may be present or absent depending on the bulk composition of the rock. ... Sillimanite typically occurs as fine needles distributed through quartz and

biotite or as fibrolite veinlets between grains of quartz and feldspar, although in some specimens it forms large prismatic crystals."

Milton (1961) noted fibrolitic sillimanite in the Littleton Formation, Hall Mountain and Surplus Mountain, Andover North Surplus; Black Brook, TC; Meadow Brook area, Newry; and Riley Hill area, Riley. Milton (1961) not only noted sillimanite plus andalusite and andalusite plus kyanite associations in the Old Speck Mountain quadrangle, he wrote: "Sillimanite and the less common kyanite and andalusite are almost invariably fresh. This contrasts with the extensive sericitization of sillimanite and andalusite in comparable areas in New Hampshire and elsewhere."

True (1869) gave an early report for Bethel and other localities: "Fibrolite. - Bethel. This variety of Sillimanite, from its fracture and hardness, would seem to indicate the character of a distinct species. It is abundant. ... Sillimanite. Fine specimens have been found in Mica Slate in Bangor. Also in Garland." (The occurrence of sillimanite in the Bangor area is doubtful (Charles Guidotti, personal communication, 1990).) Fisher (1962) noted the widespread occurrence of sillimanite in gneisses and schists in the Bethel quadrangle.

Sillimanite from Bethel was widely sold by Nathan Perry and other dealers in the nineteenth century. H. H. Tammin of Denver, Colorado sold similar specimens in his pre-1900's mineral collections (Thomas Bee, personal communication, 1993). Fisher (1962) wrote of quartz-biotite-sillimanite gneiss from the Bethel quadrangle: "The coarse massive gneiss ... is medium-grained with a marked segregation of minerals. The rock is divided into contrasting masses of quartz-plagioclase-muscovite and biotite. Sillimanite tends to occur in clots, usually with the biotite. The gneiss ranges from rocks in which the light masses appear as islands in a dark host to the reverse. The coarse massive gneiss in many places resembles an igneous rock, but the weathered surface of most outcrops shows bedding. ... The sillimanite of this rock is coarse enough to permit optical measurements." Specimens consist of snow-white matted subparallel sillimanite needles which form rich veinlets (to 8 mm) in the gneiss. Fisher (1962) reported the chemical analysis of a quartz-plagioclase-muscovite-biotite-sillimanite gneiss from an outcrop on U.S. Route #2 near the Wild River, Gilead and illustrated similar specimens from Caribou Mountain, Mason.

Jackson (1953) reported "finely fibrous sillimanite usually in radiating tufts" in gneiss from the Hedgehog Hill area, Byron.

White fine-grained fibrous patches (to 1 x 2 cm) of sillimanite are intergrown in almandine-chrysoberyl-bearing pegmatite at the Witt Hill prospect, Greenwood.

The finest Maine location of sillimanite may be from Orrs Island and Harpswell Neck, Harpswell where pure thick masses (more than 25 x 15 x 10 cm) of long-fiber sillimanite are found in quartz veins that cut pelitic schist of the Cape Elizabeth Formation (Hussey, 1971a).

Warner and Pankiowskyj (1965) noted distinctive occurrences in Livermore and Livermore Falls: "Patch Mountain

Formation in river below dam. ... Around corner to north is a weathered crop showing excellent sillimanite knots (maggots)."

Coarse white sillimanite prisms (to 7 x 3 mm) have been found "south of the post office" in **North Yarmouth** (CC 9146).

Philbrick (1936) noted interesting sillimanite intergrowths in the Onawa pluton contact-metamorphosed rocks (hornfelses), **Elliotsville**, **Willimantic**, and **T7R9 NWP**: "The andalusite is generally rimmed by a thin bundle of fibers of sillimanite which extend into the neighboring quartz grains and tend to give added relief to the andalusite grains." Philbrick commented regarding the associated aplite veins: "From these veins, fine fibers of sillimanite (fibrolite)... extend into ellipsoidal grains of quartz and potash feldspar, usually orthoclase. ... The biotite is spotted and pleochroic in shades of orange; from it extend fibers of sillimanite. Tourmaline and andalusite occurring in these veins are similarly surrounded by sillimanite."

Thick (to several cm) parallel fibrous veins of sillimanite are found in andalusite schist on Small Point, **Phippsburg**. It also occurs as snow-white mats (to several cm) in quartz and andalusite matrix, and alone in quartz veins.

White to tan to green-tinted sillimanite in fine bundles of needles (to 3 mm long) are found in muscovite-biotite schist from a shopping center construction site west of **Rumford** along U. S. Route #2.

Rich concentrations of sillimanite are found in biotite schist at the Sidney road metal quarry, on Route #23, **Sidney**.

Fine-grained sillimanite is found in microcline-quartz pegmatite at the Silva Biron quarry, **Sumner**. Fairbanks (1964) wrote of a lost locality in Sumner: "Within the past few years an unreported occurrence of compact, cutable fibrolite, (sillimanite), was found by the writer in West Sumner, Maine. I am well aware that gemologists do not consider white fibrolite a gem but some that is black must be so classified. When heated the black fibrolite becomes red. Since 'citrine' produced by heat-treatment of non-gem, off-color amethyst is acceptable, similarly treated fibrolite must be also. One of the fibrolites collected is shaped like a mouse with properly placed solid black eyes. Examination of the 'eyes' with a pocket lens reveals perfect crystal cross sections. The mineral was determined as ordinary hornblende. Incidentally the material from this find is indistinguishable from that from Idaho." The Fairbanks (1964) report requires some interpretation, but seems worthy of further investigation. A fibrous black mineral which was formerly? thought to be hornblende, but might now be identified as sillimanite would make very interesting specimens.

Fisher (1941) wrote of **Wales**:

"On Minwah Hill, half a mile west of East Wales..., a vertically dipping, southwestward-facing cliff 70 feet high is cut by fractures parallel to the regional strike and dip of the rocks. Solution of interbedded calcareous zones in the quartz-mica-sillimanite schist has taken place. Some fractures are open for 2 feet in width and 12 feet along the strike. Red garnets associated with vein quartz, one-half inch diopside crystals, and calcite plates line the wall of some of the fractures.

Sillimanite crystals, an inch in length, are numerous in some of the schist beds.

Quartz-mica-sillimanite schist crops out on the western flank of Sabattus Mountain. Lenses of quartz-feldspar-garnet-diopside are abundant. Knots of muscovite-bearing sillimanite occur in 2¹/₂-inch beds in biotite schist and can be traced for 16 feet along the strike where they pass into a garnet-rich schist free of sillimanite."

Blocky crystals (to 10 x 4 x 4 cm) of sillimanite are found in biotite schist near the railroad station, **Warren**. No terminations have been observed. Forsyth (1955b), recognizing the abundance of sillimanite in Warren, experimented to remove the host rock and concentrate the sillimanite. Forsyth (1955b) wrote: "The rock is dark gray in color and consists of medium grained quartz, feldspar, biotite, muscovite, red garnet, and specular hematite, with coarser porphyroblasts of sillimanite ranging in length from ¹/₄ to 1 inch. The sillimanite grains, as well as most of the other minerals, contain abundant inclusions of an opaque mineral which has tentatively been identified as the specular hematite previously mentioned. The average sillimanite content based upon grain counts of crushed rock has been estimated at 10 - 11 %. ... Concentrations of sillimanite can often be observed along many of the vein-host rock boundaries." Cheney (1967) wrote of Warren: "A rusty weathering sillimanite-bearing fine grained biotite gneiss is well exposed on the median ridge of Vaughan Neck and extends southwestward to North Pond. The sillimanite occurs as transparent to tan needles up to 2 cm long or as brown fan-shaped grains up to 0.5 by 3.0 cm." Newberg (1979) noted in the Megunticook Formation: "However a coarse grained sillimanite garnet gneiss outcrops in the vicinity of Warren Station. The rock in thin section contains a sillimanite-quartz-muscovite-biotite-garnet assemblage. Evidence of cataclasis is obvious in the 'exploded' appearance of the sillimanite which contains abundant inclusions of muscovite."

Silky to vitreous bundles (10 x 3 mm) of sillimanite crystals are found in biotite schist in a road cut on the Sidney road, **Waterville**.

Thick snow-white mats (1 mm thick) of inter-tangled fine sillimanite needles are found concentrated with biotite and muscovite grains in granite pegmatite from road cuts along U. S. Route #1, **Woolwich**.

A coarse-grained columnar milky white to tan sillimanite mass (2 x 3 cm) from **Yarmouth** was observed in a collection, but was untested. The mineral could pass for a blocky mass of scapolite.

Larrabee (1964) noted sillimanite along the Pocomoonshine Gabbro-Diorite contact, and Ludman (1986) wrote of the Digdeguash Formation exposed on Seavey Ridge, **Plantation 21**: "Sillimanite first appears as needles, then mats of fibrolite intergrown with biotite, so that sillimanite zone biotite flakes typically have a silky appearance recognizable in the field. Fibrolite also rims and replaces andalusite crystals. Prismatic sillimanite first appears near the sillimanite-K-feldspar isograd and increases in size until the gabbro contact."

Sillimanite Replacements

Berry (1987) wrote of sillimanite replacements in the Camden Hills area, **Camden**:

"A second metamorphic event caused the prograde demise of the older andalusite and staurolite megacrysts, and the growth of fibrolite with coarsening of the matrix. The mechanism envisioned for the breakdown of andalusite to fibrolite is that of Carmichael (1969). In this model, the net chemical reaction is andalusite-sillimanite, but it is accomplished by the physical replacement of andalusite by coarse muscovite. Meanwhile, matrix muscovite is physically replaced by fibrolite. This cation exchange mechanism is supported in these rocks by (1) the location of fibrolite in the matrix just outside andalusite pseudomorphs and not in contact with relict andalusite; by (2) partial pseudomorphs in which poikilitic andalusite and muscovite are intergrown; and by (3) the smaller portion of muscovite in the matrix of rocks with more fibrolite.

Foster (1983) proposed a similar prograde cation exchange reaction in which staurolite is physically replaced by laths of muscovite, biotite, and quartz. Abundant pseudomorphs in the Camden Hills similar in texture and composition to staurolite pseudomorphs reported by Guidotti (1968[b]) are inferred to have replaced staurolite, although no relict staurolite was found. Staurolite is known from nearby rocks in the Belfast quadrangle (Bickel, 1974) and the Thomaston quadrangle (Boutcot et al., 1972).

An isograd for this proposed regional retrograde event is shown... Fibrolite occurs only in the central and northwestern part of the area where sufficient temperatures were attained. The increase in metamorphic grade is marked by a modal increase in fibrolite together with matrix coarsening to the northwest, away from the isograd.

During the prograde sillimanite-pseudomorph event, the matrix minerals were annealed to produce polygonal textures. Bent grains and undulatory extinction are rare."

mine promoters were not above bringing rich silver, etc. ore samples into a new mining district and claiming that they were uncovered in the local mine that they were promoting. As most businessmen have no frame of reference concerning the typical visual aspects of ores, specimens of very dissimilar nature to the general mine production could easily be passed off. Collectors with knowledge concerning ores from particular localities would not be so easily persuaded. The Maine silver mining districts were remote from the areas frequented by mineral collectors, so very few samples are preserved to represent the mining ventures. Given the small number of samples viewed, the descriptions are based on what has been observed, without the prejudice necessary to discount any fraudulent specimens, though the known samples do not particularly resemble those which might be from out-of-state localities. Emmons (1910) and Li (1942) did not observe any silver minerals, and many of the above localities have to be regarded with extreme caution. Most silver reports are substantiated only by galena as the silver ore. In some fairness, the intention in reporting native silver may not have always been fraudulent, as nineteenth century science assumed the presence of discrete molecules, if not sub-microscopic inclusions, that were responsible for "impurities" reported in chemical analyses: therefore, silver in galena was sometimes thought to be present as native silver.

The York County specimen at the Smithsonian (USNM # R000258) is certainly from **Acton**, probably from the Acton mine. The silver consists of a small hackly silvery-metallic highly irregular plate (about 5 x 5 mm) intergrown with corroded and black sooty-stained galena and quartz.

Silver was reported from the Granger mine, **Blue Hill** (MMJ, August 27, 1880): "It is reported that native silver has been found at the bottom of the shaft." No specimens known.

A silver specimen from **Deer Isle** resides in the American Museum of Natural History mineral collection. The piece consists of a compact, fine-grained gray matrix with a fracture surface (about 4 x 9 cm) coated by massive white calcite 2-3 mm thick. The calcite coating is discontinuous, and metallic silvery to tarnished, hackly grains (1-2 mm each) of silver protrude from the calcite. One report of the Deer Isle mine indicated (MMJ, October 22, 1880): "At the depth of 110 feet two lateral drifts are being run, the north drift is in heavy dark ore and with a seam eight to twelve inches in thickness carrying native silver between hanging wall and dark ore. The south drift is in heavy dark ore and shows also a streak of native silver ore." Later activity indicated more specimens (MMJ, August 26, 1881): "I am taking out and have sent you some very rich specimens of native silver from the stope on the 100 level." The mine area has been graded and landscaped, so perhaps the only place left to collect Deer Isle mine silver ore would be the shipwreck on the coast of Iceland where a load of ore is residing, its journey to the smelter at Swanzey, England having been interrupted (MMJ, November 11, 1881).

Silver was *de rigueur* for any "silver mine" and so it was reported (MMJ, May 7, 1880) of the Lebanon-Acton mine,

SILVER

Ag

Acton - *Dirigo M*; **Blue Hill** - *Blue Hill M*, *Granger M?*; **Brooksville?** - *Manhattan M*; **Deer Isle** - *Deer Isle M*; **Franklin?** - *Franklin Extension M*; **Gouldsboro?** - *Gouldsboro M*; **Hancock?** - *McFarland M*; **Lebanon?** - *Lebanon Acton M*; **Lowell?** - *Shorey M*; **Pembroke?** - *Big Hill M*; **Penobscot?** - *Annear M*, *Hercules M*; **Sedgwick?** - *Edgemoggin [sic] M*; **Sullivan** - *Fanueil Hall and Sullivan M?*, *Milton M?*, *Salem-Sullivan M?*, *Sullivan M*, *Waukeag M*; **Surry?** - *Silver Bonanza M*; **York?**; **York County?** (= **Acton?**)

Silver is inconspicuous in the Maine samples which remain to represent the species. Early reports in the *Maine Mining Journal* suggest that some impressive looking samples were found. Modern mining historians have suggested that stock and

Lebanon: "The feeders have been growing richer and richer as depth has been attained, and now considerable galena is being obtained with more or less native silver."

Silver was over-enthusiastically reported from the Shorey mine, **Lowell** (MMJ, October 15, 1880): "Work is progressing favorably and the shaft has reached a depth of about fifty feet. We have been shown some specimens of ore taken from the shaft on Saturday last, which are literally covered with native silver."

Bartlett (October 15, 1880) noted of the Hercules mine, **Penobscot:** "For example, at the Hercules mine the following varieties of ores may be seen: - galena, zinc blende, copper pyrites, iron pyrites, gray copper, native copper, silicate of copper, arsenical pyrites, native silver, together with other various kinds of silver and gold ores..."

The silver specimen at the Smithsonian Institution (USNM #0093576) from **Sullivan** originally came from the U.S. Naval Academy collection. The silver forms a black-tarnished, arcuate wire (about 5 mm) loosely attached to a small crystallized quartz vug (1 cm) in "phyllite." A small amount of light-green clinochlore is seen in 2 mm fine-grained, but splendid, granular clusters and this type of chlorite is typical of the Sullivan mine area. Kempton (1879) reported of the Sullivan mine: "A coffer dam was built and shaft commenced. The first native silver threads were found about ten feet down. The vein was uncovered in several other places, also below high-water mark, proving that the showing at the shaft location was the poorest yet found. ... At this time the shaft is about 100 feet deep. ... The ore is essentially silver, sulphides and native, in quartz and slaty gangues, with slight amounts of iron, zinc, etc., as sulphides, and also galena. Of the silver minerals, stromeyerite is most plentiful, stephanite next, argentite (silver glance), common, native silver in flakes very plenty, threads frequent, lumps occasional. Ruby silver is exceedingly rare; antimonial silver has been found. The occasional yellow copper sulphide met with has a peculiar lustre and runs very rich in silver." On March 31, 1882 (MMJ), when the Sullivan mine shaft was reported to be at 410 feet (125 meters), it was also reported: "Very beautiful recent specimens, highly charged with native silver, are shown at the Superintendent's office, and the present showing is very satisfactory to the company." Additional reports are cited under stromeyerite.

Silver was reported of the Waukeag mine, **Sullivan** (MMJ, December 3, 1880): "The gangue is a fine grained quartzite, carrying black sulphurets of silver, and is beautifully coated with bright native silver flakes, with spots of telluride of gold."

A locality rarely mentioned includes the Silver Bonanza mine, **Surry** (MMJ, March 26, 1880): "Capt. Geo. W. Collins has discovered a most promising silver vein at the head of Morgan's Bay in South Surry, near Blue Hill line. ... The vein is five inches wide at the top-wall and vein two and one-half feet. One blast of powder produced specimens showing fine silver, which mining experts pronounce to be among the richest ever found in Hancock county." No specimens known.

Very few reports of actual silver production pertain to the **Woodstock** mines. Toppan (1932) wrote: "About 5000 ounces

of silver were obtained from mines at Sullivan and at Bryant Pond..." The source report for Bryant Pond village, Woodstock silver production is not known, and it is not possible to know how gullible the receipt of the report might have been. Lapham (1882) noted of Woodstock while the remains of its "silver boom" were still smouldering:

"Ores of iron, lead, copper, arsenic, zinc, gold and silver have been found within the limits of this town, in small quantities. Their distribution, in minute particles, in some of our rocky formations, have led some to believe that the precious metals and also lead exists here in paying quantities, and considerable time and money have been expended in prospecting, blasting and sinking shafts, but the supposed treasures yet elude the grasp of the eager seekers, and the realization of their hopes seems to be as far off as ever. If they are there - which is exceedingly doubtful - they are probably so deeply hidden that human eyes will never behold them."

sincite?

Alder Stream?; Jim Pond?

Lander (1955) listed "sincite" from **Jim Pond** and **Alder Stream**. No mineral name is obviously implied.

skogbolite = tapiolite

Topsham - Fisher Q

smarskite? = misspelling of samarskite (Morrill et al., 1958)

smectite group - see montmorillonite, nontronite, saponite

The smectites constitute a group of minerals seen only in clay-sized particles. The name smectite suggests the smectic (sticky) character of the minerals when they are moist. Many times the smectites are found as replacement minerals. The smectite group is sometimes called the montmorillonite group.

SMITHSONITE (Calcite Group)

ZnCO₃

Blue Hill - *Black Hawk M*; **Brooksville** - *Callahan M (= Cape Rosier M)*; **Lubec** - *Lubec Lead M*; **Pembroke** - *Barrett P (= Dolsan Pit), Big Hill M,*

Brown (probably ferroan) botryoidal smithsonite (1 mm) composed of multiple growth, slightly offset crystals as well as steeply rhombohedral multiple-growth clusters with globular ends is found in vugs in brown sphalerite along with sparse grains

of chalcopyrite and galena at the Black Hawk mine, **Blue Hill**. (Some specimens of this description could be zincian siderite.)

White rounded rhombohedra (to 2 mm) of smithsonite with a thin opaque white coating were found in vugs in talc at the Cape Rosier mine, **Brooksville**. Carpenter and Foster (1960) said, "Smithsonite is by far the most common supergene mineral at Cape Rosier. At this locality it is easily recognized by its occurrence as white cellular masses of extremely minute colorless crystals. In some specimens the smithsonite is replacing sphalerite along crystal boundaries and cleavage planes." Smithsonite from the Callahan mine is naturally similar to the earlier Cape Rosier mine material from the same locality. Rounded snow-white coated crystals in vugs and fracture surfaces in brown talc are indistinguishable from the earlier material. Botryoidal (to 1 mm) brown smithsonite is found in vugs of dark brown sphalerite from the Callahan mine. Rare small blue-green smithsonite crystals (to 1 mm) were found at the Cape Rosier mine with cuprite and malachite.

Pearly rounded white smithsonite "rice grains" (to 2 mm) are found in quartz vugs with clear, indistinctly crystallized hemimorphite from the Lubec Lead mine, **Lubec**.

Transparent steep "fibrous" rhombohedral crystals (1-2 mm) with smooth normal rhombohedral terminations are found in granular massive sphalerite, chalcopyrite and quartz with limonite coating and occasional associated aurichalcite and malachite from the Dolsan pit, **Pembroke**.

soapstone - a rock composed almost exclusively of talc

SODALITE



Litchfield - *Dennis Hill A*; **Newfield** - *"game reserve", Straw Hill A*; **Parsonsfield** - *Randall Mountain stock*; **West Gardiner** - *drift boulders, Smith Farm A, True Farm A, Wharff Farm A*; **York?** - *Spouting Rock A*

Sodalite is well known in the litchfieldite rocks of central Maine, particularly in **Litchfield**. The mineral is found in deep blue patches in nepheline and albite rock. While patches of massive sodalite have been found to 10 x 15 cm, the mineral more commonly forms blue patches of several millimeters separated from similar patches by the white and gray associated species. In some specimens, the blue sodalite seems to follow fractures (to 3 cm thick) in the syenite, and a thin contact (to 0.7 cm) of chalky-white hydronepheline can be found between the sodalite and albite. Cancrinite and lepidomelane can be associated as well as minor zircon. Cancrinite crystals have been found embedded in Litchfield sodalite. Most of the specimens occur in loose boulders, but an outcrop has been found in Litchfield. Clarke (1900c) reported an analysis of Litchfield sodalite. Haven (1930)

described Litchfield sodalite and its associations. Much ado has been made of the "high quality" and rareness of Litchfield sodalite (Cartwright, 1988), but blue sodalite is not even unique to Litchfield as far as Maine is concerned. Mount Saint-Hilaire, Quebec, Canada, has abundant sodalite and provides some of the world's best blue crystals. While Maine sodalite, at its best, is as good as blue sodalite from the dozen or so Ontario, Canada occurrences, the extraordinary blue sodalite in commercially exploited mines near Jacupiranga, Sao Paulo, Brazil and Namaqualand, Namibia reduces Litchfield sodalite to academic interest only.

Carpenter (1953) reported sodalite with nepheline (q.v.) from the Straw Hill area, **Newfield**. A specimen of Newfield blue sodalite (patches to 3 cm) is preserved at the American Museum of Natural History. Gilman (1978) noted of the Randall Mountain stock, **Parsonsfield**: "Nepheline was identified in one specimen as was sodalite."

Kunz (1885) reported sodalite from **West Gardiner**: "On some of the West Gardiner farms there are ledges of rocks that are evidently the source of these boulders. The boulders occur principally on the farms of Moses True, Capt. Joseph Wharff, and Rufus Smith."

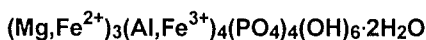
Keeley (1924) noted of basalt near Spouting Rock, Ogunquit, **York**: "The plagioclase is nearly everywhere penetrated by colorless, parallel, fibres of extreme tenuity and there are numerous rounded or polygonal phenocrysts of a colorless isotropic material, noticeably lower in refractive index than balsam, which can hardly be anything but sodalite ..." The mineral could have been analcime, etc.

The Cancrinite and Sodalite Confusion

Sodalite was named in 1810, while cancrinite was named in 1839 and nepheline was named in 1801 though it was recognizably described over 25 years before. The following discussion concerns the apparent confusion of these three minerals by C. T. Jackson, who was working during a time when mineral reference collections were small and adequately labeled specimens were rare. Charles T. Jackson is cited as being a skilled mineral analyst, for his time, and in one instance is called "the best chemist in Boston." The quality of chemical analyses during this era was mediocre at best and present day mineralogists rarely cite "early" analyses unless they fortuitously agree with modern results. In 1845 (abstracted by Silliman et al., 1846), Jackson reported the analyses of cancrinite and nepheline from Litchfield, Maine. Not only are the analyses different from what we would now accept, but so is the description of the samples. The cancrinite was said to be "deep azure blue color" and the nepheline "occurs occasionally in six-sided prisms of a lemon or sulphur yellow color." Cancrinite was such a new species at the time, it might be suspected that a confusion occurred and that the blue mineral was actually sodalite and the yellow material was, in fact, cancrinite - especially since the analyses would agree better. In Alger (1844), cancrinite was listed as being "azure blue" from near

Ilmenite in Siberia, the only locality that he mentioned. Jackson's analysis failed to detect carbonate, but did report substantial sulphate - results you would not expect to be easily confused. Probably in light of obvious chatter and eyebrow-raising among contemporary mineralogists, Silliman et al. (1846) reported: "Dr. Jackson consequently analyzed a specimen of the foreign mineral so far as to ascertain that no carbonic acid exists in it, and that it does contain sulphur and sulphuric acid." The vishnevite-cancrinite from the Ilmen mountains in Siberia (Zavaritsky, 1929) does have appreciable sulfur. Subsequent analyses of yellow Litchfield cancrinite show it to be sulfur-free (Clarke, 1886c, Clarke and Steiger, 1902). Vishnevite is a blue cancrinite-group mineral, but has yet to be reported from Maine. In addition, no "normal" blue cancrinite has been found in Maine subsequently. The sodalite from Litchfield is sulfur-free as well, and lazurite is not known from Maine. The quandary remains, "Did Jackson find vishnevite in Litchfield - a material which has never been found there again?" The yellow nature of the nepheline is probably the result of alteration to normal cancrinite. The inconsistency that nepheline crystals are unknown at Litchfield, but for Jackson's report, is apparent. A final confusion can be offered to make the story even more complex. Hexagonal cross-sections of cancrinite crystals frozen in matrix are in the American Museum of Natural History and Northeastern University, as well as a few private collections. (At one time, the AMNH specimen was reputedly the only cancrinite crystal known from anywhere.) In all probability, Jackson's cancrinite was not watched while the material dissolved in preparation for analysis and the carbon dioxide bubbled slowly out of the solution unnoticed. The origin of the sulfur is not obvious. Pyrite or other sulfur-bearing minerals are not common from the litchfieldite (cancrinite-bearing nepheline syenite) of the area. One wonders why some of the original Litchfield cancrinite was not reanalyzed along with the Siberian material to check the consistency of the first analyses. The sulfate-rich Ilmen material was an unfortunate coincidence, as few of the many cancrinites of the world contain appreciable sulfur.

SOUZALITE



Newry - Bell Pit

Souzalite is a scarce and inconspicuous mineral in Maine. At the Bell Pit, **Newry** it forms tiny (less than 1 mm) bright blue-green fibrous patches (to 1 mm) as inclusions in granular tan siderite and quartz or rare ludlamite. The patches of inclusions can produce a ghostly blue-green haze within the host. A few blue grains (to 0.5 mm) of scorzalite can be associated.

specular oxide of iron = specularite = hematite

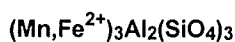
SPERRYLITE (Pyrite Group)

PtAs₂

Union - Harriman P; **Warren** - Warren Nickel P

The announcement of sperrylite from **Union** and **Warren** was made without description or substantiating data (Rainville and Park (1976): "None of the isotropic minerals was identified except sperrylite (PtAs₂), but the anisotropic mineral has been identified as niggliite (PtTe - PtSn), because it compares favorably to samples of that mineral from South African deposits."

SPESSARTINE (Garnet Group)



Appleton Ridge Formation Garnet Zone - Belmont, Searsmont; **Auburn** - Keith Q, Maine Feldspar Q?; **Aziscohos Formation** - Adamstown, Lincoln Plantation, Magalloway, Parkertown; **Benner Hill unit** - Cushing, Rockland, Rockport, South Thomaston, Thomaston, Warren; **Buckfield** - Bennett Q; **Camden** - base of Mount Battie; **Caratunk**; **TD** - Bemis Stream P; **Dallas?** - camptonite dike; **TDR2 WELS** - Maple Mountain P; **Lang** - Blanchard Ponds A; **Newry?** - Dunton Q; **Peru?** - Hedgehog Hill Q; **Phippsburg?** - The Basin L; **Rumford?** - Black Mountain Q; **Spring Point Formation** - Harpswell, Old Orchard Beach, Portland, South Portland; **Stoneham?** - Lord Hill Q; **Topsham?** - Fisher Q; **T3R9 WELS** - Hovey Mountain P

Garnet is a well-known concentrator of manganese. Spessartine is typically more manganese-rich than coexisting iron- and manganese-bearing minerals. Analyses of selected pegmatite "spessartines" from Maine localities, however, show that they are mostly manganese-bearing almandine and not spessartine. The garnets were usually early-formed and not part of the manganese-enriched late-stage igneous fluids. Garnets which form very late and near gem pockets can be manganese-rich and qualify as spessartine. Garnets which have a black staining on them are not necessarily manganese dominant. (Some scientific reports of "spessartine" are incorrect. While garnets may be so highly substituted that no one component reaches 50% or more of an end-member composition, garnets which are richest in a particular end-member may be given the name of that end-member. Quite a number of "spessartine" reports have been made when the almandine component was actually the richest component, but the writer wanted to indicate the manganoan character of the garnet. Manganoan almandine is the term for almandines which have a high spessartine component, but which are still iron-dominant. As many metamorphic garnets in Maine are manganoan, numerous over-enthusiastic reports are known. Some geologists have assumed that rocks which resemble cotecules are *a priori* manganese-rich, but this assumption needs

verification every time as some such rocks are manganese-deficient.)

Pinkish orange masses (to 2 cm) of spessartine (unanalyzed) occur in blocky albite at the Keith quarry, **Auburn**. Large (to 5+ cm) garnet crystals from the Maine Feldspar quarry, Auburn are likely almandine.

Harwood et al. (1970) wrote of the Aziscohos Formation, **Adamstown, Lincoln Plantation, Magalloway, and Parker-town**: "In addition to these principal rock types, the formation contains about 10 percent of biotite-quartz-plagioclase gneiss, carbonaceous quartzite, calc-silicate rock, and quartz-spessartite rock."

The Benner Hill Formation, **Cushing, Rockland, Rockport, South Thomaston, Thomaston, and Warren**, contains abundant "spessartine" (Charles Guidotti, personal communication, 1990).

Boudette (1991) speculated on spessartine in a camptonite dike, **Dallas**: "Dike (2) somewhat altered near Fansangah Gorge fault; appears to be spessartite because there is no evidence of either clinopyroxene phenocrysts or amygdules." Boudette (1991) also noted spessartine in metalimestone of the Rangeley Formation outcropping near Blanchard Ponds, **Lang**.

Hussey (1988) wrote of **Harpwell, Old Orchard Beach, Portland, South Portland**: "The Spring Point Formation consists primarily of metamorphic basic and intermediate volcanic tuffs and flows. These are represented now by chlorite-spessartite phyllite, actinolite gneiss, and hornblende-garnet amphibolite locally with cummingtonite and rarely anthophyllite." Hussey (1971c) noted similar occurrences: "In the biotite zone, in addition to chlorite which is still abundant, small amounts of biotite and minute spessartitic garnets are developed."

Landes (1925) noted that reddish brown, presumably poorly crystallized, spessartine was found in the Bennett quarry pegmatite, Buckfield, while Wise and Rose (in press) analyzed it from the Bennett quarry aplites.

Though Holman (1935) listed spessartine from the Dunton quarry, **Newry**, a large (1.5 cm) fragmented red garnet in albite from there has been recently analyzed (this study) and identified as a manganoan almandine (~55% almandine - ~45% spessartine).

Almandine crystals from Hedgehog Hill quarry, **Peru** frequently have a black coating on them and some collectors have erroneously assumed that the stain was due to a high manganese content indicating spessartine. The Hedgehog Hill garnet is almandine.

Bright orange complex dodecahedral grossular occurs at a number of places in **Phippsburg** including The Basin locality. Due to the bright orange color, some collectors have erroneously thought the mineral was spessartine. Jackson (1838a) reported: "manganesian garnet."

LaCroix (1922) and Bailey (1930) listed spessartine from Black Mountain quarry, **Rumford**. No specimens known. The garnet at Black Mountain quarry is probably a manganoan almandine.

One sample from the Garnet Zone of the Appleton Ridge Formation, **Searsmont** gave an analysis with 55% spessartine (Bickel, 1974). Kimball (1981) reported analyses of spessartine (50% to 66% end-member) from the Muzzy Ridge Member of the Appleton Ridge Formation, **Belmont and Searsmont** area: "The garnets are in euhedral crystals 0.02 to 0.1 mm across and generally contain numerous inclusions of graphite and quartz. ...and are usually surrounded by biotite."

Stewart (1938) wrote of the Fisher quarry, **Topsham**: "In the upper extension of the main pocket several red garnets of the variety spessartite [sic] occur embedded and replacing cleavelandite. These crystals vary from a quarter of an inch to half an inch in diameter. Later hydrothermal solutions have reacted with the garnets and partially altered them to sericite." No data given.

Fine-grained brown spessartine is a microscopic component of manganese beds in the Hovey Mountain prospect, **T3R9 WELS** and Maple Mountain prospect, **TDR2 WELS**. Pavlides and Milton (1962) wrote: "Spessartite garnet in some of the deposits on Maple and Hovey Mountains occurs in laminae containing light-colored minerals and opaque oxides, and in the light-colored pods in hematitic slate and banded hematite ironstone. Spessartite may make up 50 percent of some laminae and pods."

spessartite = obsolete spelling of spessartine

sphaerostilbite - see stellerite

SPHALERITE

ZnS

Acton - Boston-Acton M, *Dirigo M*; **Auburn** - Groves Q, *Pulsifer Q*; **Bingham** - Saw Mills A, Wyman Dam excavation; **Blue Hill** - Black Hawk M, Douglass M, Owen Lead M; **Brooksville** - Callahan M (= Cape Rosier M), Jones/Dodge P; **Buckfield** - Bennett Q, Bessey Q, General Electric Q; **Bucksport** - "east of Snow Mine"; **TC**; **Carthage** - Briggs - Saunders farm; **Casco** - Mount Quito Magnetite M; **Castine** - Emerson M; **Cherryfield** - Cherryfield M; **Concord** - Robinson M; **TD** - Bemis Stream P; **Deer Isle** - Deer Isle M; **Dexter**; **Franklin** - Franklin M, Franklin Extension M; **Garland** - Preble Hill M; **Gouldsboro** - Gouldsborough M, Kerona P, West Bay M; **Greenwood** - Tamminen Q; **Guilford** - Bennett M; **Hampden** - Lawrence M; **Hancock** - Pomeroy farm M; **Hollis** - Hollis Center road cut; **Jackson** - Jackson Gold Mining and Milling Company M; **Knox** - Stone M; **Lebanon** - Acton-Lebanon M; **Lubec** - Lubec Lead M, West Quoddy Head M; **Milton** - Mount Glines M; **Monticello** - greenstone dike; **Newry** - Bell Pit, Dunton Q, Nevel Q, Rose Quartz Crystal L; **North Anson**; **Norway** - Millettsville A; **Paris** - Mount Mica Q; **Parlin Pond** - Pyrite Creek A; **Parmachenee** - Magalloway River First East Branch A; **Parsonsfield** - Elmrow Farm A, Kezar Falls A; **Pembroke** - Barrett P (= Dolsan Pit), Big Hill M; **Penobscot** - Hercules M, Clyde Limeburner P; **Phippsburg** - Mount Arat P;

Rangeley; Raymond - Camp Hinds L; **Rockport** - Riverside M; **Rumford** - Black Mountain Q, Goddard Ledge Q, Red Hill Q; **Sanford** - Webster P, Goodall Farm P; **Sangerville; Sedgwick** - Edgemoggin [sic] M; **Standish** - Breakheart Hill A, Route #25 road cut; **Stoneham** - Cole Q, Lord Hill Q; **Sullivan; Thomaston** - Williams Q; **Topsham; Warren** - Starrett Q; **Wesley** - Bacon and Snow M, Rollins M, Seavey Lake A; **Whiting** - Cooper M; **Woodstock** - Bryant Pond A

Sphalerite from the various metal mines and prospects is virtually always massive. The ore consists of fine- to coarse-grained cleavages (up to several millimeters) with a color which varies, even at one mine, from brown to almost black. Some black sphalerite has been given the varietal name marmatite. The darkest grains usually still show brown internal reflections. The sphalerite is typically intergrown with other minerals such as galena, chalcopryite, pyrite, and quartz. Sphalerite from pegmatites is usually associated with microcline, triphylite, siderite, etc., but only occasionally with other sulfides. Schofield (1875), Schrader et al. (1917), Smith (1907), and Burr (1941) listed many sphalerite localities.

Sharp-edged, smooth-faced black tetrahedra (to 2 mm) of sphalerite were found in fractures in the Black Hawk mine, **Blue Hill** associated with clinocllore, chalcopryite crystals (to 3 mm), titanite crystals (to 0.5 cm), etc. (Hugh Durgin, personal communication, 1993).

At the Callahan mine, **Brooksville**, the intergrowth of chalcopryite and sphalerite resembles the interfingering of sandstone layers (usually no wider than several centimeters) varying from pure lenses to thin wisps. A peculiar cellular mass of reddish brown to black sphalerite with tiny stellate clusters (to 2 mm) of white hemimorphite crystals was also found at the Callahan mine.

Reddish brown sphalerite cleavages (to 1 cm) occur sparsely to closely spaced in milky quartz and calcite with occasional fine-grained dark green clinocllore at the Cherryfield mine, **Cherryfield**. Although the Cherryfield mine was supposed to be a silver mine, galena is a relatively scarce component of the sulfide ore.

Schofield (1875) wrote of **Dexter**: "In Dexter there is a mine of lead ore which was discovered a great while ago in digging a well in slate rock charged with veins of quartz. It was found in the quartz, associated with iron pyrites, ochreous oxide of iron, sulphuret of zinc, and sulphuret of copper and iron. The vein widened as it extended in depth, the ore being from one to three inches in width."

Sphalerite in pegmatites tends to be coarse-grained. Brownish-black sphalerite from the Nevel quarry, **Newry** is found in cleavages (to 1 cm) in masses to 10 cm replacing microcline or albite. It is locally associated with spodumene. A single broken complex tetrahedral sphalerite crystal (to 2 cm; Jorgensen collection, Maine State Museum) was found frozen in quartz at the Nevel quarry. Seaman (1975c) indicated that masses to "14 pounds" had been found. Similar sphalerite is found at the

Red Hill quarry, **Rumford**. King (1993a) recorded sphalerite crystals from the Ridge #1 pegmatite quarry, but Robinson and King (1993a,b) noted that the material was actually siderite. Cole (1952) wrote of the Goddard Ledge quarry, Rumford: "The sphalerite here is coal black, like that of Red Hill, thus showing a percentage of iron in its composition and constituting true 'black jack'." Sphalerite nodules (to 1.5 cm) have been found as inclusions in cream-colored beryl at Black Mountain, Rumford. Late-stage sphalerite, in siderite or associated with phosphates, can be seen in amber to golden yellow cleavages and masses (to several millimeters) such as from the Bell Pit or Dunton quarry, **Newry** or the General Electric quarry, **Buckfield**. A single transparent to translucent honey-yellow pseudo-octahedron (3 mm) with blue tourmaline needle and prism crystals (to 1 mm) and pyrite cubes (much less than 1 mm) has been found in a cleavelandite vug at the Nevel quarry, Newry. Sphalerite cleavages (1-3 mm), yellow to light brown, have been found in the siderite-mon-tebrasite assemblage at the Bell pit, Newry.

Fournier (1970) located a sulfide-bearing outcrop near First East Branch Magalloway River, **Parmachenee**: "The area of mineralization may be defined approximately by a narrow linear zone which parallels the regional structure along the southeastern flanks of Thrasher Peaks. Known limits of this zone are about 300 feet in width and more than three miles in length. Significant quantities of sulfides, however, are known at only a few locations within the zone. ... The outcrop at the stop is heavily mineralized with pyrite, chalcopryite and sphalerite in decreasing order of abundance. Very minor amounts of galena are also present; pyrrhotite has not been noted. The zone, which is about 20 feet across and extends across the road, is parallel with the general schistosity of the outcrop."

Cox (1970) wrote of a silver-lead vein south of Kezar Falls, **Parsonsfeld**: "Sphalerite from ... Kezar Falls, ... deposits contains 1.5 to 2 percent cadmium and 1 to 1.5 percent iron." Jackson (1838a) also noted Kezar Falls sphalerite.

Dolloff (1936) reported some unusual sphalerite from a **Standish** pegmatite:

"Sphalerite occurs as an unusual black variety which carries a large amount of iron, and is probably marmatite. In massive form, the surface exhibits an almost adamantine luster and seems to have a good cleavage. It is often coated with a white film and is found with the other sulphides and albite in cavities of triphylite.

At the New Hampshire concrete road cut [route 25], it occurs not in the massive form, but as an extremely fine powder that scarcely adheres to the drusy albite upon which it has been deposited.

Again, at Breakheart Hill, it occurs with pyrite, and in this specimen, it is replacing the associated mica in bay-like and channel-like invasions, leaving island-like and peninsular-like remnants of the mica."

Forsyth (1955a) noted of **Wesley**: "A small cupola of this granite is found in the fractured metasediments southeast of Seavey Lake. A 12 inch carbonate vein cutting through the granite contains small amounts of disseminated pyrite, chalcopryite, and sphalerite."

pyrite, sphalerite, along with traces of gold and silver. The cupola, exposed only at the top of a small rise, appears to be completely surrounded by metasediments and no other veins were observed in this locality."

sphene = obsolete name for titanite

SPINEL (Spinel Group)

(Mg,Fe²⁺)Al₂O₄

Auburn?; **Baileyville** - *Farrar Hill A*; **Blue Hill** - *Black Hawk M, Ellsworth Schist?*; **Calais?**; **Deer Isle?** - *Verde Antique Q*; **Greenwood?** - *Harvard Q*; **Moxie pluton contact** - **Big Squaw, Greenville, Little Squaw, Squaretown**; **Norway?** (= **West Paris**) - *Cobble Hill Q*; **Pierce Pond** - *Hurricane Mountain Formation*; **Rumford?** - *Black Mountain Q*; **Stow?**; **Union?** - *Harriman P*; **Warren?** - *Warren Nickel P*; *Woodland Formation* - **Alexander, Cooper, Crawford**

Spinel is a species name and a group name: see chromite, gahnite, hercynite, magnetite, ulvöspinel, as well as spinel. The existence of a species name and an identical group name has generated confusion among the uninitiated. Chromite is a *spinel*, as is magnetite, etc. Many references can be found where these minerals are called chrome spinel and iron spinel, respectively. Similarly, gahnite is sometimes called zinc spinel. Unfortunately, the chemical prefix is frequently misinterpreted to suggest that a zinc spinel, for example, is a spinel with some zinc and the name becomes shortened to simply spinel. The localities Auburn, Greenwood, Norway, and Stow are probably gahnite localities rather than true spinel localities. Wintringham (1955, similarly 1962) noted: "Both spinel and gahnite have been reported from Noyes Mountain (Harvard Quarry); the spinel, however, probably would prove to be gahnite (zinc spinel) if the specimens were re-examined." The loose use of the word spinel in earlier days is exemplified by Smith et al. (1907): "The rock also shows numerous grains of a blue-green, singly refracting mineral showing angular fractures, which is either spinel or garnet..." Some green spinels observed in this section could be hercynite.

Barker (1954) wrote of spinel from "Mount Apatite," **Auburn**, but the material, as described, is undoubtedly gahnite. No chemical data given.

Ludman and Hill (1986; and almost exactly 1990) stated of **Baileyville**: "Green spinel was observed in one restite layer on the flanks of Farrar Hill." No data given.

Yates and Howd (1988) wrote of the Black Hawk mine, **Blue Hill**: "The Si-deficient, Mg-enriched samples BHRAD1 and BHRAD4 both contain enstatite with low Fe/(Fe+Mg) and high Al. The Fe/(Fe+Mg) content of enstatite is intermediate with respect to coexisting forsterite and spinel. Differences between the average alumina contents of enstatite in the forsterite-present (BHRAD4) and forsterite-absent (BHRAD1) assemblages are insignificant... Individual spinel grains intergrown with forsterite

tend to be slightly more magnesian than those associated with enstatite alone... Spinel is the non-sulfide phase most enriched in iron in both BHRAD1 and BHRAD4, which is in part due to ferric iron. Of the non-sulfide minerals in BHRAD1 and BHRAD4 only spinel incorporates significant amounts of Zn. However, true gahnite is present only in samples bearing sphalerite (e.g. BHE15)." Yates and Howd (1988) provide chemical analyses of both spinel and gahnite from the Black Hawk mine. Li (1942) reported, without substantiating data, of the Ellsworth Schist, Blue Hill: "The andalusite includes dusty carbonaceous matter, magnetite, hercynite, and green spinel (pleonaste)." Forsyth (1953) reported gahnite.

Espenshade and Boudette (1967) wrote of the sillimanite-cordierite hornfels of the Moxie pluton contact, **Big Squaw, Greenville, Little Squaw, Squaretown**: "Spinel occurs with cordierite and orthopyroxene in some hornfels inclusions in the Moxie pluton."

Perkins (1922b) noted spinel from Cobble Hill, **Norway** (= **West Paris**), but also indicated gahnite from an unspecified Norway locality.

Bailey (1893) noted of the Black Mountain quarry, **Rumford**: "Spinel (one fine yellowish crystal..." The report may have been made on yellow octahedral microlite.

Boone et al. (1989) wrote of plagioclase in carbonaceous feldspathic quartzite blocks of the Hurricane Mountain Formation, **Pierce Pond**: "At least half of the larger grains show a crudely zonal clouding by nearly opaque rods and filaments, roughly 5 to 10 µm thick, and aligned approximately 75° to the basal cleavage. Their abundance decreases noticeably near the margins. The inclusions are deep brown or brownish red, and are isotropic. In polished section, they are scarcely distinguishable from host feldspar in reflected light. These characteristics resemble aluminous spinel..."

Spinel is reported by Bastin (1908a,b), Houston (1954, 1956), and Rainville and Park (1976). The data by Rainville and Park (1976) for **Union** and **Warren** indicate that the use of the word by Bastin (1908a,b) was generic and that chromian hercynite, ferrous iron-rich chromite?, and chromian ulvöspinel were probably found. No data were provided by Houston (1954, 1956): "At the Union deposit it [spinel] is present in minor amounts associated with hornblende."

Ludman (1990a) wrote of the Woodland Formation, **Alexander, Cooper, and Crawford**: "Green spinel is present in a few localities as well."

spodiosite?

Stoneham - *Lord Hill Q*

Dana (1892) made the following report after a systematic description of triplite and griphite and before spodiosite: "A phosphate occurring in green massive forms resembling apatite, at Stoneham, Me., afforded O.H. Drake (priv. contr.): P₂O₅ 40.54 FeO 33.39 MnO 11.47 CaO 2.53 MgO 0.36 Na₂O 6.16 K₂O 1.57

$F\ 3.70\ Fe_2O_3\ 0.79\ Al_2O_3\ 1.38 = 101.89$, deduct $O(=2F)\ [1.59 = 100.30]$ It is optically biaxial (Pfd.) and may represent a new species; the analysis, however, does not yield a satisfactory formula."

Spodiosite is listed as a doubtful mineral by Palache et al. (1944), but they provided data indicating it was interesting enough to consider for further study. Holden (1920) wrote: "... a ferrous fluophosphate from Stoneham, Maine, has been found to show a composition lying approximately midway between the sarcopside and apatite ratios, $R:(F,OH):(PO_4) = 12:3:7$. The purpose of the present note is to call attention to another apparently intermediate mineral, also from Stoneham, the analysis of which is given (as a peculiar "apatite") in *U.S. Geological Survey Bulletin* 591, p. 349 [originally Clarke, 1886a]. The ratio derivable from this analysis is 11:6:4, which is $\frac{2}{3}$ of the way from sarcopside to triplite ($7:2:4 + 2 \times (2:1:1) = 11:6:4$). The chief base in this mineral is calcium, so the member of the triplite group concerned is spodiosite; but the properties of the Stoneham mineral are so unlike those ascribed to spodiosite as to make its distinctness seem at least possible. Studies of the optical properties, with special reference to homogeneity, of minerals appearing to occupy intermediate positions in the series are necessary, however, before their status can be settled."

The analysis reported by Clarke (1886a) seems to be that of a completely different species than "spodiosite". Clarke (1886a) wrote: "The last named mineral [apatite] occurs in small crystals, and also in large dark-green masses. ... The high proportion of fluorine found in this analysis was undoubtedly due to intermixed fluorite. The large amount of magnesia, moreover, suggests the desirability of a careful search at the locality for wagnerite." The analysis given (Clarke, 1886a) yields an unsatisfactory formula and is either very much in error or that of a mixture or it represents a new mineral. No specimens known.

The nature of this material is in doubt. It would be convenient to suggest that the material was a mixture, but its green color and high iron content suggest it is still worth investigating. Material matching the description has not been collected in recent times, but it may have been overlooked as massive green apatite.

SPODUMENE (Pyroxene Group)

$LiAlSi_2O_6$

Andover? (= Dunton Q, Newry?); **Auburn** - Greenlaw Q, Maine Feldspar Q, Pulsifer Q, Wade Q; **Buckfield** - Bennett Q; **Byron** - Beaver Mountain A; **Cushing** - State Prison Farm spodumene P = Peg Claims Dike 1; **TD** - Bemis Stream P; **TE** - Harden-Keith-Small P; **Fryeburg?** - Kezar Pond A; **Georgetown** - Tourmaline P (=Harvard Cut); **Gorham?** - Dundee Falls A; **Greenwood** - Emmons Q, Harvard Q, Tamminen Q, Waisanen Q; **Hartford?**; **Hebron** - Mount Rubellite Q; **Litchfield?**; **Lovell?**; **Minot?** (= Maine Feldspar Q, Auburn); **Newry** - Crooker Q, Dunton Q, Kinglet Q, Martin P, Nevel Q, Pegmatite 24 P, Rose Quartz Crystal

L, Spodumene Brook P; **Norway** - BB #7 Q; **Paris** - Mount Marie Q, Mount Mica Q; **Peru** - Hedgehog Hill Q, Perry P; **Poland** - Berry-Havey Q; **Rumford** - Black Mountain Q; **Warren** - Peg Claims Dike 2, Starrett P, Starrett #2 P; **West Gardiner?**; **Windham** - Foster Corner A; **Wilton?**

Spodumene is a mineral which rarely forms terminated crystals. Wherever it is found, the spodumene usually consists of some of the largest crystals present in the deposit, yet terminations are scarce. Spodumene is usually found in white to ash-gray fibrous to splintery slab-shaped masses with perfect cleavage. An interesting wavy suture pattern is frequently seen which cuts across the prism or cleavage. Hess et al. (1943) wrote of the alteration of spodumene: "Cymatolite is still used to designate the mass. Spodumene is replaced by it but, on the other hand, the cymatolite follows cracks through quartz and feldspar, where it has evidently replaced those two minerals only. Some crystals replaced by pinite have kept their crystal form and are surrounded by cymatolite. The pinite replacement has been called killinite, ... also under the impression that it was a new mineral." Norton and Schlegel (1955) wrote of Maine, and the rest of New England, in their only statement concerning the region: "Reserves are small." Gunnell (1928) observed that some Oxford County spodumene is thermoluminescent.

The Andover Mystery

As early as 1885, Kunz indicated that spodumene had been found at **Andover**: "During the last year Mr. E. G. Bailey and Dr. A. C. Hamlin have opened the Mount Black locality at Rumford and [emphasis added] Andover, Maine." Kunz (1887c) reported: "... the discovery of fine pink spodumene at Andover, Maine." These dates predate the supposed discovery of the Dunton quarry location (1898). Sterrett (1907) stated: "The discovery of kunzite, or lilac-colored spodumene, at Andover, Oxford County, Me., will add a new interest to the gem industry of that state if pieces large enough for cutting are found. ... Mr. F. G. Hillman, of New Bedford, Mass., has reported the discovery of lilac-colored spodumene, or kunzite, as well as of some with a greenish color, called hiddenite by the informant, at Andover, Oxford County, Me. A cleavage specimen sent to the Survey measured about 12 by 10 by $3\frac{1}{2}$ millimeters and had a very pretty clear lilac color. It was not entirely without cleavage cracks, however. The greenish material had a pale aquamarine, nearly clear, though rather badly fractured. This spodumene was obtained near the surface, and it is hoped flawless material will be found with depth." Notice was also made of the Dunton quarry (Sterrett, 1907) which suggested that the Dunton quarry was a different and thus separate location. Sterrett (1908) noted: "Further work on the lilac and pale-green spodumene deposit at Andover, Oxford County, Me., has yielded mineral of good color, though clear only in small patches. Mr. F. G. Hillman reported surprisingly beautiful gems cut from material that had been pronounced valueless by two dealers in precious stones." Bastin

(1911) noted the Andover occurrence, but it is clear he was reiterating earlier reports. Morrill et al. (1958) was the first to ascribe the hiddenite report to the Dunton quarry, Newry.

The Andover locality could be considered a "lost" locality, or perhaps it was an early reference to the Dunton quarry, or even the Black Mountain quarry. Burr (1930) listed Rumford as the only kunzite locality in Maine and listed no pegmatite minerals in Andover.

Kunz (1904b) noted tourmaline mining activity which has been attributed to the Dunton quarry, Newry: "The tourmaline[s] from Rumford Falls, Oxford County, Me., are mined on the side of a densely wooded mountain, at an altitude of 2,511 feet above the sea. ... The associated minerals of the locality are quartz, feldspar, mica, lepidolite, amblygonite, and a pale lilac spodumene resembling the variety kunzite, but opaque." Webb (1904) noted "near the vicinity of Rumford Falls" and at an elevation of "2,500 feet above sea level" that the deposit had pale lilac opaque spodumene. Kunz (1905) added notice of the "Rumford Falls" locality, but never mentioned the name Newry. There is no point in the town of Rumford that is higher than Black Mountain at 2355 feet above sea level, and that peak is the highest in the East Andover 7.5 minute quadrangle, which also includes the Newry localities. The Dunton quarry was about equidistant between the villages of Andover and Rumford Falls (Rumford). Andover does have suitably high elevations to make good on the report (Little Puzzle Mountain and Long Mountain) as well as suitable elevations in Andover North Surplus and Andover West Surplus. If the reported elevation were a misprint by 1000 feet too much, it would coincide with the approximate elevation of the Dunton quarry.

Specimen Descriptions

Smoothly etched transparent and vitreous spodumene fragments (to 1.5 cm) have been found at the Wade quarry, **Auburn**. Tan granular and radially fibrous minerals including eosphorite are found on the spodumene surface.

Sterrett (1916) wrote of Auburn: "Mr. N. G. Smith, of the Maine Feldspar Co., submitted a specimen of purplish lilac-colored spodumene found during 1914 in the quarry of that company on Mount Apatite, near Auburn, Me. This spodumene is translucent to opaque. The color is as good as that found in much of the California iris or kunzite; the mineral only lacks transparency to make it a valuable gem. Evidently the specimen was broken from a crystal of some size, and Mr. Smith reports the finding of many pounds of the spodumene. It is probable that some of this material cut en cabochon could be used as an ornamental stone." Hess et al. (1943) appear to have mistakenly reported the location in Minot: "In the southeastern part of the town of Minot, ... on the south side of Mount Apatite, is the quarry of the Maine Feldspar Co., in which a little pollucite, spodumene, amblygonite, and lepidolite are reported to have been found."

Landes (1925) noted of the Bennett quarry, **Buckfield**: "Most of the spodumene at Buckfield has been rather completely kaolinized. ... Veins of lepidolite, belonging to a later period of mineralization, cut through several of the kaolinized spodumene specimens." White, tan, to amber veinlets of spodumene (to several mm thick and several cm long) cut across some pollucite at the Bennet quarry. Sometimes the veinlets contain granular quartz and are partially replaced by cookeite, lepidolite, and/or kaolinite (chemical analyses and XRD, this study). The spodumene is unknown #8 of King (1994).

Sundelius (1963) described the Peg Claims located in **Cushing** (Dike 1) and **Warren** (Dike 2). The deposit was originally called the State Prison Farm prospect. Sundelius said of the minerals: "This investigation is concerned with a group of zoned, granitic pegmatites in which spodumene is present from wall to wall and is orientated normal to the walls. ... Spodumene occurs as narrow, subhedral laths ranging in length from 1 inch to 14 inches. They are a dull tan in surface exposure and a pale green in drill core. Some of the spodumene laths are molded around elliptically-shaped perthite crystals. In several places, it was noted that spodumene crystals split around individual perthite crystals. ... In thin section, spodumene crystals are seen to contain small, generally optically discontinuous quartz blebs in a regular sieve-like pattern. ... Spodumene is altered along grain boundaries and partings to fine-grained fibrous aggregates of quartz and a micaceous mineral. ... The intergrowths [of quartz and spodumene] in Dike 1 probably represent primary crystallization textures and not recrystallization of petalite."

Spodumene from the Bemis Stream prospect, **Township D**, consists of small irregular tannish gray, sometimes orange-stained crystals (to 10 x 12 cm) embedded in cleavelandite and quartz. The spodumene is sometimes replaced by green to brownish green damourite.

Trefethen (1945) reported of the Harden-Keith-Small prospect, **TE**: "Sidney Harden, Rangeley, made one of the most interesting discoveries of pegmatite recently recorded. The deposit lies on the school lot of township E, south of Rangeley. The deposit has access to the C.C.C. road, and lies on the southern flank of Four Ponds Mountain, Rangeley Quadrangle. Three small pegmatite dikes, as shown on the map... carry spodumene intergrown with quartz and microcline. There is little mica present, and minor tourmaline. From the areas exposed at the present time, an estimated 800 to 1,000 tons of spodumene are present in the pegmatite. Visual estimate places the spodumene content at some ten per cent. The crystals vary in size from a fraction of an inch up to several inches in length. The type of deposit is similar to the Warren deposit previously described. The dikes are narrow, four to six feet wide. ... There is a minor amount of columbite-tantalite in small grains found in the central dike." Moench (1971) mapped the pegmatite, but only in its regional relationships.

Outstanding etched fluorescent (orange in short-wave and long-wave ultraviolet light) spodumene fragments were found in gem pockets at the Tourmaline Prospect (= Harvard Cut), **Geor-**

getown. The transparent spodumene is pale green or pale pink. The specimens are photosensitive and bleach to colorless when exposed to light. Etch surfaces are developed which sometimes suggest crystal faces and terminations. The spodumene is usually flawless and could cut small gemstones. The largest fragment found was about 8 x 3 x 1 cm (Ray Woodman, personal communication, 1974).

Hitchcock (1862b) first listed spodumene from **Litchfield**; Hess et al. (1943), Morrill et al. (1958) and Schreck (1961) continued the listing. No specimens or reasonable occurrence known. The mineral should be considered misidentified.

Hess et al. (1943) also noted: "Spodumene has been reported as in considerable quantity in two pegmatites west of Kezar Pond; town of Fryeburg;... [and] Wilton..." Morrill et al. (1958) place the two pegmatites "west of Kezar Pond" in **Lovell**.

The Nevel quarry in **Newry** has produced terminated spodumene crystals to 30 x 7 cm. The ashen white to green crystals are frequently frozen in quartz and/or cleavelandite. The termination shape resembles the bladed shape of "Roman" swords or traditional picket fences. Shainin and Dellwig (1955) wrote of Newry spodumene: "Spodumene has been found in all the Newry Hill pegmatites except the Red Crossbill, and [has been found] in the Spodumene Brook pegmatites on Plumbago Mountain. ... Practically all the spodumene occurs in fresh, white to pale green, flattened subhedral to euhedral prisms. The average crystal is 2 feet long, 6 inches wide, and 3 inches thick. Crystals in the core of the Dunton pegmatite, however, are only two-thirds this size. The largest crystals occur in the core-margin zone of the Main pegmatite, where a prism 10 feet long, 4 feet wide, and 5 inches thick was exposed in the Nevel mine..." Rose quartz crystals or triphylite can be associated. Most of the spodumene is found frozen in quartz-muscovite matrix.

Fraser (1930) wrote of the Dunton quarry area, probably the locality now called the Crooker quarry, but possibly the actual Dunton quarry, Newry: "In the northern pegmatite some of the crystals were over ten feet in length. A structure not before recognized in spodumene was shown by a large crystal fragment. A series of bands traverses the cleavages much as pericline twin lamellae appear in plagioclase. The bands are one or two mm. wide, fairly even but interrupted, sometimes gently curved. Their general attitude in the block is nearly parallel to the basal pinacoid. That they are due to twinning of some sort is certain but the law was not determined. There is no sign of alteration in the spodumene. Spodumene very commonly encloses mauve lepidolite." Hess et al. (1943) further elucidated: "About 200 feet along the top of the ridge north of the Dunton pegmatite is another but much smaller lens that in 1926 showed a number of boardlike spodumene crystals, some which had fairly good crystal terminations." Gemmy kunzite fragments hosted by cloudy pink spodumene would cut into gemstones of less than 1 carat (HH collection).

Hess et al. (1943) wrote of the Kinglet quarry, Newry: "Possibly 500 feet in a direct line down hill southwest of the Dunton pegmatite another was opened with an exposed perpen-

dicular face about 70 feet long and 12 feet high. Spodumene was more plentiful here than in the other pegmatites of the ridge. One crystal, as exposed, was 10 feet in length and 13 by 8 inches in cross section. Many of the crystals had pyramidal terminations." Hess and Ralston (1938) also reported on the Kinglet quarry, but not by name.

Hess et al. (1943) wrote of the summit of Plumbago Mountain: "Spodumene is exposed at many places and, at several points where there is an apparent thickening of the quartzose phase, the spodumene occurs in crystals as much as 10 inches thick and nearly square. Some are part glassy. ... The best outcrop of spodumene seen was near the lowest part of the pegmatite on the northeast side..." Shainin and Dellwig (1955) reported:

"Many crystals in the Kinglet pegmatite are pale green on fresh surfaces; Verrow (1940, p. 51) and Hess et al. (1943, p. 15) report pink spodumene from the Gem mine in the Dunton pegmatite. George Crooker (personal communication) found colorless, transparent, and almost flawless parts of spodumene crystals in the core-margin zone of the Main pegmatite [= Nevel quarry].

Many spodumene crystals in the Dunton, Crooker, and Kinglet pegmatites are bordered by rims of radiating white cleavelandite plates that appear to have grown outward from the spodumene. The cleavelandite rims are less common in the Main pegmatite, where relatively small amounts of cleavelandite occur... Several crystals in the core-margin zone of the Main pegmatite are cut by fractures, along which fine-grained, unoriented greenish muscovite has replaced the spodumene... In the Spodumene Brook pegmatites, spodumene forms 33 percent of the quartz-spodumene pegmatite unit in the West pegmatite."

The state record for the longest spodumene crystal (6.3 x 1 x 0.3 m) was found at the Martin prospect, Newry (Joe Martin, personal communication, 1992). Some of the Martin prospect spodumene is replaced by unctuous pale yellow-green pinite (q.v.).

Kunz (1888a) noted of the Perry prospect, **Peru**: "In 1887, at the spodumene locality at Peru, Maine, which has furnished tons of that material for commercial purposes, there were found some crystals in which the original spodumene had been almost entirely replaced by white quartz, with the exception of a white core of crystallized albite. These crystals are remarkable for the sharpness of the striated prismatic faces; the terminations are not so distinct. The surface of the crystals is covered with a coating of damourite." Williams (1888) listed spodumene from "Brown's Ferry, Peru." Marble (1928) wrote of the Peru Mica prospect (= Perry P): "Spodumene is plentiful, sometimes as single crystals in quartz matrix but more often in a confused mixture with cleavelandite and some petalite."

Kunz (1885) wrote of the Black Mountain quarry, **Rumford**: "During the last year Mr. E. G. Bailey and Dr. A. C. Hamlin have opened the Mount Black locality at Rumford and Andover, Maine. The indications here are quite good for gems, and a quantity of rubellite, a great quantity of lepidolite, spodumene 3

feet long, cookeite, amblygonite, and other minerals similar to those of the Mount Mica, were taken out, none however of gem quality." Kunz (1886b) added: "Spodumene was observed in imperfect crystals 7 cm. long, and in fine cleavages 10 cm. by 6..." Hess et al. (1943) described the occurrence of spodumene at the Black Mountain quarries: "Buried in the lepidolite are a few crystals of spodumene of which the largest seen was about 8 inches long, 7 inches broad and 1 inch thick. Here and there are bundles 1 to 3 inches thick of tourmaline crystals 1/8 inch in diameter. ... Outside of the lens of lepidolite... Spodumene crystals as much as 3 feet long, 8 inches wide and 2 or 3 inches thick are also scattered through the quartz, with here and there small nodules of amblygonite of 1 to 3 cubic inches each surrounded by a dark envelope [sic] of pinitite... about 1/8 inch thick..." Maillot et al. (1949) reported: "Individual crystals 5 feet long and 6 inches or more wide have been observed" and indicated that 2 avoirdupois tons of spodumene had been shipped.

Faulkner (1951) made a marvelous observation at the Black Mountain quarry: "A Spodumene crystal in a big chunk of Lepidolite interested me. I tried to crack it out with an 8-pound sledge-hammer. The sledge merely bounced. And in the dusk, the spot which the sledge had struck would glow very distinctly."

The spodumene from the Starrett prospect in **Warren** is composed of grains (to 15 cm) closely packed together in quartz matrix. The blocky spodumene grains can resemble a "log jam" aggregate in the quartz matrix. Gabriel et al. (1942) reported on trace elements in Warren spodumene. Hess et al. (1943) reported: "In 1930, 30 short tons of hand-picked spodumene containing 5 percent Li_2O was sold from the property, and in 1933 about 18.5 tons was shipped. One mass of spodumene and quartz was 23 feet long and 5 feet wide, and tapered from 18 inches to 1 inch in thickness. (From a letter of H. G. Starrett dated April 10, 1941.) About 1,500 feet west is another outcrop of pegmatite in which a small opening has been made, exposing a mixture of quartz, albite, and slender parallel crystals of spodumene as much as 4 inches long $\frac{1}{2}$ inch wide, and $\frac{1}{16}$ inch thick, having a worm-eaten appearance. The irregularity seems to be due to replacement of the spodumene crystals by quartz." Trefethen (1945) wrote of the Starrett quarry: "This property belonging to Hollis Starrett, Warren, Maine, is located in the south part of Warren township, and close to the Rockland branch of the Maine Central Railroad. There are two separate occurrences of spodumene pegmatite on this property... The larger of these was worked by Mr. Starrett in 1930-33. About fifty tons of spodumene were produced and shipped from this opening. Mr. Starrett reported the lithia contents at about five per cent. The spodumene occurs disseminated unevenly through this pegmatite, intergrown with microcline and quartz. The greater concentration appears on the southern half of the exposure. The crystals vary from a fraction of an inch to more than a foot in length, averaging perhaps $2" \times 3" \times \frac{3}{4}"$ A visual estimate of the spodumene content is ten per cent for the southern half, a width of some fifteen feet." Trefethen (1945) wrote of the Starrett #2 prospect, Warren: "Some 1500 feet west of the preceding prospect, about 300 feet east of the

railroad, is another showing of small size. Margining the west side of the pegmatite dike is a $2\frac{1}{2}$ foot zone of intergrown spodumene, albite, and quartz. The spodumene here is in small crystals; the largest noted was four inches. This deposit appears richer in spodumene than prospect number one..."

Jackson (1839) wrote of **Windham**: "In this town, near the bridge, I found an abundance of mica slate rocks, filled with large crystals of staurolite, also large detached blocks of granite, containing a rare mineral called spodumene, it being one of the minerals containing the new and fixed alkali [sic], lithia." Hitchcock (1861) added: "A large granite vein appears in the north part of the town. Boulders of granite in the vicinity contain the rare mineral spodumene." The locality has been suggested to be near Fosters Corner (Merle Brown, personal communication, 1990) and an ashen gray cleavage of spodumene (to 5×8 cm) with minor quartz from Windham was obtained from the Ecole des Mines in Paris, France (now HU unnumbered). The source locality is now lost.

spreustein = hydronephelite

stahlite = misprint for sahlite; Morrill et al. (1958)

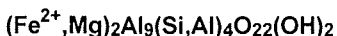
STANNITE



Bradstreet - *Catheart Mountain P*

Hollister (1978) reported stannite, without description, from the Catheart Mountain prospect, **Bradstreet**. The usually bronzy to silvery metallic mineral was undoubtedly observed only in fine-grained polished samples of sulfide ore.

STAUROLITE



Ammonoosuc Volcanics - **Upton**; **Andover** - *Wyman Mountain A*; **Appleton** - *Appleton Ridge A*; *Benner Hill sequence* - **Cushing**, **Friendship**, **Warren**; **Bridgton**; **Brunswick**; **Byron** - *Coos Canyon A*, *Swift River A*; **Camden**; **Carrying Place**; **Dixfield quadrangle** - *staurolite zone*; **Farmington-New Sharon** - *Bragdon Brook road A*; *Gonic Formation* - **Berwick**, **North Berwick**, **Sanford**; **Gorham**; **Harpwell** - *Barnes Point A*, *Lands End A*, *Orrs Island*; *Hebron?*; **Kingfield** - *Deer Farm Road A*; **Livermore Falls**; **Monmouth**; **Mount Abraham**; **Naples**; **Newry** - *heavy mineral sand*, *Littleton Formation*; *Old Town?*; **Phippsburg** - *Cape Small*, *Small Point*; **Rangeley**; **Readfield**; **Reading**; *Redington pluton contact* - **Dallas**, **Redington**; **Rumford** - *Red Hill A*; **Saint John River**; **Sebago**; **Sidney** - *Bog Road A*; **South**

China - southern China Lake A; South Windham; Standish; Staurolite zone - Avon, Byron, Carthage, Chesterville, TD, Dixfield, TE, Farmington, Freeman, Jay, Madrid, New Sharon, Perkins, Peru?, Phillips, Rangeley Plantation, Salem, Sandy River, Strong, Temple, Vienna, Washington, Weld, Wilton, T6 North of Weld, Upton; Thomaston quadrangle - Cushing, Saint George, South Thomaston, Warren; Vassalboro; Windham - Cook Road L; Winthrop - East Winthrop, float boulders, Waterville Formation

Staurolite is a rock-forming mineral of metamorphic origin. It is generally found continuously through the zones of rocks which contain it, though knots of concentrations are typical. Many reported staurolite occurrences refer to heavy mineral fractions in stream sediments, etc. Staurolite isograds were mapped by Guidotti (1970) and Moench and Pankiowskyj (1988). Burr (1930) listed many towns for staurolite, several of which may refer to discoveries of "float" boulders or sands. Pratt and Allen (1949) noted of staurolite they mapped in **Avon, Carthage, Chesterville, Dixfield, Farmington, Freeman, Jay, Madrid, New Sharon, Perkins, Peru?, Phillips, Salem, Strong, Temple, Vienna, Washington, Weld, Wilton, and T6 North of Weld**: "That part of the schist containing the staurolite commonly has much biotite mica; locally it also has garnet and muscovite. The staurolite crystals themselves vary from very small to one and a half inches in length." Dutrow (1985) studied staurolite compositions in the Farmington quadrangle. Dyar et al. (1991) studied staurolite compositions and structures from Byron, East Dixfield, West Sidney, and East Winthrop. Staurolite is very well developed in the Appleton Ridge area, **Appleton** (Charles Guidotti, personal communication, 1991).

Rectangular, brown staurolite crystals (to 3 cm, but normally 5 mm or less) with a rhombic cross-section and pitted surfaces are frequently encountered during gold panning along the East and West branches of the Swift River, **Byron**. Exceptional exposures of brown staurolite metacrysts (to 3 cm) are found in regularly spaced staurolite-congested layers in the rocks in Coos Canyon, Byron. Sharp, symmetrical crystals are abundant along with rounded and imperfect crystals. Additional staurolite zones in this area extend from above Saddleback Mountain, **Sandy River** southward through **Avon, Byron, TD, TE, Madrid, Phillips, Salem, and T6 North of Weld** and are a result of numerous contact metamorphic effects around small to large plutons. Jackson (1953) wrote of the western area in question: "The staurolite is a clear glassy brown with poikilitic inclusions of quartz and biotite. Most of the crystals have a soft thin altered marginal zone which give them a dull brown luster where unbroken." The staurolite crystals are so dark brown as to be virtually opaque in hand specimen. Guidotti (1965b, 1968b, and 1974) indicated that staurolite had been partially to completely replaced by muscovite. Muscovite pseudomorphs in particular have been observed on Brimstone Mountain, **TD** and between Brimstone Mountain and Dolly Mountain along the Swift River, **Byron**. Pankiowskyj (1964) noted similar muscovite

pseudomorphs after staurolite in the Dixfield quadrangle, while Moench (1971) also indicated that much staurolite had been, at least partially, replaced. Guidotti (1968b) described the formation of the TD and Byron pseudomorphs: "In the upper staurolite zone, moderately poikilitic 1 cm subhedral to euhedral staurolite occurs in medium-grained, well-foliated matrix of muscovite, biotite, quartz, and plagioclase. Coinciding approximately with the first appearance of sillimanite, staurolite in many specimens becomes anhedral with coarse laths of muscovite occurring around the outer rim... At progressively higher grades in the lower sillimanite zone the muscovite rimming becomes more pronounced and the enclosed staurolite shrinks... until it disappears at the isograd marking the upper sillimanite zone... The degree of pseudomorphing is readily observable even in the field. In some cases the pseudomorphs exhibit shapes typical of staurolite twins and occasionally include several 2 mm garnets. Above the isograd marking the upper sillimanite zone the aggregates of muscovite in the pseudomorphs tend to recrystallize into single large plates, up to 2 cm across, and commonly lie at high angles to the enclosing foliation... In some cases these muscovite plates contain swarms of fibrolitic sillimanite."

Hamlin (1826) reported: "*Staurolite* in mica slate, which contains also minute crystals of garnet. It exists in plantation letter **E**, about 40 miles from this [Paris], in the north eastern angle of this county, and was discovered a short time since, by the Hon. Enoch Lincoln, who informs me that it exists there in immense quantities, frequently presenting beautiful, well defined, crystallized forms."

Newberg (1979) noted of **Cushing, Friendship, and Warren**: "In rocks of the Benner Hill sequence pseudomorphs of muscovite after staurolite are common evidence that at least in the southwest portion of the map area the rocks have been affected by retrograde metamorphism. ... In one thin section, O-302, of a rock sample from the east boundary of the map area all three minerals are present. The sillimanite is anhedral with very irregular and 'gradational' (with respect to muscovite) grain boundaries while the garnet and staurolite occur as large euhedral crystals." Boucot et al. (1972) generally mapped areas containing muscovite pseudomorphs after staurolite in the Thomaston quadrangle, **Cushing, Saint George, South Thomaston, and Warren** and described the third known worldwide occurrence of recognizable fossils in such highly metamorphosed rocks.

Katz (1917) wrote of the Gonic Formation, **Berwick, North Berwick, and Sanford**: "The beds of argillaceous origin that have developed into garnetiferous and staurolitic phyllite... predominate..." Arthur Hussey (personal communication, 1992) wrote of the Gonic Formation: "Excellent staurolite crystals up to 1 cm along with porphyroblasts of biotite and garnet are common in the Gonic Formation..."

Boone (1970a) noted of the silvery schists on the Deer Farm road, **Kingfield**: "The pelite here reflects an intermediate grade of metamorphism, with layers 3-4 mm thick containing the assemblages biotite-staurolite-andalusite, and biotite-staurolite-chloritoid..."

Boone (1955) wrote of the **Farmington - New Sharon** area: "The staurolite-almandine schist from near the Bragdon Brook road contains abundant, conspicuously large staurolite porphyroblasts 10-20 millimeters in length. The almandine porphyroblasts, however, are commonly 2-3 millimeters in diameter. Twinned staurolite is present but not common. ... Staurolite invariably shows zonal structure. In some cases a ghost foliation extending through the crystals is revealed by the arrangement of poikilitically enclosed fine-grained quartz."

Vitro Minerals Company found staurolite in heavy mineral fractions of sand or soil samples from an unspecified locality, **Newry**.

The **Old Town** staurolite occurrence listed by Morrill and Hinckley (1959) is probably misidentified (Charles Guidotti, personal communication, 1990).

Arthur Hussey (personal communication, 1992) noted staurolite occurrences in coastal Maine, **Phippsburg** and **Harp-swell**: "One of the finest staurolite localities in Maine is at Cape Small, Phippsburg... Here staurolite crystals are rather stubby twins up to 2 cm long. They are associated with biotite and garnet porphyroblasts, large poikiloblasts of pink andalusite, and 2 to 6 cm pseudomorphs of muscovite after chialstolite (?) in a pelitic schist. This is part of the Cape Elizabeth Formation. Twinned and untwinned staurolite is sparingly present in the Cape Elizabeth Formation in Harpswell, particularly on Bailey Island at Lands End, the western side of Harpswell south of Barnes Point, and Orrs Island (Hussey, 1971c). ... Pseudomorphs of muscovite and chlorite after staurolite twins, and relict partially replaced staurolite crystals are present in the Yarmouth Island Member of the Cushing Formation in the Bethel Point area of East Harpswell (Hussey, 1971a)."

Boudette (1991) noted staurolite along the Redington pluton contact, **Dallas** and **Redington**: "Garnet, staurolite, and chialstolite blades as much as 2 cm long formed in places in type section sequence nearest Redington pluton..."

Osberg (1968) mapped a staurolite isograd in **Sidney** from Carlton to Messalonskee Lake and eastwards toward the Kennebec River: "Outcrops of quartz-muscovite-biotite-staurolite-andalusite-garnet schist may be observed along Bog and Middle Roads north of North Augusta, and cordierite-bearing schist may be seen in West Sidney."

Perkins (1928) noted of **South China** as well as the Franklin County staurolite localities just mentioned: "At the south end of China Lake and along the road between Phillips and Rangeley, staurolite is found in well-developed crystals, often taking the form of crosses."

Milton (1961) noted the presence of staurolite phenocrysts in the Ammonoosuc Volcanics between the Swift River at Route #26 and East B Hill, **Upton**. Staurolite was also noted with kyanite in the kyanite schist member of the Ammonoosuc Volcanics. Trace to accessory amounts of staurolite were noted for a schistose conglomerate (Littleton Formation) on the west ridge of Puzzle Mountain, **Newry**; a silvery-gray schist on a ridge south of Great Brook and Meadow Brooks, **Newry**; Puzzle

Mountain - Plumbago Mountain ridge, **Newry**; southwest of "town corner," **Newry**; and southern Wyman Mountain, near USGS bench mark "898" (feet), **Andover**. Milton (1961) said of the Puzzle Mountain - Plumbago Mountain Ridge occurrence: "Staurolite occurs in large poikilitic porphyroblasts up to an inch long... Although these are almost invariably 60° twins, the cross is usually poorly developed, with the smaller individual appearing only as excrescences on the side of the larger."

By far the best staurolite crystals in Maine have been found at the Cook Road locality in **Windham**. They rank among the best staurolites from the United States, although not as large as those from Pearl Lake, New Hampshire. Kunz (1892a) wrote: "Brilliant crystals are found at Windham, Me., some of the twins forming fine crosses." The crystals there are up to 5 cm long by 2 cm wide and have vitreous luster. Crystal faces are sometimes pitted due to interruption of the surface by quartz and almandine grains. The host rock is a quartz-biotite schist. Both St. Andrews and Maltese Cross twins are known from the locality, but twinning is not as frequently seen as from the familiar Georgia and Virginia localities. Penfield and Pratt (1894) studied Windham staurolite along with specimens from several other world localities to determine the nature of inclusions (poikilitic quartz) in the mineral.

Dark brownish black staurolite crystals (to 3 cm) are found embedded in fine-grained gray mica schist boulders, **Winthrop**. The staurolites are sometimes crudely formed and are frequently Saint Andrews-twinned. Pale pink almandine crystals (to 2 mm) are sometimes attached to the staurolite. Jackson (1838a) wrote of Winthrop: "One mile North from the town, near the pond, good mica-slate is found suitable for flagging stones. It contains a few crystals of brown staurotide, scattered in its mass." Fisher (1941) reported staurolite and chloritoid from several central Maine localities: "Pyrite, chloritoid, and limonite are the chief accessories of the calcareous phase of the Waterville [Vassalboro] formation. ... Two facies of the Winthrop phyllite are recognized. Small chloritoid plates characterize one facies, and staurolite and garnet the other. The garnet-staurolite facies has been traced southward along the strike from Winthrop into the northeastern portion of the Lewiston quadrangle. Along the Maine Central Railroad 1½ miles southeast of the outlet of Wilson Pond it overlies conformably a middle-grade zone marble. The chloritoid facies has been traced northward along the strike into the Belgrade Lakes area where it gradually merges with the Waterville slates. ... Scattered rectangular plates of nearly opaque chloritoid and elongated staurolites are not oriented."

staurotide = staurolite

steatite (Talc Group) = fine-grained talc

Harp-swell - *Jaquish Island A*; **Orrs Island** - *Orrs Island Soapstone quarry*

STELLERITE (Zeolite Group)



Mount Desert - Grencl Q; Stoneham

Stellerite is a calcium-rich member of the stilbite group of zeolites. Tan to colorless transparent stellerite crystals (to 3 mm) are found in miarolitic cavities at the Grencl quarry, Hall Quarry village area, **Mount Desert**. The crystals form relatively simple rectangular prisms which are deeply striated lengthwise and which have a perceptible pearly luster on the "b" pinacoid. The small termination faces are rectangular and at right angles to the "prism" faces. A characteristic feature is the small curvature of the termination. The stellerite is found with clear to white albite crystals (to 2 mm), occasional quartz crystals (to 2 mm) as well as minor granular clinocllore. Minute actinolite needles (to 1 mm) grow into the base of the stellerite, and purple fluorite grains (to 3 mm) are found on the fractures. The individual stellerite crystals can have a "Roman sword" termination or have "c" pinacoid faces which cut the pyramidal faces to very small size, giving the crystal a simple rectangular habit.

One specimen of the sphaerostilbite variety of stellerite (AMNH 88367, unanalyzed) from **Stoneham** consists of a white botryoidal (to 8 mm) mineral composed of columnar crystals with flat terminations sutured together, tightly to individually sprinkled over an etched fracture surface of green calc-silicate rock.

stephanite?

Franklin?; Gouldsboro - Gouldsboro M; Hancock - McFarland M; Lowell - Shorey M; Sullivan - Sullivan M

No specimens or descriptions are known. This is probably a fraudulently reported mineral to attract investors. Kempton (1879) reported of the Sullivan mine, **Sullivan** (also repeated in MMJ, March 26, 1880): "The ore is essentially silver, sulphides and native, in quartz and slaty gangues, with slight amounts of iron, zinc, etc., as sulphides, and also galena. Of the silver minerals, stromeyerite is most plentiful, stephanite next, argentite (silver glance), common, native silver in flakes very plenty, threads frequent, lumps occasional. Ruby silver is exceedingly rare; antimonial silver has been found. The occasional yellow copper sulphide met with has a peculiar lustre and runs very rich in silver." The statements about the richness of the stephanite ore in Maine, particularly at Sullivan, need to be tempered against statements by Ramdohr (1969) who suggested that stephanite rarely ever has economic significance much less is a major component of a silver ore. Emmons (1910), Li (1942), and Young (1962, 1963) failed to find any Maine silver minerals during their scientific studies, and no known collectors have seen or own specimens of this mineral. While rich ore pods would have been carefully selected for reduction, the complete lack of

silver ore minerals in Sullivan mine dumps, and the virtual absence of such minerals in museums, but for a unique silver specimen, suggest that incompetence and/or fraud were responsible for most of the reports. See discussions for brittle silver, stromeyerite, and silver.

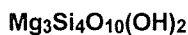
sterlingite (Mica Group) = damourite

Newry; Rumford - Black Mountain Q

Dick Nevel (letter to Wallace E. Richmond, Jr., May 25, 1938) wrote of **Newry**: "Several specimens showing associated minerals of Qtz., spodumene, sterlingite. From the new prospect that produced the large purpurite [sic] mass. Most of the specimens are of good to fair size but I haven't them here before me excepting one which is 4 x 5". lot, \$1.00." From this description, it can be surmised that foliated to fibrous muscovite or cymatolite was called sterlingite at Newry. No specimens known.

Bailey (1929) listed a sterlingite variety of damourite and muscovite, without description, from the Black Mountain quarry, **Rumford**. No specimens known.

STEVENSITE



Thomaston - Dragon Q

Stevensite is a component in the waxy orange to brown fine-grained masses (to $10^+ \times 10^+ \times 2^+$ cm) of deweylite or kerolite found in veins in the dolomitic marble at the Dragon Cement Company quarry, **Thomaston**.

STEWARTITE

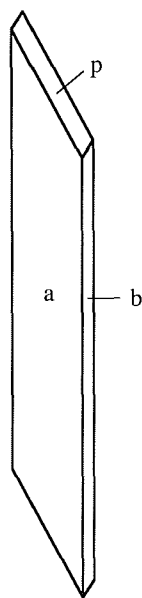


Greenwood - Emmons Q; Newry - Dunton Q; Paris - Mount Mica Q; Poland - Berry-Havey Q; Stoneham - Cole Q

Stewartite is a relatively inconspicuous species. It generally forms small sprays of 1-2 mm amber to golden yellow pointed, bladed crystals. The closely related mineral, laueite, can resemble stewartite, but always has a lower-angle termination. In Maine, stewartite appears to have a consistently steep termination.

Stewartite crystals (less than 1 mm) in tight yellow botryoidal groups (to 2 mm) are found in vugs of altered lithiophilite at the Emmons quarry, **Greenwood** in association with rhodochrosite/siderite. Avocado-green earthy mitridatite coats vugs in the carbonate, and other associated minerals include secondary phosphates such as strunzite and hydroxylapatite.

The siderite nodules found in blue tourmaline eyes in cleavelandite from the Dunton quarry, **Newry** have yielded



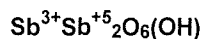
Stewartite, Mount Mica Q, Paris

numerous interesting phosphates. Stewartite is a scarce member of the assemblage. It is found in tiny (1 mm or less) "hedgehog-like" clusters of crystal points extending out of a nearly spherical mass of yellow stewartite. Yellow to butterscotch-yellow laueite crystals with the typical low angle terminations are usually associated, along with reddish brown diadochite and cream-colored fairfieldite. The mineral was known in Maine in the early 1930's (Holman, 1935).

Stewartite from Mount Mica quarry, **Paris** was found during the Plumbago Mining company's operations. The 1 mm steeply terminated transparent yellow crystals were found in mitridatite-lined vugs in quartz associated with yellow laueite crystals (1 mm).

Tan, yellow to yellow-brown stewartite crystals are found in sub-parallel to radial groupings of individually bladed crystals (to 0.5 mm) at the Berry-Havey quarry, **Poland**. Some of the stewartite clusters (to 1 mm) are nearly spherical with a uniformly spiked surface. The stewartite is found implanted on golden brown eosphorite crystals (to 3 mm) along with siderite rhombohedra (to 2 mm) and occasional very tiny strunzite crystals (very much less than 1 mm) or hureaulite and phosphosiderite with muscovite and quartz.

STIBICONITE



Levant - Antimonial Silver M; **Linneus** - Drew Hill sulfide veins; **Stoneham**? - Lord Hill Q

Waxy to earthy tan to tannish yellow masses (to 2 mm) and thin white pseudomorphs (to several cm) of stibiconite after

stibnite are found in quartz vugs from the Antimonial Silver mine, **Levant** and the Drew Hill sulfide veins, **Linneus**.

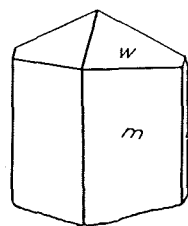
Stibiconite? replacements after stibnite? have been sight identified as occurring at the Lord Hill quarry, **Stoneham** (Bjareby #4892), but the specimens have been chemically analyzed and X-rayed (this study) and are bismutite after bismuthinite (stibnite group).

STIBIOTANTALITE



Topsham - Fisher Q

Stibiotantalite is not a member of the columbite group, and, but for its name and accidental chemistry, bears no close relationship to tantalite. Stibiotantalite forms tan to light brown rectangular platy crystals (1-2 mm) which are clustered (to 5 mm) in jackstraw fashion in albite. Pagoda-like growths of yellow muscovite with silvery to fine-grained margins, along with quartz crystals (to 3 mm) and occasional green microlite (to 3 mm) are associated. Some of the stibiotantalite crystals are included in massive quartz. The crystals show a very pointed rhombic cross-section. Stewart (1938) and Palache and Gonyer (1940) reported of the mineral from the Fisher quarry, **Topsham**: "The specimen, about half a square centimeter in area, consists of a crystal of microlite, one surface of which is coated with albite, a little sericite and about 30 tiny crystals of stibiotantalite. The pale gray to brownish crystals are about 1 mm. long and .3 mm. in greater diameter. Most of them are implanted by one end of the *c*-axis and show a single prism and pyramid... The pinacoidal cleavage is perfect and truncates the thin edges of the prism." Only a few additional specimens are known.



Stibiotantalite, Fisher Q, Topsham (from Palache and Gonyer, 1940)

STIBNITE (Stibnite Group)



Acton - Acton M; **Blue Hill** - Douglass M; **Buckfield**?; **Carmel** - Carmel M; **Eastport**?; **Falmouth**?; **Hallowell**?; **Hampden** - Consolidated Hampden M, Lawrence M; **Levant** - Antimonial Silver M; **Linneus** - Drew Hill sulfide veins; **Saco River bed** - **Standish**?; **Sullivan**?; **Vanceboro**?

Houghton (1861) first reported stibnite from **Carmel** as sulphuret of antimony and it was further noted by Shepard (1864). Neither author provided descriptions. Further reports were made (MMJ, June 4, 1880). Morrill and Hinckley (1959) noted that the Carmel Antimony mine had stibnite "crystals," but bright silvery cleavages (to several cm) in rusty quartz are the only specimens observed today.

Large striated silvery metallic cleavages (up to 5 x 10 cm) of stibnite are found in brown-stained quartz matrix from the Antimonial Silver mine, **Levant**. The stibnite can be acicular to ribbon-like and partially to completely replaced by stibiconite.

Stibnite from the Drew Hill sulfide veins, **Linneus** are found as terminated crystals (to 4 x 0.3 mm) in vugs of quartz crystals (to 4 mm) as well as broad (to 3 cm) silvery metallic cleavages. The stibnite is striated and typically has tan to yellow waxy masses and coatings of stibiconite and/or valentinite and kaolinite on both the crystals of stibnite and on the quartz. Occasionally, fine-grained red schafarzikite and metastibnite impregnates the stibnite masses. The schafarzikite and metastibnite layers can be one millimeter thick.

Mr. W (1809) gave an interesting account of looking for and discovering mineral veins near **Standish?**:

"I am led to these observations by reflecting on a fact, lately communicated to me by a friend, viz. that so great is the scarcity, in this country at present, of the mineral called antimony, so indispensably necessary in the manufacture of printing types, that unless a supply can be speedily procured from Europe, the proprietors of the type foundry in this city [Philadelphia], the largest and most extensive in the United States, will be obliged to discharge one half, or perhaps two thirds of all their hands; and thus will a severe check be given to the present unexampled progress of arts and literature in this flourishing, peaceful and happy country, for want of a single article, which perhaps, lies at no great distance, in inexhaustible quantities under our very feet. I confess I was less mortified to hear that the exportation of this article had been prohibited by the respective governments of France and Great Britain, than to be told, that *antimony is nowhere found native within the territory of the United States*, and that to procure it, we must admit to the most humiliating impositions. If the first of these assertions were absolutely true, that in an extent of two thousand miles by one thousand, of plains, vallies, mountains and precipices, a single mineral, so common in other parts of the earth, should be entirely wanting in this, it would be a kind of miracle in the mineralogy of our country, without a parallel in any other part of the globe.

But this is highly improbable; nay, I have no hesitation in asserting it as my opinion, that native antimony does actually exist in this country, in as great quantities, and perhaps as much purity, as in any other country whatever; and, that if proper search were made, it would most certainly be found. The facts and circumstances on which this opinion is founded, I shall, for the information of those immediately concerned, and for the encouragement of others, briefly detail.

In the winter of 1808, being in Portsmouth, New Hampshire, I was shown a mineral substance, evidently sulphureted antimony, which was said to have been found in the bed of the Saco river, about twenty

miles above the town of that name, in the District of Maine. A celebrated mineralogist now, or lately in this city, had been presented with specimens of the same, and directed to that part of the river where it was found; but mistaking the place for the *banks*, instead of *bed* of the river, the waters of which were at that time high; he wandered about for a whole day in the rain in search of the spot, but without success. As the river during my visit was in the same state, I had no better opportunity of examining than my predecessor; and this place remains still unexplored. The land adjoining is the property of a Mr, Nathaniel Parsons, who lives about two miles north west from York court house, in the same district of Maine."

Mr. W (1809) continued to discuss his learning of additional antimony ore locations in Hadley, Vermont and Thompson's Mill, North Carolina. In each case, the significance of the finds eluded the finders and no additional interest or activity resulted:

"After such highly encouraging proofs, let us hear no more whining, that this valuable mineral *nowhere exists within the territory of the United States*; but let those who have skill and opportunities for making excursions, be on the alert, and leave no stone unturned in the pursuit; for, with prophetic certainty, I almost venture to pronounce in this, as in a much more solemn and important affair, SEEK DILIGENTLY AND YE SHALL FIND" (W, 1809).

STILBITE (Zeolite Group)



Blue Hill - Route #15 road cut, Route #172 road cut; **Calais** - U.S. Route #1 road cut; **Franklin**; **Hallowell**; **Mount Desert** - Grenville Q; **Orland** - U.S. Route #1 road cut; **Perry** - Loring Cove A; **Phippsburg** - metamorphic limestone; **Stoneham**; **Stonington** - New England Stone Industries Q; **Vinalhaven** - Sands Granite Q; **T10SD** - Catherine Hill Q

White stellate sprays (to 3 cm) of stilbite are found completely lining fractures in calc-silicate rock in road cuts along Routes # 15 and # 172 in **Blue Hill**. No terminations were found.

A road cut along U. S. Route #1, **Calais** produced exceptional prehnite crystals, with a number of specimens overgrown by white prismatic stilbite crystals. The rectangular stilbite crystals (to 5 mm) show striated, closely spaced, subparallel crystals with small pyramidal faces.

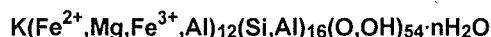
Stilbite from the Loring Cove area, **Perry** is found in altered basalt vesicles. The clear stilbite cleavages are frequently colored salmon-pink and fill vugs (to 5 mm) lined with a green waxy mineral (perhaps a chlorite, serpentine, or even celadonite).

Small tan stilbite crystals (to 3 mm) were found in an enlarged joint-surface cavity which also contained quartz crystal fragments, ilmenite fragments (to 5 mm) and zircon at the Crotch Island quarry, **Stonington**. Some stilbite crystals (to 3 mm) at the New England Stone Industries quarry on Crotch Island occur as one of the late minerals to form in miarolitic cavities (Woodrow

Thompson, personal communication, 1993). At this locality smoky quartz crystals (to several cm) can be coated with red-brown drusy hematite scales and films which in turn can be overgrown by creamy to amber rectangular prismatic stilbite crystals with small modifying faces, and milky white laumontite crystals (to 3 mm), all overgrown by calcite and epidote.

Smith (1923) said of the Sands quarry, **Vinalhaven**: "Joints (C) are coated in places with crystalline calcite to the thickness of 0.25 inch, or with hematite, chlorite, and stilbite in microscopic films.

STILPNOMELANE (Stilpnomelane Group)



basaltic dikes - Easton, Mars Hill; TDR2 WELS - Maple Mountain P; Deer Isle - Dunhams Point A; Dunn Brook Formation - T8R3 WELS, T9R3 WELS; TER2 WELS; Hodgdon - northeast of Westford Hill; Hurricane Mountain Formation - Chase Stream, Misery, Sapling; Jim Pond - road cut Route #27; Upper Enchanted - Upper Enchanted Pond A; T3R9 WELS - Hovey Mountain P

Considerable confusion exists in the nomenclature of the stilpnomelane group. Chemical analyses of the mineral vary widely and a number of species names have been proposed. Lennilenapeite is the magnesium-dominant member of the group, while franklinphilite is the manganese-dominant member. Historical usage has preferred stilpnomelane for the ferrous-dominant mineral and chalcodite (or ferristilpnomelane) for the ferric-dominant material. It is certain that Maine "stilpnomelane" encompasses several species. Stilpnomelane is a micaceous mineral, but seldom shows cleavage flakes larger than a few millimeters.

Stewart (1956) first noted stilpnomelane on Dunhams Point, **Deer Isle**, and it was later studied by Frondel and Ito (1965) and Smith and Frondel (1968). The material consists of dark brown to brownish black foliated and undulating masses of nearly pure micaceous stilpnomelane (flakes to 1 cm).

Pavlides (1971) noted: "Stilpnomelane? along rock cleavage" in a green phyllite exposed northeast of Westford Hill, **Hodgdon**.

Boone et al. (1989) wrote of the Hurricane Mountain Formation mélange, **Chase Stream, Misery, and Sapling**: "In some specimens, fine-grained clusters of stilpnomelane and white mica surround plagioclase grains."

Radiating dark gray-green to gray-brown waxy to vitreous stilpnomelane foliae (to 7x5 mm) are found embedded in white ferroan dolomite in a road cut on Route #27, **Jim Pond**. Masses of the ferroan dolomite appear rusty red-brown on exposure to weathering. This material is outstanding by American standards.

Pavlides (1978) wrote of diabasic and basaltic dikes, **Mars Hill and Easton**: "Carbonate is present locally and rare flakes of brown biotite (?) or stilpnomelane are present in a few rocks."

Light golden brown films of stilpnomelane coat brachiopod impressions, Little Enchanted Pond area, **Upper Enchanted**.

Though stilpnomelane composes 10-50 % of some manganese-bearing rocks in Aroostook County, along with chlorite, no adequate description has been made of it. Eilertsen (1952) lists it from the **T3R9 WELS, TDR2 WELS, and TER2 WELS** deposits. Pavlides and Milton (1962) say of the Hovey Mountain, **T3R9 WELS** and Maple Mountain prospect, **TDR2 WELS** material:

"Stilpnomelane is generally an abundant accessory mineral in the metaperlitic keratophyre of Saddleback and Hedgehog Mountains, and it typically occurs as sheaflike bundles of very fine grained needles. It is markedly pleochroic from bright yellow to deep olive brown and may be ferristilpnomelane (Winchell and Winchell, 1951, p. 390). A mineral with similar habit but with pleochroism ranging from pale yellow to deep green and resembling ferrostilpnomelane is a sparse constituent in a few of the metaperlitic keratophyres examined. ... The manganese-bearing siliceous carbonate rocks on Maple and Hovey Mountains, exclusive of most of those associated with the Maple-Hovey and Southern Hovey deposits, contain magnetite. In some places, these siliceous carbonate rocks are somewhat similar both in their megascopic features and mineralogy to the banded magnetite-bearing ironstone believed to have developed by metamorphism of primary banded hematite rock.

The distribution of the nonopaque and opaque minerals in the magnetite-bearing siliceous carbonate rocks is highly variable. The light-colored laminae consist principally of carbonate with different amounts of chlorite, cryptocrystalline apatite, quartz, and ferristilpnomelane (?). In places, a pale pink to red color is imparted to these layers by limonite and red oxides associated with the carbonate. The dark-green layers are composed chiefly of chlorite and also contain minor amounts of the above-mentioned minerals. ... Stilpnomelane, identified by X-ray pattern, ... has also been found in rhodonite-bearing veinlets. In one place it occurs in fibrous growth, perpendicular to the wall of a stringer."

Given the manganese-rich nature of the association, this stilpnomelane should be chemically analyzed. No specimens available. Pavlides and Milton (1962) also found stilpnomelane in the greenstone on Spruce Top Hill and Number Nine Mountain, **TDR2 WELS**. Stilpnomelane was also reported by Pavlides (1962).

Pavlides (1973) noted stilpnomelane in the Dunn Brook Formation, **T8R3 WELS** and **T9R3 WELS**.

STRENGITE



Greenwood - Emmons Q; Newry - Dunton Q

The Emmons quarry, **Greenwood** has produced pale pinkish lilac granular crystals (much less than 1 mm) of strengite associated with dark coppery red bermanite, golden orange-

brown jahnsite-(MnMnMn), yellow stewartite, white fairfieldite, olive-green mitridatite, and red-brown robertsite in small vugs in oxidized lithiophilite.

Strengite is a very inconspicuous and difficult to identify species in Maine. At the Dunton quarry, **Newry** strengite is found as tiny, much less than 1 mm, botryoidal crystal aggregates in black-stained siderite-triophyllite in blue tourmaline eyes. The granular looking aggregates of strengite are clear to the palest shades of pink or lilac. The associated minerals reported by Seaman (1975d) included: landesite?, laueite, rockbridgeite, and stewartite.

stromeyerite?

Sullivan - Sullivan M

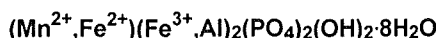
No specimens are preserved in collections and no descriptions are known. Kempton (1879) reported of the Sullivan mine, **Sullivan**: "The ore is essentially silver, sulphides and native, in quartz and slaty gangues, with slight amounts of iron, zinc, etc., as sulphides, and also galena. Of the silver minerals, stromeyerite is most plentiful, stephanite next, argentite (silver glance), common, native silver in flakes very plenty, threads frequent, lumps occasional. Ruby silver is exceedingly rare; antimonial silver has been found." This list was repeated in the *Maine Mining Journal*, March 26, 1880. This is probably a fraudulently reported suite of minerals designed to attract investors. The statements made about the richness of stromeyerite ore need to be tempered against statements by Ramdohr (1969) who stated he had not seen a specimen of stromeyerite larger than 0.5 cm from anywhere in the world, including the great European silver mines. Emmons (1910), Li (1942), and Young (1962, 1963) failed to find any silver minerals during their scientific studies, and no known collectors have seen, and no museum collections own, specimens of this mineral from Sullivan. While rich ore pods would have been carefully selected for reduction, the complete lack of ore minerals in Sullivan dumps suggest that incompetence and/or fraud were responsible for the reports. No subsequent contemporary Sullivan mine report mentioned stromeyerite in the ore suite: for example (MMJ, April 29, 1881):

"The ore is a fine-grained argentiferous galena assorted with zinc blende, sulphurets of copper, iron pyrites, and some gold.

The average pulp assay is low, on account of a loss of the fine particles of native silver and sulphurets in transmission from the stopes to the mill..."

Similarly (MMJ, July 1, 1881), a complete-looking species list of Sullivan mine ore did not mention stromeyerite, stephanite, or argentite, though an equally improbable list was published including horn silver (= chlorargyrite [q.v.]).

*STRUNZITE (Strunzite Group)



Greenwood - Emmons Q; **Hebron?** - Mount Rubellite Q; **Newry** - Bell Pit, Dunton Q, Nevel Q; **Norway** - BB #6 Q; **Paris** - Mount Mica Q; **Poland** - Berry-Havey Q; **Rumford** - Black Mountain Q?, Goddard Ledge Q(= Ford Hill Q?), Red Hill Q; **Stoneham** - Cole Q, Lord Hill Q; **Unity?**

Strunzite was known for many years from many localities, before it was finally described. The reason for the lag in the description was the small acicular to fibrous nature of the crystals. Initially, no locality had produced enough material for a chemical analysis to be performed. The material was affectionately called "Frondel's whiskers," as the needle-like crystals were assiduously sought by Clifford Frondel, the mineral's namer. When enough material became available, 11 localities were announced at once (Frondel, 1958a,b). The co-type localities in Maine include BB quarry, Norway; Red Hill quarry, Rumford; and an unspecified quarry at Newry. Frondel (1958a,b) also listed Unity, Maine as a type locality for strunzite, but this listing may have been a mistake, as no specimens are from, and no appropriate localities are known in Unity, Maine. There is a strunzite locality in Unity, New Hampshire.

Strunzite is the most commonly reported member of the strunzite group from pegmatites. Iron-rich members of the group, ferrostrunzite and ferristrunzite, have been usually found in iron-rich sedimentary rocks, etc. Ferrostrunzite may be present in particularly iron-rich pegmatite assemblages, but a scarcity of chemical analyses may be responsible for this "under-representation." Manganoan ferrostrunzite (EDAX, this study) comes from the Dunton quarry, Newry in an iron-rich association. At all of its localities in Maine, strunzite is found in crystal cavities (usually 1-2 mm) in siderite/rhodochrosite. The fine strunzite needles (to several mm and extremely thin and "splintery") are tan to clear or straw-colored and can be confused with fluorapatite, hydroxylapatite, moraesite, etc. It is supposed that true strunzite also occurs at the Dunton quarry along with manganoan phosphates.

Tan to cream-colored needles (to 2 mm) have been found interlayered in lepidolite cleavages (to 5 mm) from the Mount Rubellite quarry, **Hebron**, but the material seems to be misidentified apatite.

Tan, almost transparent strunzite crystals (1 mm and less) are found at the Bell pit, **Newry** in association with white platy fairfieldite masses (to 3 cm). Tan to very pale yellow strunzite is also found at the Bell pit in vugs in clean or brown to black stained siderite. The crystals can be arranged in jackstraw fashion on siderite and quartz crystals (to 2 mm). The strunzite sometimes forms "paint brush-like" sprays and seems to wrap around or infill the nooks around crystals of associated species in the siderite assemblage.

The Nevel quarry (Twin Tunnels Q), Newry strunzite is found in siderite and cleavelandite matrix frequently associated with fairfieldite. The acicular tan to buff strunzite crystals (less than 1 mm) are frequently grouped in "matchstick" like bundles or somewhat plumose aggregates on occasionally etched siderite crystals (less than 1 mm), sometimes associated with octahedral and cubo-octahedral pyrite crystals (less than 1 mm), purple heterosite, or earthy green mitridatite.

At the Dunton quarry, Newry, the strunzite is found in siderite-filled blue tourmaline eyes in cleavelandite. The siderite and cleavelandite matrix can be brown to black stained. The strunzite clusters can be found flattened in stellate patterns against siderite, etc. where the mineral grew in cracks. Associated species include beraunite, laueite, and other phosphates typical of siderite assemblages. Manganoan ferrostrunzite has been identified in iron-rich micro-assemblages at the Dunton quarry (this study), but some fairly manganese-rich associations also occur there.

The BB #6 quarry, Norway has produced 1 mm strunzite crystals profusely sprinkled on fairfieldite in siderite-cleavelandite matrix. Tiny (less than 1 mm) orange-brown striated jahnsite-(CaMnMn) crystals appear to be sprinkled on the slightly mitridatite-stained fairfieldite.

Strunzite from the Mount Mica quarry, Paris occurs as tan inconspicuous needles (less than 1 mm) in vugs of corroded triphylite rimmed by blue elbaite. Green fibrous beraunite, orange to white hureaulite, tan to brown siderite, etc. can be associated.

At the Berry-Havey quarry, Poland enormous (to 7 mm) buff to straw-yellow strunzite crystals in "paint brush" clusters have been found with etched pink rhodochrosite and rhodochrosite crystals (to 3 mm) and earthy avocado-green mitridatite coating fairfieldite crystals (to 3 mm) in 1 cm groupings, and with yellow-green to greenish-brown platy dickinsonite crystals (less than 1 mm) in quartz matrix. Rounded fluorapatite crystals (to 2 mm) and white botryoidal fluorapatite (less than 1 mm) can be associated. Strunzite crystals (in jackstraw clusters to 1-2 mm) occur on brown manganoan siderite crystals (to 2 mm) and quartzoid quartz crystals (to 2 mm), also at the Berry-Havey quarry.

Strunzite at the Red Hill quarry, Rumford occurs in vugs of tan manganoan siderite in black-stained albite/cleavelandite-quartz matrix. The short, straight strunzite needles (1 mm and less) are tan, buff, straw-yellow, orange tinted, etc. They can have a splintery appearance and cluster in tightly packed "carpets" lining vugs. Individual crystals, though almost entirely inconspicuous, can be found. Strunzite is almost never snow-white. Associated species include green beraunite, ludlamite cleavages and crystals (to 3 mm), vivianite cleavages (to 4 cm) and individual vivianite crystals (to 3 mm), and very tiny (much less than 1 mm) almost acicular golden brown siderite crystals. Rock-bridgeite was reported from the Black Mountain quarry by Thompson et al. (1989, 1991) and Francis et al. (1993), but

examination of the only known specimen suggests the correct locality is one of the Red Hill quarries.

The Goddard Ledge and Ford Hill quarries, Rumford have strunzite crystals (to 6 mm) reminiscent of strunzite from Hagen-dorf, Bavaria, Germany. The matrix consists of vuggy etched blue-gray triphylite, and associated minerals include butter-scotch-colored jahnsite (to 1 mm), medium to dark red siderite crystals (to 1 mm), and peculiar orange laueite crystals (to 1 mm with square cross-section)(Bjareby collection).

Strunzite from the Lord Hill quarry, Stoneham is found with hureaulite along the altered margins of triplite masses (to 40 cm). The buff to straw-colored strunzite forms dense groups (to 3 mm) of straight crystals (less than 1 mm) with pink blocky hureaulite crystals (to 2 mm). Tiny (very much less than 1 mm) yellow-green platy crystals associated might be related to dick-insonite as well as a mineral which is like bright brick-red bermanite.

The listing of strunzite from Unity by Frondel (1958a,b) is undoubtedly a mistake for Unity, New Hampshire. No Unity, Maine specimens or appropriate localities are known.

struvite? = misprint for strunzite in Morrill et al. (1958)

Rumford? - Red Hill quarry

SULFUR

S

Acton? - Boston-Acton M; **Casco?** - Webbs Mills A; **Katahdin Iron Works?** - Katahdin Iron Works M; **Linneus** - Drew Hill sulfide veins

Ordinarily, sulfur appears to be a misidentification or post-mine growth in Maine. Compton (1921) may have been describing refined sulfur when she wrote of Casco: "An iron mine at Webb's Mills tests a high per cent of iron and will be profitable when transportation facilities can be provided. At the present time distance to the nearest railroad station takes off all profit. Sulfur of a very fine grade occurs here, the richest deposit, unfortunately, lying under a building."

At the Drew Hill sulfide veins, Linneus, sulfur has been found as tiny (1 mm) asymmetric, equant, nearly colorless crystals. The sulfur is found occasionally with powdery red coatings of schafarzikite and metastibnite associated with tan powdery coatings of fine-grained valentinite and kaolinite and occasional waxy tan coatings of stibiconite (George Robinson, personal communication, 1991).

sulphate of alumina? and **sulphate of iron?**

Prospect - Fort Point A

Jackson (1838a) noted of the Fort Point area, **Prospect**: "The pyrites mixed with the slate causes it to decompose, and sulphate of alumina and sulphate of iron are formed." No specimens known.

sulphuret of iron = pyrite or pyrrhotite

sulphuret of molybdena = molybdenite

sulphuret of nickel = incorrectly attributed to nickeline (q.v.)

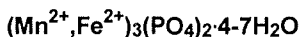
sulphuret of silver = acanthite and/or "argentite"

svanbergite? (Crandallite Group)

Newry - Bell Pit

Svanbergite was identified on a specimen from Bell Pit, **Newry** which was submitted to a "California college" (Effe Gray, personal communication, 1967). Specimens from the original find labeled svanbergite from the Gray collection have proved by chemical analyses (this study and Brownfield and Foord, in press) to be other members of the group: goyazite and gorceixite.

SWITZERITE / METASWITZERITE



Greenwood - Emmons Q; **Newry** - Bell Pit, Dunton Q; **Paris** - Mount Marie Q

The original switzerite (Leavens and White, 1967) was redefined by White et al. (1986). Switzerite spontaneously loses some of the water from its crystal structure into the atmosphere. The dehydrated material is called metaswitzerite. Crystals which have been freshly exposed are probably fully hydrated and they lose some of their water due to the low relative humidity of the surrounding air.

Pale tan to pink transparent thin switzerite/metaswitzerite blades (to less than 1 mm) that have a "Roman sword" style termination have been found in massive white apatite- and jahnsite-(MnMnMn)-bearing vugs in oxidized lithiophilite from the Emmons quarry, **Greenwood** (Gene Bearss, personal communication, 1990).

Switzerite/metaswitzerite (XRD, Paul Moore, personal communication, 1977; King, 1977b) has been found in small cavities in white fluorapatite at the Bell pit, **Newry**. The mineral forms thin, striated blades, singly distributed, to 2 mm. The

crystals are clear with a pale pink to brown tint. Some Bell Pit switzerite occurs as bronzy brown micaceous flakes (to 0.5 mm) associated with dark blue vivianite films, with pale pink rhodochrosite in contact with tan siderite.

Switzerite from the Dunton quarry, **Newry** occurs as irregular bronzy brown platy cleavages (to 3 x 3 mm) which are frozen in triphylite stained irregularly by vivianite.

sylvanite?

Sorrento - Golden Circle M?

Morrill and Hinckley (1959) list sylvanite from the Golden Circle mine, **Sorrento**. The *Maine Mining Journal* (July 9, 1880) reported for Sorrento:

"GOLDEN CIRCLE. - A recent assay made by Mr. Fisk of Ellsworth, of ore from this mine gave the following result: \$374.84 gold. We also publish an analysis by Prof. Bartlett, which is as follows:

Gentlemen: - I have completed a careful analysis of the metallic crystals found in the Golden Circle quartz and find it to be composed of the following substances, estimated in one hundred parts:

Bismuth	78.58 per cent.
Tellurium	1.60 "
Lead.....	.45 "
Gold.....	1.55 "
Sulphur.....	2.85 "
Silica.....	14.10 "
Silver and Loss.....	.87 "

Total 100.00

The analysis was made on the crystals, freed as much as possible from the quartz. The results are extremely interesting since it adds another rare compound to our already full list of minerals and one too that was scarcely looked for. The quartz contains not only native bismuth but minute quantities of telluride of gold as well. Further examination will probably show other compounds of tellurium and bismuth. In the analysis native bismuth and gold tellurium are taken together since it was impossible to separate the crystals before making the assay. I have quite a large button of pure bismuth saved from the assay, which I am pleased to say is the first bismuth metal ever extracted from Maine ores.

Respectfully yours,

F. L. BARTLETT, State Assayer.

Portland, July 1st, 1880."

No specimens or other references are known to exist. It seems likely that "gold telluride" became translated to sylvanite during the time of Morrill and Hinckley (1959) as sylvanite is not listed by previous compilers of Maine species checklists.

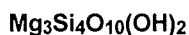
Kempton (1879) said of the Cline mine, Hancock: "The ore here is copper pyrites, galena, etc., at the surface assaying well for silver, and appears to carry gold and silver in form of

tellurides at a depth of 60 feet." Kempton also reported of Sullivan: "In the Brook shaft some telluride ore has occurred, but not enough in quantity to enable the mineral to be identified.

It carries both gold and silver. In the Ashley the same occurred..." See also bismuth, gold telluride, and tetradyomite. No specimens known.

T

TALC (Talc Group)



Alder Stream - Blanchard Pond A; **Bethel?**; **Blue Hill** - Black Hawk M; **Boil Mountain Complex** - **Alder Stream**, **Jim Pond**, **Kibby**, **Seven Ponds**; **Brooksville** - Callahan M (= Cape Rosier M); **Calais?** - Maine Red Granite Q; **Camden**; **Coburn Gore** - Chain Lakes massif; **Deer Isle**; **Dexter**; **TDR2 WELS** - Ketchum Lake A, Maple Mountain P; **Ellsworth?** - Ellsworth Falls A; **Hampden?** - Consolidated Hampden M; **Harpswell** - Jaquish Island A, Orrs Island A; **Hope** - Pierce M; **Jim Pond** - Jim Pond-Route #27 A; **Kibby**; **Lower Enchanted** - Enchanted Stream A; **Mount Chase** - Mount Chase A; **Paris?** - Mount Mica Q? (unequivocally = cookeite); **Portland?** - Fish Point A; **Raymond?** - Camp Hinds L; **Rockland** - Dunton Q; **Sidney**; **Sullivan** - Sullivan M; **Thomaston** - Dragon Cement Q, Williams Q; **Vassalboro**; **Warren** - Knox M, Lower Q, Upper Q; **T3R5 BKP WKR** - Spencer Stream A; **T3R9 WELS** - Hovey Mountain P

Talc is a curiosity mineral of metamorphic origin in Maine, as far as collectors are concerned. A few small soapstone prospects are occasionally mentioned, but no attractive specimens are known. Talc is frequently a minor component of rocks and detectable only due to the greasy feel it imparts to them. Early reports, especially in Jackson (1837a,b, 1838a,b, 1839) as well as by other nineteenth-century geologists, would refer to "tal-cose" slate or other "tal-cose" rocks. The reports were not necessarily intended to suggest that the rock actually contained talc, but that the rock had a look and feel suggesting similar properties to a rock which did contain talc. Schofield (1875) wrote, in general: "The talcose schist ... consists normally of successive layers of talc and quartz. Often the talc is replaced by talcite or some mineral resembling talc, and what is often called talcose schist is only an altered variety of clay slate, while the true talcose schist is a rare variety among the talcose schists in all parts of the world." Jackson (1837a) noted: "Soapstone, or talcose rock, is found at Harpswell, Orr's Island, and at Jaquish [Island], and has been wrought at one or two places. It is difficult to work, but is very durable, withstanding the action of fire. The bed at Orr's Island is fourteen feet wide, and may furnish a considerable supply of this material."

The Boil Mountain Complex is an extremely interesting geologic feature comprising an excellent, but thin and incomplete ophiolite sequence indicating continental collision. The complex was named for Boil Mountain, **Seven Ponds** and ex-

tends eastward to **Alder Stream** and **Jim Pond** with a faulted offset in **Kibby**. The complex further extends in an ever north-easterly discontinuous arc to **Attean**. Boudette (1982) noted that a serpentinite composed part of the basal units: "Soapstone and a distinctive marble-like carbonate rock (arnoldite), composed mostly of dolomite-magnesite with subordinate chromiferous muscovite, chromite, and magnetite, are usually associated with the clinochrysotile serpentinite." Boudette (1970) earlier noted that along a trail west of Blanchard Pond, **Alder Stream**: "Rocks of the alpine complex are notably altered chloritic varieties of epidiorite, quartz diorite, and pyroxenite with abundant serpentinite and talc segregations." Talc from an unspecified area in **Kibby** is gray-white through sooty gray and is very fine-grained, showing no individual flakes to the naked eye. Hurley and Thompson (1950) mapped talc bodies in **Jim Pond** and **Lower Enchanted**: "In the same belt, other highs coincided with bodies of ultramafic rock carrying no significant asbestos. Some of these bodies were bordered by zones of talc-carbonate. At least two of these zones were more than 100' wide, with a talc content that may be of future economic interest. One of these zones occurs at 45° 15' N. and 70° 29' W. near the road by Jim Pond; the other at 45° 21' N. and 70° 7' W. on Enchanted Stream." Boudette (1991) reported magnetite-bearing talc from unnamed serpentinite units, Alder Stream, and Seven Ponds.

"Slippery" talc is found as silvery-white grading to light brownish-green foliated masses in some of the enclosing rock around the sulfide deposit at the Callahan mine, **Brooksville**. Doyle (1970) noted similar lithology at the Black Hawk mine, **Blue Hill**: "Pyrite, chalcopyrite and sphalerite are the ore minerals, occurring within a talc-chlorite-carbonate unit in the Castine formation. ... The talc ore zone dips 45° at the surface, shallowing to 20°-25° with depth."

White talc has been found replacing anthophyllite in the Chain Lakes massif, **Coburn Gore** (Charles Guidotti, personal communication, 1990).

Pavrides et al. (1965) noted of **TDR2 WELS**: "Carbonate-talc schist is exposed at a few places along the gully of the stream draining Ketchum Lake."

The "talc" from the Argonaut mine, **Hampden** is actually sericite.

Ekren and Frischknecht (1967) wrote of **Mount Chase**: "Small amounts of asbestos and talc occur in a few shear zones in the volcanic rocks of the Mount Chase area."

The report of talc at Mount Mica quarry, **Paris** by Shepard (1830) has been confidently attributed to the mineral cookeite (q.v.).

Morrill et al. (1958) listed "Talc Xls" from Fish Point on the Eastern Promenade, **Portland**, but the extremely unusual nature of actual talc crystals seems to make the report unlikely. No specimens known.

Herbert Haven noted in his diary May 23, 1935 of the the Camp Hinds locality, **Raymond**: "We went to work on the ledges in this camp. We procured specimens of radiated crystals of talc; of marialite (a variety of Wernerite), Hornblende crystals, Epidote crystals and Vesuvianite crystals." The talc identification is highly unlikely. No specimens known.

Talc occurs sporadically in the **Rockland** and **Thomaston** marble areas. At the Dragon Cement quarry, Thomaston, talc usually occurs as fine-grained snow-white masses (to over 1 cm) associated with tremolite spays in marble. Bastin (1908b) said: "... in the more calcareous portion considerable amounts of greenish talc are usually present. ... Talc is locally abundant, especially along slickensided fracture planes." Bastin (1906) reported of the Dunton quarry, Rockland: "... a considerable amount of rock is rendered worthless because of the abundant development of talc..."

Emmons (1910) reported talc "in the ore" from the Sullivan mine, **Sullivan**. No specimens known.

In the Lower quarry and Upper quarry, **Warren**: "The talc is abundant in small irregular veins" (Bastin, 1908b).

talcite = fine-grained muscovite

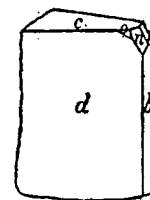
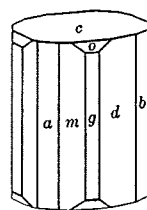
talcose schist - in the old sense, usually refers to clay slate or phyllite (Jackson, 1837a,b, 1838a,b, 1839); talc (q.v.) itself is unusual in these rocks and "talcose" schist reports should not be listed as talc occurrences.

tantalite? (Columbite Group)

$(\text{Fe}^{2+}, \text{Mn}^{2+})(\text{Ta})_2\text{O}_6$

Buckfield? - Bennett Q; **Byron?** - Swift River; **TE?**, **Newry?** - Dunton Q; **Paris?** - Mount Mica Q; **Poland?**, **Rumford?**, **Standish?**, **Topsham?**, **Union?**, **Warren?**

Tantalite is a rare mineral worldwide and in Maine. Unfortunately, most of the world's tantalite reports come from the use of the hyphenated series name "tantalite-columbite" and the reporter or reader, erroneously assuming that one end of the series is as common as the other, shortens the name to just "tantalite." Additional listings may have come from erroneously calling manganotantalite by the shorter name tantalite. Baker (1945), who had access to reports of tantalum ore analyses, etc. wrote: "Other domestic occurrences of tantalite, largely of academic interest, have been reported from various localities. The pegmatite zones in Maine, which have long been a source of mica and feldspar, yield negligible quantities of tantalite." Morrill et al. (1958) reported numerous tantalite occurrences, but no data have substantiated the listings.



"Tantalite," Mount Mica Q, Paris (left - from Palache et al., 1944; right - from Goldschmidt, 1913)

The only scientifically based report of tantalite in Maine was that of Warren (1898) for the Mount Mica quarry, **Paris**: "There are also in the Brush collection a few specimens of tantalite received from Mr. L. K. Stone of Paris, and identified by Prof. Penfield. The specific gravity of the crystals is very high, 7.26, thus indicating that they are tantalite and not columbite. They contain iron, and little or no manganese, which adds to the interest connected with them, since the crystallized tantalite previously described has been of the manganese variety. Only a very little material was found and it is not well adapted for crystallographic study as the faces of the crystals are dull, but sufficiently accurate measurements could be obtained to identify the forms, which were found to correspond to well-known ones on columbite. The habit of one of the crystals is shown in fig. 10, and fig. 11 represents the arrangement of the faces on the corner of another crystal." Given the very high specific gravity, qualitative(?) determination of manganese, and the well-known careful scientific technique of Yale mineralogists, the report of tantalite at Paris is credible. (The use of the Warren (1898) drawing by Dana (1899), Ford (1932), and Palache et al. (1944) has reinforced the tantalite occurrence in the minds of some Maine collectors to the point that they imagine it is found at all "columbite/tantalite" localities.) The methods of identification stated by Warren (1898) are insufficient to distinguish tapiolite from tantalite. Smith (1882) listed tantalite from Paris.

Burr (1930, 1942) listed tantalite without substantiating data from **Standish** and the Starrett quarry, **Warren**.

TAPIOLITE

$(\text{Fe}^{2+}, \text{Mn}^{2+})(\text{Ta}, \text{Nb})_2\text{O}_6$

Auburn - Fisher Q; **Brunswick?** - Bagley Ledge Q; **Buckfield** - Bennett Q; **TD** - Bemis Stream P; **Newry** - Dunton Q?, Nevel Q, Rose Quartz Crystal L, Scotty Q?; **Paris** - Mount Mica Q; **Rumford?** - Black Mountain Q; **Topsham** - Fisher Q

Tapiolite is a scarce mineral even at its reported Maine occurrences where usually only one or two specimens are known for each locality. Lahti et al. (1983) indicated that the use of the name ferrotapiolite is "permitted" for specimens which have been determined by chemical analysis to be iron-dominant, but

the name tapiolite has not yet been superseded. (Note: tapiolite is compositionally the same as tantalite.)

Morrill et al. (1958) reported tapiolite from **Brunswick** and Seaman (1975d) noted that tapiolite had been found at the Bagley Ledge quarry. No specimens known. The Warren (1898) report referred to a crystal loaned by Mr. Towne of Brunswick, but the locality of the crystal is stated to be Paris.

Tapiolite is reported from the Bennett quarry, **Buckfield** by Wise and Rose (in press) as black inclusions in black manganotantalite. The minerals cannot be visually distinguished.

Small (1 mm) wedge-shaped black grains embedded in cleavelandite from the Bemis Stream prospect, **TD** are compositionally identical to tapiolite (Michael Wise, personal communication, 1992).

Peacor (1960) reported of the Nevel quarry, **Newry**: "A tapiolite [sic] crystal over an inch in diameter was found embedded in sphalerite associated with spodumene, muscovite and quartz." No specimens available for examination. Supposed tapiolite crystals from the Dunton quarry, Newry (Bjareby collection) are zircon crystals (to 3 mm).

Black tapiolite crystals (to 3 mm) from the Rose Quartz Crystal locality, Newry are found in cleavelandite vugs. Bladed black manganotantalite crystals (to 2 mm) grow on or interpenetrate the tapiolite. The tapiolite crystals are submetallic in luster on the prism, but almost adamantine on the pyramid. Some of the tapiolite crystals show a contact (twin(?)) or intergrowth of another mineral) where a slightly larger "central slab" divides the main crystal.

A Mount Mica quarry, **Paris** tapiolite crystal (YU 1808) is highly distorted and without matrix. The tapiolite has a wedge-shaped cross-section and the probable matrix may have been cleavelandite or the "sand" of a gem pocket.

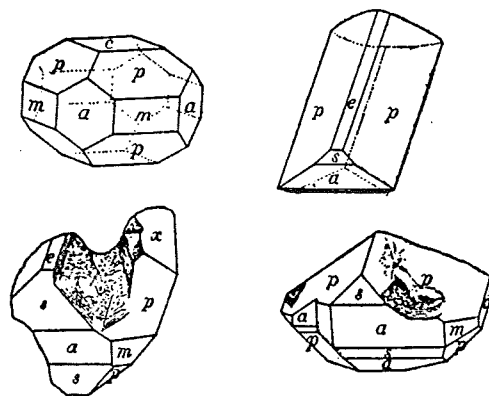
A supposed Black Mountain quarry, **Rumford** tapiolite is manganocolumbite (this study).

A large rounded black tapiolite crystal (to 4 cm) from the Fisher quarry, **Topsham** is in the George Vaux collection, Bryn Mawr college, Bryn Mawr, Pennsylvania. The mineral was first reported from Maine by Warren (1898):

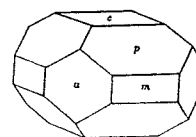
"The tapiolite crystals to be described here are from the feldspar quarries of Topsham, Maine ... A crystal obtained from Mr. L. B. Merrill of Paris, Maine, and now in the Brush collection at New Haven, has the habit shown in fig. 6. This crystal is apparently not twinned. Its diameter is about 18^{mm} and specific gravity 7.67.

Fig. 7 represents a crystal belonging to Mr. T. F. Lamb of Portland, Me. This crystal is a twin, measuring about 2^{cm} in diameter and having a specific gravity of 7.68. The crystal faces are rough, and they show, when examined with a lens, a superficial growth of minute prismatic crystals in twin position, and crossing at angles of about 60. The surface of the crystal resembles some of the brookite crystals from Magnet Cove, Arkansas, with a growth of rutile crystals in twin position upon their surface.

Fig. 8 represents a simple and almost ideally symmetrical crystal, about 5^{mm} in diameter and with a specific gravity of 7.87, loaned by



(from Goldschmidt, 1922)



(from Palache et al., 1944)

Tapiolite, Fisher Q, Topsham

Mr. J. S. Towne of Brunswick, Me. Fig. 9 represents a very symmetrical twin crystal also loaned by Mr. Towne. It has a length of 2^{cm}, a breadth of 1^{cm}, and the specific gravity is 7.66.

The high specific gravity of these tapiolite crystals indicate that they are essentially tantalites and contain very little niobium, as has also been proved by qualitative chemical tests. They contain iron as the base, and give only a very slight reaction for manganese."

The only Topsham tapiolite crystal observed (YU 1827) is an asymmetrically developed polyhedron (about 2 x 2 cm) with a wedge-shaped cross-section and is without matrix or specific locality.

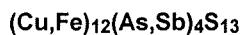
tellurium? - probably refers to element in ore, see tetradyomite

Sorrento - Golden Circle M

Morrill and Hinckley (1959) made the following enigmatic reference for the Golden Circle mine, Sorrento: "Free Gold in Q.; Bismuth (Native); Tellurium." The bismuth telluride sulfide, tetradyomite (q.v.), is known from the Golden Circle mine. Blow-pipe analysis of such material would reveal tellurium, but the native element was undoubtedly not found. The original report may have been (MMJ, June 25, 1880): "He has also ascertained that the metal which has hitherto been supposed to be molybdenum is *tellurium*, and very rich in gold." Further reports suggest gold telluride (q.v.) and native bismuth (q.v.) were in the ore.

Some assay reports were thought (by Morrill and Hinckley, 1959) to represent sylvanite (q.v.).

TENNANTITE (Tetrahedrite Group)



Acton - Acton Consolidated M, Bullion M; **Blue Hill** - Douglass M; **Brooksville** - Callahan M; **Franklin?** - Franklin Extension M

No samples of tennantite are known to represent the species in Maine.

Gray copper was reported from the Acton Consolidated mine, **Acton** (MMJ, June 11, 1880) and from the Bullion mine, Acton (MMJ, June 18, 1880).

Arsenopyrite and stibnite were both reported (Morrill and Hinckley, 1959) from the Douglass mine, **Blue Hill**, but it is not known if both tennantite and tetrahedrite were found. Tennantite, or "gray copper," is a metallic, often granular, dark gray metallic mineral. It undoubtedly is found intergrown with chalcopyrite and/or bornite. As it is mentioned in various reports in the *Maine Mining Journal*, as gray copper, it may have been found in masses of several centimeters in size.

Gray copper was tentatively reported from the Franklin Extension mine, **Franklin** (MMJ, March 31, 1882).

TENORITE



Pembroke - Barrett P (= Dolsan Pit)

Tenorite at the Barrett prospect, **Pembroke** can be bituminous with a resinous luster in small patches (to 5 x 5 mm). It occurs on limonite-coated quartz vugs associated with botryoidal malachite (to 1 mm), azurite crystals (to 1 mm), crudely formed quartz crystals (to 2 mm), and massive chalcopyrite in the matrix.

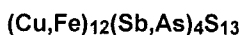
TETRADYMITITE



Sorrento - Golden Circle M; Sullivan?

Only one specimen of tetradymite from Maine has been preserved (HU # 81365). The Golden Circle mine, **Sorrento** specimen consists of a 3 x 7 mm silvery-white metallic perfect cleavage in milky quartz. The tetradymite looks like silvery, high-luster galena, but has a foliation which makes it resemble off-color molybdenite. Native gold grains (to 2 mm) are found in the associated quartz matrix.

TETRAHEDRITE (Tetrahedrite Group)



Blue Hill - Black Hawk M, Douglass M; **Carmel**; **Deer Isle** - Deer Isle M; **Enfield**; **Gouldsboro** - Gouldsboro M; **Hampden** - Consolidated Hampden M, Lawrence M; **Levant** - McKusik M; **Lowell** - McKinley M; **Passadumkeag?**; **Penobscot** - Hercules M; **Steuben**; **Sullivan**

The reports of tetrahedrite or tennantite (q.v.) generally lack consideration of the dominance of antimony or arsenic in the particular sample. Qualitative tests are sensitive to both elements, and identifications without quantitative analysis should at least consider the chemistry of associated species such as arsenopyrite, stibnite, etc.

As arsenopyrite and stibnite are both reported from the Douglass mine, **Blue Hill**, it is not known if both tennantite and tetrahedrite were found. Tetrahedrite, or "gray copper," is a metallic, often granular, dark gray metallic mineral. It undoubtedly is found intergrown with chalcopyrite and/or bornite. As it is mentioned in various reports in the *Maine Mining Journal*, as gray copper, it undoubtedly was found as masses of several centimeters in size.

Yates and Howd (1988) reported of a mineral assemblage from the Black Hawk mine, **Blue Hill**: "Anhedral masses of galena commonly serve as a matrix to other sulfide minerals and accompanying silicate and oxide minerals. While other sulfide minerals form coarse-grained polycrystalline aggregates, galena-rich samples characteristically contain poikiloblastic, crystallographically continuous domains of galena as large as 50 cm across. Galena is also a common constituent of amazonitic, granitic rocks, where it is in places finely disseminated around the periphery of amazonite grains. The sulfosalt minerals tetrahedrite, bournonite, and boulangerite, identified optically and with the microprobe, appear only in galena-rich samples and are intimately intergrown with galena." The tetrahedrite, boulangerite, and bournonite apparently form grains of the order of 0.1 mm in maximum dimension.

Tetrahedrite was unequivocally reported (MMJ, November 4, 1881) from the Deer Isle mine, **Deer Isle**: "The ore is *Tetrahedrite*, or argentiferous gray copper." Three specimens (unanalyzed) of tetrahedrite from Deer Isle (AMNH 54426, 54435, 54493) show a variety of appearances. The specimens are rich ore samples with fine-grained granular wrought-iron gray tetrahedrite variously with or without fine-grained granular chalcopyrite, milky quartz, and white calcite cleavages.

Stewart (April 2, 1880) wrote of the Consolidated Hampden mine, **Hampden**: "This quartzitic gangue is traversed by innumerable seams, bands and reticulated veins of quartz all heavily charged with argentiferous galena, sulphuret of antimony, tetrahedrite, copper pyrites and iron pyrites." No specimens known.

Bartlett (October 15, 1880) listed gray copper in the suite of minerals from the Hercules mine, **Penobscot**. Morrill and Hinckley (1959) evidently translated this to tetrahedrite despite the arsenopyrite in the ore. No specimens known.

thomsonite? (Zeolite Group)

Mount Desert? - *Grenci-Ellis Q*; **Thomaston?** - *Williams Q*

A specimen of slightly water-worn, coarse white radially grouped "thomsonite" (to 5 cm) with celadonite attachments and labeled **Mount Desert** is known (HU unnumbered), but is assuredly a specimen from far away, perhaps Nova Scotia. The specimen may have been recovered by a scallop dragger, etc. and brought into port at Mount Desert. "Thomsonite" from the Grenci-Ellis quarry, Mount Desert is a new mineral (see unknown #1).

Houghton (1861) listed thomsonite from **Thomaston** without description. Morrill and Hinckley (1959) seemed to further specify, ambiguously, the occurrence at the Williams quarry. No specimens known. A semi-humorous account (MMJ, February 10, 1882) reported: "The Maine Mining Journal says that among the minerals found in Rockland and Camden are Hematite, Tremolite, Thomsonite, Limonite, etc., etc. It should have added Rumtite, Outlatatnit, and Drunkenfite; there are more of the latter three in Camden than there are of the former. - [*Camden Herald*]." The latter three names are not mineral names.

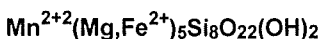
THOROGUMMITE



Topsham - *Havey #2 Q*

Bright, milky yellow, crude bipyramidal(?) thorogummite (chemical analysis, XRD, this study) is found as 1-3 mm grains embedded in oligoclase and smoky quartz closely associated with xenotime-(Y) at the Havey #2 quarry, **Topsham**. The thorogummite is slightly calcian and is very phosphate-rich and contains significant aluminum. Both thorogummite and grayite fluoresce yellow-green in short-wave ultraviolet light and can be indistinguishable in sunlight.

TIRODITE (Amphibole Group)



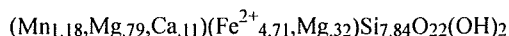
Benner Hill unit - **Belfast, Belmont, Northport, Searsmont**; *Muzzy Ridge Member of the Appleton Ridge Formation* - **Belmont, Searsmont**; *Penobscot Block* - **Camden, Hope, Lincolnville**

Due to the extreme partitioning of some elements in amphiboles (q.v.), manganese is strongly ordered in the M_4 site. For

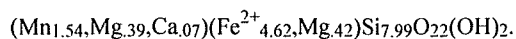
this reason, many manganoan cummingtonites are actually tirodite.

Bickel (1974) reported cummingtonite (tirodite) from the garnet, andalusite, and sillimanite zones of the central **Brooks quadrangle**. Bickel (1976) said of the Muzzy Ridge Member of the Appleton Ridge Formation, **Belmont** and **Searsmont**: "Most of the rock in the Muzzy Ridge Member is composed entirely of cummingtonite and garnet with minor biotite, plagioclase, and quartz, and with or without abundant hornblende..." The calc-silicate gneisses of the andalusite through sillimanite - K-feldspar zones of the Penobscot Block (Bickel, 1976), **Camden, Hope, Lincolnville, and Northport** contain minor amounts of cummingtonite (tirodite?). Charles Guidotti (personal communication, 1990) indicated that the cummingtonite of the Gushee Member of the Penobscot Formation and Benner Hill Formation, **Belfast, Belmont, Northport, and Searsmont** is a "manganese variety."

Kimball (1981) analyzed manganoan cummingtonite from the Muzzy Ridge Lentil of the Appleton Ridge Formation, but that material actually corresponds to tirodite. The formulas (slightly cation-rich) derived from her analyses range from:



to



"Cummingtonite occurs as colorless, well defined blades 0.01 to 0.1 mm long. Usually it occurs as randomly oriented prisms either in cummingtonite-rich zones ... or interstitially in garnet or biotite-rich zones. Cummingtonite also appears as radiating masses or as needles in quartz... The cummingtonite is usually inclusion free. ... The cummingtonites from the Appleton Ridge Formation are very manganese-rich and coexist with manganoan garnet [spessartine] and ilmenite..." (Kimball, 1981).

titanaugite (Pyroxene Group) = titanian augite

Brooksville - *Callahan M*; *Flagstaff Lake pluton* - **Coplin, Dallas, Davis, Eustis, Lang, Rangeley, Stetsontown, Tim Pond**; *Hornblende pyroxenite* - **Leeds, Wayne**; *Mesozoic dikes* - **Harpwell-Kittery**

Titanaugite is a variety of augite that, when seen in thin section, exhibits a pleochroic pink to clear coloration. While titanium substitution is the usual element to which the origin of the color is ascribed, the presence of titanium is usually assumed and not demonstrated. Titanaugite phenocrysts are characteristic of many of the Mesozoic dikes exposed along the southern Maine coast from Goose Rocks, **Harpwell** to **Kittery** (Arthur Hussey, personal communication, 1992).

Park and Bastille (1973) listed titanaugite from the host rocks of the Callahan mine area, **Brooksville** and Bouley and Hodder (1984) said: "Titanaugite, augite, and pigeonite are the

most abundant pyroxenes, variably replaced by pseudomorphous uranalite, chlorite, and talc."

Boudette (1991) noted local concentrations of titanaugite in the Flagstaff Lake pluton, **Coplin, Dallas, Davis, Eustis, Lang, Rangeley, Stetson, and Tim Pond**.

Creasy (1983) noted of a hornblende pyroxenite exposed on Androscoggin, Lothrop, and Norris Islands in Androscoggin Lake, **Leeds and Wayne**: "Coarse-grained titanaugite cumulates with minor intercumulus titaniferous amphibole and labradorite; olivine and oxide minerals are present as subordinate cumulus minerals; locally pegmatitic and miarolitic texture with coarse apatite and fluorite."

TITANITE

CaTiSiO₅

Albany - Bumpus Q; **Alfred** - Bennett Q; **Andover** - Mooselookmeguntic granodiorite; **Baldpate Mountain** diorite - **Andover West Surplus, Grafton**; **Beals** - Beals Island A; **Bethel**; **Biddeford**; **Blue Hill** - Black Hawk M; **Bristol** - Round Pond Granite Q; **Brunswick** - Cobbs Q, Stone House A, Road Metal Q; **Bryant Pond** - Bryant Pond Granite Q; **Byron** - Noisy Brook gneiss; **Calais** - Gardners Lake Black Granite Q; **Casco** - Chute P; **Cornish** - Berry Ledge L; **Cushing Formation**; **Farmington** - U.S. Route #2 A; **Frankfort** - Mosquito Mountain; **Greenwood** - Beryl L, Patch Mountain Formation; **Hartland** - Hartland Granite Q; **Jonesport** - Minerva Cove Granite Q; **Kennebunk** - U. S. Granite Q; **Leeds** - Norris Island; **Lewiston** - Robinson Mountain A; **Long Island Plantation** - Long Island Black Granite Q; **Lubec** - Lubec Lead M; **Mapleton** - Mapleton granite; **Marshfield** - Marshfield Q; **Minot** - Pitts-Tenney Q; **New Sharon?**; **Norridgewock** - Dodlin Hill Q; **North Haven** - North Haven greenstone sequence; **Norway** - Crocker Ridge Q; **Phippsburg** - The Basin L; **Roxbury**; **Rumford** - Black Mountain Q; **Sanford** - 200 m L, 600 m L; **Searsport** - Bog Hill Granite Q; **South Thomaston** - Sprucehead Granite Q; **Stonington** - New England Stone Industries Q, Parker-Ryan Q, Settlement Q; **Sullivan** - Petee Q, Sullivan Village Q; **Swans Island** - Toothaker Cove A; **Thomaston** - Williams Q; **Topsham**; **Union** - Harriman P; **Wayne**; **Webhannet pluton** - Eliot, **North Berwick**, **South Berwick**, **Wells**, **York**; **Whitefield** - Jewett Black Granite Q; **York** - Agamenticus Complex

Titanite (formerly known as sphene) is a common accessory mineral in a variety of rocks. It is commonly found in crystals frozen in granite, and related rocks, and in calc-silicate rocks in Maine. Many of the titanite reports are based on the mineral being in the host rocks which were incidentally mined along with metallic ore minerals. Dale (1907), Smith (1923), and Austin and Hussey (1958) listed a great many titanite localities in granite and building stone quarries in Maine and provide location maps, but few localities have collector-grade specimens. Burr (1939a) listed titanite, without description from: **Sanford**,

Bethel, Brunswick, Kennebunk, Thomaston, Lubec, and Wayne. Jackson (1953) noted titanite in the Noisy Brook gneiss, **Byron**.

The earliest report seems to be that of True (1869) of **Bethel**: "*Sphene*. - *Oxide of Titanium*. - Bethel. This mineral is found in wedge-shaped crystals, elongated prisms, and in small grains, disseminated through gneiss. At the Beryl locality in Greenwood, it is found in octahedral crystals." It is not immediately evident that the species was actually found at the sites cited due to the description of the crystal shapes and the reported chemical composition.

The feldspathic biotite gneiss exposed at the Bumpus quarry, **Albany** contains numerous tan to brown translucent titanite crystals (to 3 mm).

Milton (1961) wrote extensively of the "Sphene-flecked" Baldpate Mountain diorite, **Andover West Surplus and Grafton**: "Sphene-flecked rocks ('Titanitfleckengesteine') are characterized by white flecks in which the felsic minerals of the rock are unaccompanied by the mafic minerals, with a poikilitic crystal of sphene in the center of each fleck. ... Sphene-flecked rocks have been described from several areas in Europe, but this is apparently the first American locality. ... The flecks are 3 to 5 mm in diameter. They are roughly spherical; elongate flecks are randomly oriented. The distribution is a random scatter, that is, the abundance is about the same through the whole rock with no particular tendency for either clustering or uniform separation. The flecks constitute about 20% of the entire rock."

An unspecified quarry, Beals Island, **Beals** has lustrous, red-brown titanite crystals (to 4 mm) embedded in tan microcline-biotite granite.

Creamy yellow typical wedge-shaped titanite crystals (to 1 cm) were found with clinochlore and quartz in late veins cutting sphalerite ore at the Black Hawk mine, **Blue Hill** (Hugh Durgin, personal communication, 1993).

Wheeler and Wheeler (1878) noted of **Brunswick**: "TITANITE is found at Cobb's quarry, and small but fine crystals are found near Miss Narcissa Stone's house."

Exceptional tan to cream-white sub-translucent titanite crystals (to 2 cm) in saddle-shaped clusters are found embedded in calcite on diopside crystals (to 8 mm), etched and granulated vesuvianite, and gray clinozoisite at the Chute prospect, **Casco**. The Chute prospect titanite is highly unusual in that it fluoresces yellow in short-wave ultraviolet light. It barely fluoresces in long-wave ultraviolet light. Semi-qualitative chemical analysis (this study) shows no iron but substantial aluminum; otherwise this Casco mineral is a pure titanite.

Hussey (1962) noted accessory titanite in a number of igneous rocks including the granodiorite of the Webhannet pluton, **Eliot, North Berwick, South Berwick, Wells, and York**: "Sphene is locally very abundant and readily recognizable in hand specimen."

Titanite is a common accessory of calc-silicate units of the Cushing Formation exposed from **Thorndike** to south of **Portland** (Arthur Hussey, personal communication, 1992).

Carpenter (1951b) listed titanite without description from the **Limerick-Cornish** area.

Gregory (1900) noted of the Mapleton granite, **Mapleton**: "Titanite in well-developed idiomorphic crystals is more common than in most granites."

Titanite from the Pitts-Tenney quarry, **Minot** consists of red-brown to pinkish brown, rounded wedge-shaped crystals (to 4 mm) with sharp grass-green diopside crystals (to 3 mm), and white, unterminated meionite prisms (to 5 mm).

Titanite from an unspecified locality, **Roxbury** consists of tan well-formed wedge-shaped crystals (to 3 mm) with orange grossular crystals (to 4 mm) in vuggy massive meionite, gray clinozoisite, and green diopside.

Individual tan to brown translucent platy titanite crystals (to 1 cm) are found embedded in calcite with diopside crystals (to 4 mm) and white meionite crystals (to 2 cm) as well as massive meionite from the small Goodall Farm prospects (200 meter locality, 600 meter locality) associated with the Webster prospect, **Sanford**. Sanford titanite moderately fluoresces yellow in short-wave ultraviolet light and barely fluoresces yellow in long-wave, in contrast with meionite (q.v.).

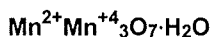
The New England Stone Industries quarry, **Stonington** and undoubtedly other granite quarries on the island and nearby mainland have produced excellent sub-translucent dark red-brown titanite crystals (to 1 cm) frozen in the granite. Micro-mount-size crystals are abundant.

titanomagnetite (Spinel Group) = titanian magnetite

Brassua Lake quadrangle

Boone et al. (1989) noted of a sample from an unlocated drill core, WCS-1, Brassua Lake quadrangle, that it contained titanomagnetite.

TODOROKITE



Auburn - Pulsifer Q; **Greenwood** - Emmons Q, Harvard Q; **Hebron** - Mount Rubellite Q; **Newry** - Dunton Q, Rose Quartz Crystal L; **Paris** - Mount Mica Q; **Poland** - Berry-Havey Q; **Stoneham** - Lord Hill Q

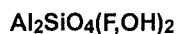
Todorokite of typical brown but lustrous scaly appearance, sometimes with silvery highlight reflections, is found in botryoidal groupings (to 3 mm) with a silky luster on clear quartz crystals (to 5 mm) in vuggy albite from the Pulsifer quarry, **Auburn**.

Bertrandite (q.v.) crystal "rods" (to 2 mm) from the Harvard quarry, **Greenwood** can be found in vuggy brown-stained albite with botryoids of brown todorokite (to several mm) which have a brilliant scaly surface.

Todorokite forms splendid, slightly iridescent, dark brown feathery botryoids (to 2 mm) with eosphorite in cleavelandite from the Mount Rubellite quarry, **Hebron**.

Earthy dark brown todorokite botryoids (to 6 mm) are found in unstained cleavelandite, lepidolite, green elbaite, etc. matrix at the Dunton quarry, **Newry**. The surface of the botryoids is typically smooth with a dull luster and a layered rather than radially fibrous texture (Paul Moore, personal communication, 1974). The todorokite is commonly found associated with lepidolite and beryllium phosphates, etc.

TOPAZ



Albany?; **Auburn** - Keith (= Towne) Q, Littlefield Farm A (=Greenlaw Q?), Pulsifer Q; **Brunswick?**; **Buckfield** - Bennett Q; **Byron?** - Swift River A; **Fryeburg?**; **Greenwood** - Harvard Q?, Tamminen Q, Waisanen Q; **Hebron** - Mount Rubellite Q; **Rumford?** - Black Mountain Q; **Stoneham** - "high bluff", Lord Hill Q; **Stow** - McAllister Q, Shell Pond brook; **Sumner** - gravel pit; **Topsham** - Fisher Q; **Woolwich?**

Topaz is scarce in most of the Maine pegmatites. While crystals to 20 kg+ have been found, only a few localities are worth describing.

Burr (1930) listed without specific details that topaz had been found in **Albany**. No specimens known.

The Keith (Towne) quarry, **Auburn** produced several blue topaz crystals, one of which was a fragment and was cut into a 43.75 carat gem (Nevel, 1929).

A gem pocket of over one cubic meter was lined by topaz crystals on the Littlefield farm pit (= Greenlaw quarry?), Auburn. The largest of the gemmy to translucent topaz crystals was reported to be about 61 x 33 cm, while a second crystal in quartz matrix was reported to be nearly as large, but the color was unstated (Chamberlain, 1898). This crystal would rank among the world's largest topaz crystals (not masses), but its whereabouts is unknown.

Milky sky-blue etched topaz crystal sections (to 5 x 7 cm) embedded in cleavelandite have been found at the Pulsifer quarry, Auburn.

Landes (1925) wrote of the Bennett quarry, **Buckfield**: "The single crystal of topaz found at Buckfield is a prismatic individual about 5 centimeters long and four in diameter. It shows faces of basal pinacoid and brachydomes which are coated with fine scales of purple lepidolite..."

Bill Garrett (Stevens, 1989) reported of the Swift River, **Byron**: "In 1981 I found a waterworn topaz. A colorless crystal that weighed approximately 150 karats. That topaz now belongs to the Maine State Museum."

Burr (1917) listed topaz from **Fryeburg**. No specimens known.

Though topaz is not known in specimens from the Harvard quarry, **Greenwood**, Warren (1898) reported: "The pseudomorphs, which are to be described, were discovered by Mr. G. L. Noyes, of Norway, Maine, at a ledge in the town of Greenwood ... In connection with the pseudomorphs just described, there occur other pseudomorphs of quartz after a prismatic, and probably an orthorhombic mineral. The crystals are prisms about 4 inches in length, having an angle about like the prism m , 110, of topaz, and are terminated by basal planes. It seems most probable that they are pseudomorphs after topaz, but the original material has been wholly removed, and the crystals now present the appearance of a shell of quartz, with the points of innumerable crystals projecting outward, while within they are cavernous, and the sides of the cavities are lined with small quartz crystals, and rounded prominences of cookeite." The Harvard quarry "topaz" pseudomorphs were probably rhombic albite crystals.

Milky white topaz crystal sections (2 x 3 cm) with black surface dendrites have been found in cleavelandite at the Waisanen quarry, Greenwood (HU collection).

A single colorless etched topaz crystal (1 cm; HU #90166) from the Mount Rubellite quarry, **Hebron** has smooth irregular faces and resembles a recrystallized "shard."

Blakemore (1952) and Wintringham (1954, 1955) listed topaz, without description, from the Black Mountain quarry, **Rumford**. No specimens known.

The Lord Hill quarry, **Stoneham** has produced both large white masses, to 50 kg, of topaz frozen in pegmatite as well as crystals from gem pockets. Green or pale purple damourite mica is sometimes found replacing the topaz. Crystallized Stoneham topaz was first found by Nathan Perry and identified by Kunz (1884a₂). The majority of the topaz crystals that are in museum collections were found in the 1960's as a by-product of feldspar mining. The largest pocket crystal, about 25 kg, is in the Harvard University collection and is probably a North American record size. It is milky to cloudy white and is tabular in aspect. It was found in pockets which produced large (100 kg+), etched smoky quartz crystals, phenakite, meta-autunite, muscovite, etc. Numerous crystals, uniformly cloudy light gray, in the 5 x 5 cm size range, were found. Several transparent crystals were found in the 1960's, and the majority of the early crystals were colorless and transparent, but a few pale blue crystals (to 4 x 4 x 4 cm) were found in nineteenth century mining operations. (A smaller, but gemmier, crystal comes from the Herbb #2 quarry, Powhattan County, Virginia.)

Topaz from Stoneham was important in the history of the species. In 1885, Clarke and Diller reported: "In the latter part of 1883, Mr. C. M. Bradbury published an analysis of the Stoneham topaz, which, if correct, would show the mineral to be quite unlike any topaz hitherto known. His results ... make the proportion of fluorine half as high again as the generally accepted formula for topaz would require. ... If we now consider these analyses..., we find first that the topaz itself is ordinary topaz, having none of the anomalous character indicated by Mr. Bradbury's work." Genth (1886) belatedly responded: "I made last

fall, at the suggestion of Mr. G. F. Kunz, an analysis of the Stoneham topaz, of which he furnished me with a perfectly transparent and colorless fragment, in order to clear up the doubt then existing about its composition, on account of an analysis published by Mr. C. M. Bradbury (Chemical News, xlviii, 109), which gave very unusual results." Genth's results would have been suitable as a duplicate analysis for Clarke and Diller (1885). The report by Clarke (1886a) also covered the same material and analyses. Penfield and Minor (1894) stated:

"The chemical composition of topaz has never been satisfactorily settled. The results of the analyses thus far published show clearly that silicon and aluminum are present in the proportion 1:2, but the percentage fluorine as given in them varies from 16.12-18.83. The formula that is usually accepted is that of Groth $[\text{Al}(\text{O.F}_2)]\text{AlSiO}_4$, corresponding to an isomorphous mixture of $(\text{AlF}_2)\text{AlSiO}_4$ with the andalusite molecule $(\text{AlO})\text{AlSiO}_4$ in which the former predominates and in which fluorine is supposed to be replaced by oxygen. ...

Since it has been shown by one of us that hydroxyl so frequently replaces fluorine, and it now seems very doubtful if bivalent oxygen ever plays this role, the idea has suggested itself that perhaps the variations in the percentages of fluorine and the failure to yield a simple ratio are due to the partial replacement of fluorine by hydroxyl. Accordingly tests were made for water and it has been found to be always present. This fact seems to have been generally overlooked."

The only topaz that Penfield and Minor (1894) tested with a higher hydroxyl substitution for fluorine than in Stoneham topaz proved to be some from Brazil. To be sure, the flurry of interest was prompted by a student's analysis which could not be duplicated and was clearly in error, but the discovery of hydroxyl's importance was reinforced by the montebrasite-amblygonite problem and the hydroxyl-herderite/herderite problem. The problem of reliable fluorine analyses during the late nineteenth century has been discussed under the sections concerning amblygonite/montebrasite and herderite/hydroxyl-herderite.

Kunz (1884a₂) wrote of Stoneham:

"Associated with topaz that exceed in size and perfection those as yet found at any American locality, I found a number that are worthy of mention. The finest crystals were from 10mm. to 65mm. long; the largest crystal measured a , 60mm., b , 65mm. c , 56mm., and was entirely perfect and transparent in parts. The color of the crystals varied from colorless to light green and light blue. Small perfect gems have been cut from some of the fragments.

The large rough crystals measured from 200mm. to 300mm. across, and weighed from 10 to 20 kilos; faces rough and the crystals broken in the bed; color of these light blue, light green, and white or yellowish.

These crystals are full of the characteristic fluid cavities."

Kunz (1892a) further described the Stoneham topaz after the discoveries of exceptional topaz at Mount Antero, Colorado: "This locality furnished good, clear, and distinct crystals of topaz

and has yielded the best crystals found in the East. The specimens are either colorless or faintly tinted with green or blue. ... Some white opaque crystals, a foot in diameter, were blasted out by the writer. ... At Stoneham, Me., green and red damourite, altered from topaz, has been cut into different odd forms and charms by the local collectors..."

Bickford (1949) wrote of Stoneham: "... we took a trip to Lords Hill as topaz had been found there. ... Found topaz in mass although we had been told of crystals that had been found there. Years later I did find some fine crystals in seams of the high bluff overlooking Horseshoe Pond."

Morrill (1969) wrote of the McAllister prospect, Deer Hill, **Stow**: "Aquamarine crystals have been found on several occasions in the south slope operations and one topaz crystal has been reported."

A colorless topaz pebble (about 2 cm; HU collection) with partly frosted and rounded, poorly recognizable crystal shape, was found in a gravel pit along route 140, **Sumner**.

Specimen collecting in 1929 by Benjamin Burbank revealed a gem pocket assemblage at the Fisher quarry, **Topsham** which contained some excellent etched topaz. Stewart (1938) reported: "Originally, the topaz crystals were probably very well crystallized, doubly terminated prisms, but later chemical activity rigorously attacked the crystals leaving only mere skeletons of the earlier forms. Some crystals were, no doubt, completely destroyed." Palache (1934) indicated he was invited to collect at the site and he described some of the material obtained:

"The largest crystal weighed just under three pounds and several others but little less, the greater portion being in small crystals. All, except two crystals, were deeply etched. ... The topazes were loosely attached and seemed to have grown in these restricted openings. ... Of the hundreds of topaz crystals recovered from the excavation only two were sufficiently free from etching to reveal their original form. One of these was doubly terminated, about three-quarters of an inch long, perfectly symmetrical, and bounded by the forms l (120) and y (041). It was found near the surface embedded in lepidolite. The other was larger, about three inches across, and was found in the bottom mud. It showed a broad surface of fresh cleavage and probably had been broken from the roof, but the place of attachment was not found. This crystal showed a more usual topaz habit with faces of the prism zone, two pyramids u (111) and i (223), and the brachydome y (041). With these exceptions the topaz crystals are but remnants of the originals both in form and size, varying from thin shells or skeletons bounded wholly by etch planes to crystals still preserving parts of the brachydome faces of y (041), but otherwise so attacked by active solvent action that all crystal faces are destroyed... The largest crystal remnant weighs about three pounds and measures four by four by five inches in the directions of the a , b , and c axes respectively. ... The whole mass of topaz recovered weighed twenty-five pounds, about half of this amount being accounted for by six crystals each a pound or more in weight.

The color is generally colorless or slightly brownish; but a number are of a delicate aquamarine blue. The etching effects are so various and

so complex that without careful study and drawings no idea of it can be conveyed. One feature, however, is universal and, as far as my experience goes, quite new for topaz. The faces of the brachypinacoid are always developed by the solvent as bright plane faces, visible in steps over the whole surface of the crystal and marked by beautifully sharp hopper-shaped depressions bounded by faces in the prism and brachydome zones. It is, therefore, always possible to orient the most shapeless fragment even in the absence of the cleavage. ... Sericite, and rarely quartz and herderite, are implanted upon etched topaz surfaces. Generally, however, the topaz was quite free from any attached material and was at once noticeable on the screen when the mud was washed out by the higher luster and shining quality of its curved etch-faces."

A few rare crystals (to 10 cm) were steeply terminated and embedded in yellow muscovite and were gemmy in a minority of the crystals' volume. The pocket also produced small (7-10 mm) elbaite crystals in addition to emerald-green microlite crystals, fluorapatite, tapiolite, and stibiotantalite.

TORBERNITE / METATORBERNITE (Autunite Group) **$\text{Cu}(\text{UO}_2)_2(\text{PO}_4)_2 \cdot 8-12\text{H}_2\text{O}$**

Albany - Bumpus Q, Johnson Q, Wardwell Q; **Auburn**; **Bowdoin** - Coombs Q; **Bowdoinham** - Dibiosso Q (=Brosso Q?); **Georgetown** - Consolidated Q; **Gilead** - Wheeler Q; **Greenwood** - Beryllium Corporation Q, Witt Hill L; **Newry** - Bell Pit, Dunton Q, Scotty Q; **Paris** - Mount Mica Q, Singepole Mountain Q; **Peru** - Joyner P, Lobikis Q; **Phippsburg** - Thomas Q; **Rumford** - Black Mountain Q; **Stoneham** - Lord Hill Q; **Topsham** - Consolidated #1 Q, Consolidated #2 Q, DiBiosso Q, Fisher Q, Square Pit; **Warren** - Starrett Q

Torbernite is a phosphate with a layered structure. The inter-layer region contains copper and water molecules. When torbernite is taken away from its moist environment in nature, the water molecules slowly evaporate out of the layer and the structure of the mineral is allowed to come closer together due to the depletion of the water to hold the layers apart. The change is irreversible. The name for torbernite which has dehydrated is metatorbernite. Freshly found autunite can have a decided greenish yellow color, and this greenish tint has prompted some collectors to misidentify this mineral as torbernite. Torbernite does not usually have an appreciable yellow base-color. The mineral is not fluorescent in ultraviolet light.

Morong (1990) noted torbernite at the Consolidated quarry, **Georgetown**: "very occasional tiny green square crystals found in edges of brown altered material, in microcline." (Note: the autunite found at the Consolidated quarry can be decidedly greenish yellow, but the green color fades as the specimens dehydrate.)

Irregular light emerald-green torbernite masses (to several millimeters) have been found interlayered in muscovite from the Wheeler quarry, **Gilead**.

Torbernite crystals (to 1 mm) are found in fine-grained masses of muscovite along with irregular, fluorescent (yellow - short-wave ultraviolet light) fluorapatite crystals at the Bell Pit, **Newry**. Tiny (less than 1 mm) green torbernite crystals are found in brown stained vugs in cleavelandite from the Dunton quarry, **Newry**. Fine-grained torbernite crystals (to much less than 1 mm) are found dusting fracture surfaces in black-stained albite-muscovite pegmatite at the Scotty quarry, **Newry**.

Torbernite crystals (to 1 mm) are found as eight-sided plates of bright milky emerald color in rusty quartz/muscovite vugs at the Mount Mica quarry, **Paris**.

Square tabular torbernite crystals (to several millimeters) coat fracture surfaces in black-stained pegmatite at the Lobikis quarry, **Peru**. Bright green, square, frequently crudely formed, torbernite crystals (to 3 mm) are found individually as well as intergrown on muscovite coatings on chrysoberyl at the Joyner prospect, **Peru**.

Square tabular green torbernite crystals (to 2 mm) are found in vugs in brown-stained cleavelandite, or with frosted quartz crystal clusters (to 5 cm) at the Lord Hill quarry, **Stoneham**. Torbernite is also found on fracture surfaces in pegmatite. Occasionally, green torbernite zones (1 mm thick) are seen overgrown on yellow autunite crystals (to 2 mm).

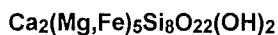
Torbernite from the Consolidated #2 quarry in **Topsham** is found as 1-2 mm square-tabular to steeply pyramidal crystals in etched brown clay-filled cavities (to 1 cm) in microcline. Steeply pyramidal anatase crystals can be associated. Palache (1934) and Burbank (1934b) reported torbernite from the Fisher quarry. No specimens are known.

Torbernite occurs at the DiBiosso quarry, **Topsham**, but the quarry is listed for Bowdoinham (as Dr. Brosso quarry) by Morrill et al. (1958) while specimen labels have indicated **Topsham**. Observed torbernite forms mint-green coatings on microcline.

tourmaline group - see dravite, elbaite/olenite, schorl, tsilaisite, and uvite

Tourmaline has long been reported from Maine localities and, at one time, the name was used as a species. By the early twentieth century, a number of names were available to designate particular compositions. Today, the specific identification of tourmaline can be a difficult problem. For example, Slack (1980) reported tourmalines (probably in the dravite-schorl range of compositions) from East Blue Hill pluton, Long Island pluton, Lucerne pluton, Isle au Haute, Rockland-East Union granitic dikes, Douglass mine, Stober prospect, Copperopolis prospect, Appleton prospect, Ellsworth quadrangle, Gushee Member of the Penobscot Formation, Bayside area, Rockland area, and Warren area without designating species. As elbaite is the most appreciated member of the group from Maine, extended discussions of tourmaline are included under that name.

TREMOLITE (Amphibole Group)



Bethel; **Blue Hill** - *Douglass M, Stewart M*; **Bowdoinham**; **Brooksville** - *Tapley #1 M*; **Calais**; **Camden**; **Castine**; **Boothbay** - *Ocean Point A*; **Portland**; **Raymond**; **Rockland** - *Limerock Street A, The Marsh A*; **Thomaston** - *Dragon Cement Q, Williams Q*; **Trescott** - *Moose River School A*; **Union** - *Harriman P, Union Q*; **Weld** - *Mount Blue A*; **Woodstock**

Tremolite is a widespread amphibole in Maine metamorphic rocks and has been reported far many more times than are indicated here. Actinolite is described under that name. Collector quality specimens are virtually unknown in Maine.

Tremolite was reported in rock from the Tapley mine, **Brooksville** (MMJ, October 15, 1880): "It contains minute crystals of tremolite; at first sight these would not be observed, but on close inspection they became apparent."

Bastin (1908b) said of **Rockland** tremolite: "A specimen from the north side of Limerock street, about one-fourth mile west of Broadway, shows quartz and tremolite as its principal minerals, with considerable amounts of zoisite and calcite and a few grains of microcline. Tremolite forms much the largest crystals in the rock and usually incloses numerous quartz grains and some of feldspar. A specimen from the east side of 'The Marsh,' a short distance south of Dunton's quarry, consists largely of tremolite in prisms and needles which reach a length of one-eighth of an inch. With this mineral are associated zoisite, calcite, and titanite."

Barker (1955) noted tremolite from the Union Limestone quarry, **Union**: "Gray columnar masses and radiating crystal groups up to two inches on limestone."

White to tan, radial to irregularly stellate silky sprays (to 3 cm) of tremolite are found in the marble at **Thomaston**. The tremolite is fluorescent cream-yellow in long-wave ultraviolet light. The Dragon Cement quarry, **Thomaston**, contains concentrations of silicate material and white, gray, to tan "log jam" clusters and stellate sprays of tremolite crystals (to 3 cm), found in white to gray mottled marble.

Lapham (1882) noted that the canaanite variety of tremolite was found in **Woodstock**. No specimens known.

TRIDYMITE (Silica Group)



Warren - *Starrett Q*

Tridymite is usually thought of as a high-temperature member of the silica group. However, many opal specimens have been shown to be very poorly crystalline tridymite which have formed at temperatures approaching those normally found at the surface of the earth. Most specimens of hyalite opal, however, are so

poorly crystalline that they do not diffract X-rays. The Maine opal specimens are all, but one, of the hyalite variety. Hyalite is kept, unassigned, as a variety of "opal" (q.v.) until this material can be identified. The name hyalite indicates that the opal forms hyaline, transparent and glassy, masses.

Milky white opal with coarse fractures and smooth rounded conchoidal fracture infills a quartz vein (to 3 mm), which has a few small (to several mm) muscovite flakes, at a locality "near" the Starrett quarry, **Warren**. Specimen ex-Herbert Haven collection.

triphane (Pyroxene Group) = spodumene

Rumford - *Black Mountain Q*

LaCroix (1922) described triphane (= spodumene) from the Black Mountain quarry, **Rumford**: "Enormes cristreaux de triphane ... atteignant plus d'un mètre de longueur ..."

TRIPHYLITE (Triphylite Group)

$\text{Li(Fe}^{2+}, \text{Mn}^{2+})\text{PO}_4$

Auburn?; **Buckfield?** - *Bennett Q*; **Frye?** - *Mount Binford bridge A*; **Greenwood** - *Tamminen Q?*, *Waisanen Q*; **Hartford?**; **Hebron** - *Hibbs Q*; **Newry** - *Bell Pit*, *Beryllium Corporation Q* (*Meadow Mountain*), *Dunton Q*, *Nevel Q*, *Puzzle Mountain - Plumbago Mountain P*, *Scotty Q*; **Norway?** - *Tubbs Ledge Q*; **Paris** - *Mount Marie Q*, *Mount Mica Q*, *Ryerson Hill Q*; **Peru** - *Lobikis Q*, *Perry P*; **Rumford** - *Black Mountain Q*, *Brown-Thurston Q*, *Goddards Ledge Q* (= *Ford Hill Q*), *Red Hill Q* (*Ridge Pegmatite Cut #1*, *West Pegmatite Cut #1*); **Standish** - *Oak Hill road cut*, *Route #25 road cut*; **Stoneham** - *Cole Q*, *Lord Hill Q*; **Topsham** - *Fisher Extension Q*; **Warren?** - *Starrett Q*

Triphylite is translucent gray to gray-blue and has several good cleavages. The blue color seen in the mineral is frequently the result of the formation of vivianite along cleavage traces in the triphylite. Triphylite masses in Maine are usually less than 10 cm. Maine triphylite does not form giant crystals of several meters as in some New Hampshire pegmatites.

Triphylite is an early-formed species in granite pegmatites. It is frequently corroded and/or oxidized subsequent to its formation, and secondary minerals have been produced in this manner. The iron to manganese ratio of parent triphylite influences the iron-manganese ratios of its secondary products. For example, the removal of lithium from triphylite and the oxidation of the triphylite's iron can result in the formation of heterosite (q.v.). As no material is usually added during the alteration process, the heterosite should have the same iron to manganese ratio as the fresh triphylite at that locality. Secondary phosphates of the unoxidized portion of the phosphate parageneses in pegmatites discussed by Moore (1973) should carry elemental ratios similar to the parent primary phosphates as discussed above, but

the analogy is incomplete due to the various events which add and remove elements from the crystallizing pegmatite-forming fluid. In addition, Moore (1973) suggested that the iron to manganese ratio of primary phosphates should be similar throughout a particular zone and this idea has been shown to be true for one pegmatite zone at the Nevel quarry, Newry (King and Pope, 1990).

When oxidation of the iron in the pegmatite-forming fluid begins, Fe^{2+} ferrous iron is converted to Fe^{3+} ferric iron, while manganous manganese Mn^{2+} , which is more resistant to oxidation, remains unaffected. The smaller ferric iron ion does not easily substitute in minerals where ferrous iron or manganous manganese fit, so late-stage phosphates can be more manganese-rich than the starting ratio of that element in parental triphylite, etc. would suggest. Magnesium and zinc, which are frequently of minor importance in triphylite, can become relatively enriched when compared to the starting amount of ferrous iron in late-stage phosphate minerals, as these elements do not undergo further oxidation. Magnesium-bearing and zinc-bearing species can become conspicuous, if volumetrically unimportant, among the last phosphate minerals to form. Finally, many minerals favor the incorporation of some elements over others (e.g. partition) and have compositions that are not representative of the composition of the parent fluid.

Landes (1925) gave one of the few scientific reports of an occurrence of both ends of the triphylite/lithiophilite series found in a single pegmatite at the Bennett quarry, **Buckfield**: "Triphylite is represented in the Buckfield collection by a single isolated fragment measuring five by five by two and a half centimeters, blue in color."

Burr (1930) listed triphylite from **Hartford**. No specimens known.

The Nevel quarry, **Newry** has produced some of the few well-formed triphylite crystals found in Maine. (Few worldwide localities produce even crude crystals of triphylite. The best triphylite crystals probably come from the Chandler Mills and G. E. Smith quarries, Newport, New Hampshire. The Newry crystals are probably the second best examples of the species. Triphylite crystals are so rare that no significant third locality is known to the authors. Giant "crystals," which are really pods frozen in host rock, are well known from the Palermo #1 quarry, North Groton, New Hampshire as well as the Hagendorf, Bavaria, Germany, and Custer and Keystone, South Dakota areas.) The Newry crystals are found in the densely packed triphylite-bearing first intermediate zone of the Main pegmatite and are sometimes embedded in muscovite and/or cleavelandite. The triphylite crystals can be exposed by carefully cleaving the muscovite away from the triphylite, layer by layer. Crystals to 1 cm are common at the locality, but are frequently neglected by collectors. The largest triphylite crystals were up to 20 x 10 cm. Marble and Morrill (1945) noted of the "Newry mine," in this case the Nevel quarry: "One of the operators had a triphylite crystal about eight inches long." Hess et al. (1943) figured the "graphic intergrowth" of triphylite in feldspar from the Nevel

quarry. Shainin and Dellwig (1955) mapped and reported on the Nevel quarry and its triphylite-rich first and second intermediate zones: "Triphylite occurs in roughly lenticular masses 1 to 8 inches in diameter and is intergrown with fine-grained muscovite and granular milky quartz. ... The triphylite unit, which occurs in irregularly shaped masses, makes up approximately half of the zone and is estimated to contain 43 percent quartz, 22 percent triphylite, 18 percent albite, 15 percent muscovite, 2.02 percent beryl, and minor black tourmaline and columbite." Schorl inclusions (to several millimeters) have been found in Nevel quarry triphylite.

Holman (1935) reported of the Dunton quarry: "Specimens of triphylite (easily mistaken for indicolite) often associated with purpurite [sic], were collected..." Fraser (1930) wrote: "This mineral is abundant and very noticeable in the pegmatite. Areas from a few inches to a foot across were seen showing the good cleavage characteristic of this mineral. It is white to pale blue when fresh. It is generally surrounded by a border of bright blue massive tourmaline which also forms veins and irregular replacement areas in the triphylite. Some of the crystals are also marked by the brilliant purple coating of heterosite... to which it has altered. Mixed with the tourmaline and clearly also a replacement is light brown granular siderite." The "white" color of the triphylite should be regarded as an exaggeration. The Dunton quarry triphylite is frequently etched, oxidized, and replaced by a host of secondary species - laueite, strunzite, mitridatite, vivianite, etc. Each of these secondary species is discussed separately.

Milton (1961) wrote of Newry: "The only mineralogically interesting pegmatite is exposed in prospect pits between 1900' and 2000' elevation on the ridge between Great Brook and Stony Brook, Newry. This pegmatite is structurally complex, with massive quartz zones, but the pattern is not clear. Minerals noted were rose quartz, triphylite, several as yet unidentified secondary phosphate minerals, tourmaline, beryl, apatite, and unidentified uranium minerals."

Toppan (1932) wrote of the Mount Mica quarry, **Paris**: "Triphylite with which are associated occasional zircons occurs as aggregates, some of which weigh as much as 50 pounds[.]" Greenish gray triphylite from Mount Mica quarry is frequently surrounded by blue tourmaline armoring (q.v.) and further frozen in cleavelandite. A thin white kaolinite-group clay, occasionally smoky gray to blue, frequently forms additional rims separating the triphylite from the blue tourmaline. The masses of triphylite (generally to 10 cm) show a branching, three-dimensional pattern.

Masses of triphylite were known from Nathan Perry's workings in **Peru** as early as the 1870's. Masses of triphylite from the Lobikis quarry, Peru are blue-gray and are sometimes partly replaced by siderite or oxidized to heterosite.

Large gray-blue masses (to 10+ cm) are found with medium-grained dark brown to black sphalerite cleavage masses, almost equally as large, in the Red Hill quarry group, West Pegmatite Cut #1, **Rumford**. A partially terminated triphylite

crystal (7 x 2 cm) was found at the Ridge Pegmatite Cut #1, Red Hill quarry group, Rumford (Robyn Green, personal communication, 1992; King 1993a).

Dolloff (1936) noted triphylite from the Oak Hill prospect, Oak Hill road cut, and the Route #25 road cut, **Standish**. Some of the triphylite was oxidized to heterosite and, at the Oak Hill prospect, was altered to a variety of secondary phosphates perhaps including rockbridgeite.

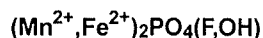
Kunz (1884a₂) noted of the Lord Hill quarry, **Stoneham**: "Triphylite, one very imperfect crystal, was found about 15mm. long."

Several reported triphylite localities are actually lithiophilite localities. Morrill et al. (1958) reported triphylite from the Tubbs Ledge quarry, **Norway** and the Tamminen quarry, **Greenwood**, but these are well known lithiophilite localities. Hess et al. (1943) called the Starrett quarry, **Warren** mineral "lithiophilite," but no specimens are known. Sundelius (1963) reported iron-rich alteration of primary phosphate in the form of heterosite from Warren.

triplite group - see triplite, triplodite, and zwieselite

The manganese end of the triplite group is well-known from Maine pegmatites. Triplite is fluorine-rich while triplodite is hydroxyl-rich. The iron-rich members of the series, zwieselite and wolfeite, are not yet known from Maine, but zwieselite (q.v.) has been reported from a known triplite locality. As more specimens of triplite are analysed, many may prove to be fluorine deficient. To date in Maine, only Emmons quarry and Dunton quarry specimens have been qualitatively analyzed for fluorine. Crystals of any of the triplite group minerals are extremely rare on a worldwide basis. Several specimens of free-standing transparent triplodite crystals are known from the Emmons quarry, Greenwood and rank among the best crystals known of their group. Triplodite will undoubtedly become commonly identified as chemical analyses are made of Maine "triplite" specimens.

TRIPLITE (Triplite Group)



Auburn - Greenlaw Q, Groves Q, Keith Q, Pulsifer Q, Wade Q; **Buckfield**; **Greenwood** - Tamminen Q; **Hebron?** - Mount Rubellite Q; **Newry?** - Nevel Q; **Poland** - Berry-Havey Q; **Rumford** - Black Mountain Q, Red Hill Q, Whitecap Mountain A; **Stoneham** - Lord Hill Q, Beryllonite Locality ("McKean Mountain")

At all of its Maine occurrences, triplite more or less looks like a dark red-brown to dark orange-brown garnet and appears to be a reaction product of lithiophilite in many cases. A high proportion of lithiophilites have the darker triplite intergrown near the junction with the "matrix." No crystals, or even just a single crystal face, of triplite are known from Maine. Morrill et

al. (1958) listed triplite from unspecified localities in **Buckfield**, and on Whitecap Mountain, **Rumford**. Wintringham (1954) listed "Triplite(?)" from the Mount Rubellite quarry, **Hebron**, and a similarly uncertain occurrence from the Nevel quarry, **Newry**. Morrill et al. (1958) unqualifiedly listed the species for an unspecified location in Hebron. No specimens known from preceding locations.

Masses of salmon-pink lithiophilite from the Pulsifer quarry, **Auburn** can have their margins intergrown with red-brown massive triplite (to several cm) which can resemble garnet. The massive triplite has an oily luster and can be in contact with white masses of montebrasite, brownish black zircon crystals, massive quartz, etc. Triplite from the Keith quarry, Auburn varies from clove-brown masses (to 1 cm) to gemmy reddish brown grains, irregularly to indistinctly rimmed by blue elbaite in "eye" texture. The triplite can form replacement rims on the lighter brown to salmon-pink lithiophilite or replace the entire lithiophilite mass, sometimes leaving the lighter colored lithiophilite as relict grains. When fine-grained, the triplite can appear dull, while some grains (to 3 mm) are gemmy and vitreous. The new Groves quarry, Auburn has cinnamon-brown triplite masses and "spots" (to several mm) enclosed in tannish brown lithiophilite, enclosed in black-stained quartz. Triplite from the Greenlaw quarry, Auburn occurs as small tan to brown masses (to 5 mm) in a very unusual association of granular rich green dickinsonite masses (to 1 cm) also replacing light grayish tan lithiophilite which is veined by a network of silvery löllingite. A very dark reddish brown gemmy massive triplite (3 x 6 cm) in microcline and muscovite (HU #91989) came from an unspecified area on Mount Apatite, Auburn, but likely from the Pulsifer-Keith quarry group. Brown resinous zircon crystal sections (to several mm) occurring as inclusions in lithiophilite at the Groves-Pulsifer-Keith quarry group should not be confused with triplite.

A close examination of the dark staining around Tamminen quarry, **Greenwood** lithiophilite will reveal red-brown triplite. The triplite is resinous and partly gemmy in small grains. Light milky orange-brown hureaulite can rarely be found replacing Tamminen quarry lithiophilite. Wintringham (1955) wrote of Greenwood: "Triplite(?) - possibly from old Tamminen workings."

Triplite from the Berry-Havey quarry, **Poland** is fine-grained and has a bright red-brown color. It is found in masses (to 6 x 6 cm) frozen in quartz along the margins of fine-grained montebrasite. Some triplite from the Berry-Havey quarry can occur as light salmon to pink masses (to 1 cm) in smoky quartz, cleavelandite, and muscovite matrix. Some corroded triplite masses can have a cellular appearance. Some light-colored triplite can so closely resemble lithiophilite that when they are not present on the same specimen, they are visually easily confused.

Kunz (1886b) wrote of the Black Mountain quarry, **Rumford**: "Triplite was observed in small, irregular masses." No specimens known.

Large masses (to 30 x 40 cm) of brown triplite at the Lord Hill quarry, **Stoneham** can resemble masses of garnet, but triplite has a poor cleavage. Black mottled stains can be seen along layers in the mineral, as well as occasional lilac to purple interlayered phosphosiderite. The triplite is found frozen in albite granite pegmatite. Kunz (1884a₂) wrote of the Lord Hill quarry:

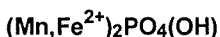
"Triplite is scattered all through the rock in pieces from one gramme to one kilo in weight, staining all the other minerals, especially the quartz and cleavelandite.

One mass that may have been a large rough crystal furnished over fifty kilos of this mineral. The color is a light chocolate brown, streaked with almost transparent veins of a lighter colored variety of the same mineral, and is remarkably pure in character, translucent in small pieces, possibly the Var Zweiselite[sic]."

The high manganese content of the Stoneham triplite (King and Pope, unpublished data, 1976) seems to preclude the zweiselite suggestion. Hureaulite crystals (to several mm) can be found in vugs in corroded triplite at the Lord Hill quarry.

Dana and Wells (1889a,b) listed triplite among the associated minerals at the Beryllonite Locality, Stoneham.

TRIPLOIDITE (Triplite Group)



Greenwood - Emmons Q; **Newry** - Dunton Q; **Standish?** - Oak Hill road cut

Triploidite occurs at the Emmons quarry, **Greenwood** as clear, virtually colorless thinly wedge-shaped crystals (to 1 mm) in vugs in altered lithiophilite along with landesite (Gene Bearss, personal communication, 1992). (The species was verified, this study, by X-ray diffraction and chemical analysis.) Triploidite is normally a shade of brown and the colorless crystals are unexpected. The Emmons quarry crystals are the best of their species and probably the best of their group of related minerals. Emmons quarry dark coffee-brown granular masses (to several cm) of triploidite (unanalyzed) replace lithiophilite, interspersed with granular rhodochrosite, etc.

Triploidite occurs at the Dunton quarry, **Newry** as nearly circular masses (5-10 mm) with tan granular siderite in blue elbaite eyes. The pink to pinkish brown masses superficially resemble garnet and can have a thin (to several mm) corona of muscovite. Some amber-brown Dunton quarry triploidite in cleavelandite is associated with dickinsonite (q.v.)

Dolloff (1936) wrote of triploidite from the Oak Hill road cut, **Standish**, but the data and associated minerals suggest that the mineral found was the iron-rich member of the series, wolfeite. Wolfeite, however, was not known at the time of

Doloff's study. The data were few, but consistent with a triploidite series mineral. Doloff (1936) described the material well, but suggested that it altered to "purpurite." The purpurite-heterosite series seems to require a lithiophilite-triphyllite precursor (Paul B. Moore, personal communication, 1974). The implication is that heterosite-related minerals are not stable and will not form without the pre-establishment of the triphyllite structure. While the identifications of Doloff (1936) are not verified, his observations are provocative:

"Triploidite has the composition $(\text{Mn,Fe})_2(\text{OH})(\text{PO}_4)$. Blowpipe and chemical tests confirmed these elements. The cleavage is well developed. The color is brown, but the streak varies from brown to purple where the triploidite has altered to purpurite which inherited the structure of the host.

Fragments under the microscope are highly colored yellow to reddish-brown with indices above 1.700, plus 2V medium, $p > v$ extreme [sic; $r > v$?], $Z \Delta c$ almost 0 degrees.

The triploidite occurs with the triphyllite in quartz veins with muscovite. It also occurs as isolated patches, but as this is in the zone of shearing, the original structure has undoubtedly been broken. ... Some triploidite in the brecciated area is surrounded by rims of a white mineral which is a member of the apatite group."

A Standish "triploidite" (HU 119077) was shown to be hureaulite (William Metropolis, personal communication, 1988). Specimen not located for examination (this study).

tsilaisite? (Tourmaline Group) - a hypothetical manganese-rich member of the tourmaline group

Blue Hill - Black Hawk M

Bouley (1978) used the word tsilaisite informally to suggest that some Black Hawk mine, **Blue Hill** tourmaline was manganese-rich. Slack et al. (1980) suggested the mineral was dravite.

tungsten?

Paris - Mount Mica Q

Robinson (1825) listed tungsten? from Mount Mica in a personal communication from E. L. Hamlin. It is likely that the mineral found was manganocolumbite.

tungstite?

Topsham?

Tungstite was listed by Dana and Brush (1868) from **Topsham**. Wheeler and Wheeler (1878) wrote of the greater Topsham - Brunswick - Harpswell area: "TUNGSTITE is supposed to have been found, but it is not known with certainty." No specimens are known.

turgite = iridescent hematite

Monson - Hollman Hill Q; Oxbow - Cupsuptic River Q; Waterville - Interstate Route #95 road cut

Turgite is an iridescent variety of hematite which frequently occurs as thin films. Slate from many Maine localities, including the Hollman Hill quarry, **Monson** can have a rainbow iridescent turgite coating formed between slate lamellae.

The crumpled phyllite exposed at the Cupsuptic River quarry, **Oxbow** can have iridescent turgite films which vary from golden yellow through splashes of gunmetal blue, metallic green, and, occasionally metallic red.

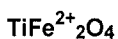
tyuyamunite?

Newfield? - Bergendahl P

Morrill et al. (1958) reported, without description or substantiation, the unbelievable occurrence of tyuyamunite in the simple arsenopyrite deposit at the now back-filled Bergendahl prospect, **Newfield**.

U

ULVÖSPINEL (Spinel Group)



Union - Harriman P

"Most of the Harriman [Union] spinels consist of two distinct phases. The dark phase (reflected light) is an aluminum-rich chrome spinel [aluminian chromite]; the light phase is an iron-rich chrome spinel containing several percent titanium. A third phase, found in association with only a small number of spinels, is exceptionally rich in titanium. ... The third phase, a chromian ulvöspinel, is of special interest because the only terrestrial occurrences reported are from the Bushveld [South Africa]... A series of these chromian ulvöspinel have recently been described from lunar samples..." (Rainville and Park, 1976).

unakite = rock name for a pink granite with abundant patches of light-green epidote

unknown mineral #1

Mount Desert - Grenci-Ellis Quarry

A smooth botryoidal mineral (to 5 mm), formerly thought to be thomsonite, is found in vugs (to 1 cm) at the Grenci-Ellis quarry, in Hall Quarry village, **Mount Desert** along with complex quartz crystals (to 3 mm), striated magnetite crystals (to 3 mm), and transparent albite crystals (to 2 mm) in tourmaline-bearing granite. The unknown has an orange-tan color, but the radially fibrous interior is color and texturally-zoned. The fibers show pearly luster highlights and grade toward the base of the fibers to milky white in color. The mineral is probably concentrated along mineralized fractures or joints in the quarry. The mineral appears to be a rare earth carbonate which has the X-ray pattern of siderite (chemical analyses and XRD, this study). Further study is in progress.

unknown mineral #2 (red manganese phosphate)

Buckfield - Bennett Q; Newry - Dunton Q

A still unidentified mineral was first reported from the Bennett quarry, **Buckfield** by Landes (1925):

"In a few specimens botryoidal surfaces of manganite (pseudomorphous after psilomelane) were coated by a thin, velvety, brick red crust. The latter very evidently resulted from alteration of the manganite, as the radiating fibers forming the rounded surface are red on that surface, but darken toward the interior, where they become indistinguishable from the black manganite.

The fibers are extremely fine, and so soft and brittle that they powder immediately when an attempt is made to work on the material. The quantity present was insufficient for a chemical analysis. A bead test proved the presence of manganese, also a phosphate reaction was obtained with ammonium molybdate. ... The mineral is biaxial and probably negative. The plates due to a good cleavage are perpendicular to X. Further optical data follow:

$$\begin{aligned}\alpha &= 1.71, 2V = \text{large}; \\ \beta &= 1.73, Y = \text{yellowish brown}; \\ \gamma &= 1.74, Z = \text{deep red brown}.\end{aligned}$$

It was at first thought that the mineral might be sicklerite, a hydrous lithium manganese phosphate. The indices of both lie between 1.71 and 1.75. Likewise, the pleochroism is somewhat similar for both. But comparison with the type sicklerite from Pala, California, brought out the following differences: 1. Birefringence greater for sicklerite. 2. Sicklerite gives good lithium flame, while unknown gives none. 3. Sicklerite readily soluble in nitric acid. Unknown difficultly soluble. 4. Sicklerite is much harder."

Fraser (1930) found another unknown, this time from the Dunton quarry, **Newry**, but without demonstrating its nature or supposed relationship with Landes' (1925) material: "On several specimens a reddish brown mineral occurred on the herderite and elsewhere. This mineral was in small radiating needles. It has been described by Landes³ [1925] and the mineral from Newry as [sic] very similar in appearance to that from Buckfield. It occurs in such minute quantities that its identification is extremely difficult." One must assume that this material was examined optically and found to have values similar to Landes' (1925) mineral.

unknown mineral #3 (Roscherite Group)

Newry - Bell Pit, Dunton Q, Nevel Q, Rose Quartz Crystal L;
Paris - Mount Mica Q; **Rumford** - Black Mountain Q

Chemical analyses (this study) indicate most Maine "roscherite" is actually a new species in the group. Description of the new species is pending.

"Roscherite" is found in close association with other beryllium phosphates. The Dunton quarry, **Newry** material is found abundantly in cavities of etched beryllonite or in interstitial voids of cleavelandite. The "roscherite" shows a variety of habits. The most conspicuous "roscherite" is composed of radially fibrous cinnamon-brown botryoids to 1 cm in masses up to 7-10 cm. The luster varies from dull to vitreous. Small (3-5 mm) botryoids show a textured surface of minutely imbricated simple crystals and are sometimes hollow. Crystals of "roscherite" are rarely larger than 1 mm. Red, pseudo-hexagonal "roscherite" crystals (1-2 mm) are also found. Associated species include rhombic albite (zygadite), beryllonite, hydroxyl-herderite, moraesite, uralolite, hydroxylapatite, and crandallite. Lindberg (1958) reported an iron-rich analysis for her Newry material. Though she listed her "roscherite" coming from the "Nevel quarry," it was most assuredly from the Dunton quarry which has been frequently called the Nevel quarry because Nevel worked that deposit in the 1920's. King (1975b) described Dunton quarry "roscherite":

"Newry has several different habits of roscherite which all yield similar x-ray patterns. At the Dunton gem quarry, roscherite is almost always associated with hydroxyl-herderite. It usually occurs as dark brown botryoids that have a rough surface of sub-parallel crystals. Internally, the botryoids are radially fibrous and are silky in luster. The fibers can be individuals rather than botryoidally grouped. Occasionally, roscherite is altered to an earthy appearance. The very dark brown color is diagnostic at this locality when considered with the internal and rough surface. Some roscherite botryoids are hollow and this is the only botryoidal mineral to be so.

The other habits include tiny, thin-tabular, pseudohexagonal forms. These two habits are rare and have been observed but once each from the Dunton gem quarry. The color of these is red-brown. ... The crystals are usually less than 1 mm, while botryoids may exceed 5 mm each and groups may be 50 mm across."

The Nevel quarry "roscherite" is radially fibrous similar to the Dunton quarry's, but is known in very few specimens. Botryoidal aggregates to 1 cm have been found in cleavelandite associated with eosphorite, pyrite, fluorapatite, fairfieldite and, in one instance, gainesite. The surface of the botryoids can be almost as smooth as an orange or composed of the rounded corners of crystals projecting out of the central mass. The "roscherite" can also be grouped individually or in splayed fashion somewhat resembling half "bow ties." The color is brownish green and small blocky crystals are subtransparent.

The Bell Pit "roscherite" is gray-green to avocado green and forms radially fibrous botryoids (to 3 mm), which have an "orange peel" surface, in the siderite assemblage matrix. A tiny (much less than 1 mm) mineral with rough to irregular equant shape can be found on associated siderite crystals.

The "roscherite" from the Rose Quartz Crystal locality at Newry is olive-green and simple rectangular in habit. The rounded, thickly intergrown roscherite, to 1 mm, is found in vugs

in cleavelandite along with hydroxyl-herderite botryoids, fluorapatite, carbonatian hydroxylapatite, and eosphorite.

Pseudohexagonal simple prismatic "roscherite" is found in blue tourmaline eyes with light brownish red siderite-rhodochrosite at the Mount Mica quarry, **Paris**. The olive-green color of the "roscherite" and the simple pseudohexagonal shape makes the closely clustered crystals (to just less than 1 mm) look like fluorapatite.

The Black Mountain quarry, **Rumford** "roscherite" is similar to the Rose Quartz Crystal locality "roscherite." The simple, rectangular prisms are olive-green and usually rounded, though undistorted crystals are known. Hydroxyl-herderite botryoids are frequently associated. The "roscherite" can be grouped in botryoids (to 2-3 mm) which have an imbricated surface texture similar to those from Newry, but the Black Mountain "roscherite" can have a surface coating which makes them look like they were coated with tiny, brassy pyrite crystals or covered by a multi-colored tarnish or both. The "roscherite" is found in cleavelandite with zygadite variety of albite, eosphorite, beryllonite, hurlbutite, hydroxyl-herderite, carbonatian hydroxylapatite, and rhodochrosite. Bjareby (1965a) noted of the Black Mountain quarry: "The roscherite occurs as small monoclinic olive brown crystals both singly and in botryoids and as pseudomorphs after tabular beryllonite. It may be closely associated with eosphorite, which usually is found as well developed individuals having grown at random in vugs in cleavelandite or as botryoids, also in fan shaped aggregates of terminated crystals."

unknown mineral #4

Paris - Mount Mica Q

A dark grass-green resinous to dull mineral forms irregular "septa" in open etched vugs in siderite from the Mount Mica quarry, **Paris**. The mineral has the X-ray pattern of an alluaudite-group species, but qualitative chemical analysis does not suggest a known species.

unknown mineral #5

Albany - Johnson Q, Pingree Ledge Q; Bowdoinham - West Booker Q; Newry - Dunton Q

A pale earthy yellow mineral frequently completely replaces uraninite grains (to 1 mm) in cleavelandite at the Dunton quarry, **Newry**. The yellow earthy mineral is a uranium silicate with an unidentified X-ray pattern. A thin brown rim of an iron silicate (chemical analysis, this study), probably hisingerite, usually surrounds the pseudomorph. Further study is pending. Additional localities have visually similar material.

unknown mineral #6

Newry - Bell Pit

Vitreous reddish coffee-brown irregularly etched gemmy fragments (to 3 mm) embedded in etched tan to slightly greenish massive siderite from the Bell Pit, **Newry** are a manganoan, though iron-dominant, phosphate with fluorine (analyses, this study). The mineral yields an X-ray pattern too unsatisfactory for zwieselite, though there are general similarities and the optical properties are significantly different. Further study is pending.

unknown mineral #7

Paris - Mount Mica Q

Bright vitreous transparent and colorless acicular crystals (to 2 mm) occur in siderite in blue tourmaline eyes from the Mount Mica quarry, **Paris**. The mineral's chemistry and optical properties (this study) do not suggest an identification. Further study is pending.

uraconite - an undefined name; specimens from Maine labeled this way are usually autunite/meta-autunite

Lovell - McAllister Q; Stoneham - Lord Hill Q

McAllister (1955) reported uraconite at the McAllister prospect, Lovell: "In mucking out after a blast here, we found ore that was unusually rich in Autunite and associated minerals. There were thick crystals of Autunite and almost every rock was coated with yellow uraconite. There was probably a ton of rock that was chuck full of these yellow uranium minerals."

uralite (Amphibole Group) = pyroxene altered to amphibole

Brooksville - Cape Rosier A; **Cutler** - Cutler diabase; **Lincolntonville** - road cut; **Monhegan** - olivine norite; **Sanford** - 200 m L

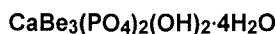
Bouley and Hodder (1984) said of the Cape Rosier area, **Brooksville**: "Titanaugite, augite, and pigeonite are the most abundant pyroxenes, variably replaced by pseudomorphous uralite, chlorite, and talc." While the process of uralitization commonly is seen in the transition of diopside to tremolite, any conversion of a monoclinic pyroxene to amphibole has been called uralite.

Gates (1961) wrote of the Cutler diabase, **Cutler**: "The bands are distinguished by their color which in turn primarily reflects [sic] the ratio between plagioclase and uralitized py-

roxene. Dark bands have a 1/1 ratio of plagioclase to uralitized pyroxene and the light bands a ratio of about 4/1. ... Clots of gabbro pegmatite are another common textural variation in the Cutler gabbro... These clots consist of large laths of plagioclase optically to suboptically enclosed in large crystals of uralitized pyroxene or intergrown with long lath-like crystals of hornblende which may not be derived from pyroxene."

Uralitized diopside crystals (to 5 mm) in calcite, from the 200 meter locality, **Sanford**, have a splintery to mosaic megascopic texture.

URALOLITE



Newry - Dunton Q

Uralolite is found in very few localities: Ural Mountains, USSR; Taquaral, Itinga County, Minas Gerais, Brazil, Weinbene, Austria, etc. It is always seen as milky-white fibrous to silky crystals, often in divergent crystal sprays. Uralolite is found at the Dunton gem quarry, **Newry** in close association with all of the beryllium phosphates known from there. It is one of the last species to form in the association and can closely resemble the more abundant moraesite, but moraesite commonly consists of "tangle fibers" while uralolite is straight radially fibrous. One remarkable specimen (HU unnumbered) has a 1.5 x 4 cm surface of beryllonite, hydroxyl-hercynite, "roscherite," etc. almost completely coated by white needle crystals (less than 1 mm long). An ultraviolet light used to examine the specimen revealed patches of uralolite intergrown with moraesite. At the Dunton quarry, uralolite fluoresces green in short-wave ultraviolet light and moraesite does not. The largest uralolite crystals at Newry (3 mm) (King, 1975b) might represent the largest known for the species. The uralolite was found as early as 1958 by Professor Roger Clapp and others, but the identity of the uralolite was not suspected as the batch sent for identification also contained more abundant moraesite and the moraesite was the material identified (Philip Foster, personal communication, 1966). Uralolite was not recognized as a species until 1964. Dunn and Gaines (1978) described the Newry material along with chemical analyses.

King (1987b, 1988) wrote: "Single crystals of beryllonite up to 20 cm have a rectangular outline, are white to cream-colored... Amber-colored, radially fibrous botryoids of hydroxyl-hercynite up to 3 mm form clusters up to 10 cm and constitute the first stage of alteration appearing on cleavage ... planes. Iron-rich roscherite (Lindberg, 1958) formed in the second phase of alteration. ... In a very late alteration phase, acicular, white moraesite and uralolite crystals up to 1 mm in patches up to 5 cm are co-genetic and coat the previously mentioned minerals. ... All of the alteration products can also be found in interstices in cleavelandite without direct contact with the parent beryllonite."

URANINITE / PITCHBLEND

UO₂ - UO₃ - [U₃O₈]

Albany - Pingree Ledge Q, Songo Pond Q, Stearns P, Wardwell Q; **Auburn** - Groves Q, Keith Q, Pulsifer Q; **Buckfield** - Bennett Q; **Gray** - Hinkley P; **Greenwood** - Tamminen Q; **Minot** - LaFlamme Q, Sturtevant Q; **Newry** - Bell Pit, Nevel Q, Dunton Q, Rose Quartz Crystal L; **Paris** - Mount Mica Q; **Poland** - Berry-Havey Q; **Pownal** - Hinkley P; **Rumford** - Black Mountain Q; **Stoneham** - Cole Q; **Stow** - Lower Colton Hill P; **Topsham** - Biotite Crystal P, Fisher Q, Russell Brothers Q, Standpipe Hill Q, Swamp #1 Q; **Warren** - Starrett Q

Uraninite is frequently not of the ideal composition reported by textbooks. R. Berman (1957), E. Berman (1955), and Frondel (1956, 1958c) reported on this variability. Uraninite, even in the freshest material found to date, contains significant UO₃ and, in some very oxidized cases, U₃O₈. The border line for a species' chemical variability is taken as 50% of the total "equivalent" atoms present. Pitchblende, which is generally taken as a variety, is usually greater than 50% UO₃. Pitchblendes vary from black pitchy massive or crystallized mineral to earthy or sooty types, including pseudomorphs after uraninite, and these pseudomorphs composed of pitchblende can be relict cores in gummite alterations. Uraninite in Maine generally forms inconspicuous dots and grains embedded in feldspar in granitic pegmatites. At least six localities in Maine have produced conspicuous uraninite crystals.

Frondel (1958c) discussed the uraninite/pitchblende problem:

"Uraninite has the ideal chemical composition UO₂, uranium dioxide. Material of this ideal composition, however, has not been found in nature. The mineral always is more or less oxidized with conversion of the U⁺⁴ in part to U⁺⁶. This oxidation takes place without destruction of the crystal structure up to a not clearly defined limit. Valence compensation is effected by a concomitant entrance of oxygen into vacant positions in the crystal structure, and the mechanism may be formulated (U⁺⁴_{1-x}U⁺⁶_x)O_{2+x}. ...

The least degree of oxidation in any natural uraninite so far analyzed is that of the material of analysis 3 (p. 16) [Branchville, Connecticut] and 41 (p. 20) [Strickland pegmatite, Portland, Connecticut], with ratios of U⁺⁴ to U⁺⁶ of 1 to 0.17 and 1 to 0.21, respectively. Analysis 3 corresponds to UO_{2.15} if constituents other than uranium are disregarded. Both samples have a relatively high specific gravity, and the material of analysis 3 was described as a black crystal with unusually high luster. The upper limit of oxidation of natural material is uncertain. Seven of the 40 analyses reported in the table (p. 16-20) have U⁺⁶ > U⁺⁴. ... Brooker and Nuffield (1952) report measurements of the U⁺⁴:U⁺⁶ ratio in highly oxidized material, and they place the upper limit of oxidation at about UO_{2.6} or U⁺⁴:U⁺⁶ = 1:1.5. ... with preservation of the

UO₂ structure... The series would end at U_{2.75} in any case, because the available vacancies are then completely filled."

Pitchblende replacements of uraninite have been found at the Groves quarry, **Auburn** as compact sooty masses (to 1 x 2 x 0.4 cm) and occasional irregular octahedral crystals (to 2 mm) in albite with gahnite and zircon. Uraninite (to 7 mm), autunite, and phosphuranylite occur embedded in triplite from the Keith quarry, Auburn.

Uraninite/pitchblende with an orange to orange-yellow fourmarierite and gummite "eye" (to 7 mm) in cleavelandite associated with lithiophilite has been found at the Tamminen quarry, **Greenwood**.

The Dunton quarry at **Newry** has produced black cubes (to 3 mm) and rounded grains of uraninite in cleavelandite. The uraninite is usually surrounded by a brown aureole (hisingerite?) and the uraninite is frequently partially or completely altered to secondary uranium minerals. Uranophane, autunite, vanmeerscheite, etc. are common replacement products.

A particularly large, but incomplete, uraninite octahedron (1.6 cm on an edge) was found in microcline at the Bell Pit, Newry (HU 103038). The analysis of the Bell Pit uraninite (HU 103038), which was a "sub-metallic crystal with smooth octahedral faces" indicated a composition near U_{2.16} disregarding non-uranium components and is, therefore, among the least oxidized of the world's uraninites (R. Berman, 1957).

Peacor (1960) noted uraninite from the Nevel quarry, Newry: "Small euhedral to subhedral crystals in the core margin and some intermediate zones." Stern (1950) reported on the X-ray pattern of Newry uraninite (HU #90884).

A single sliced specimen of tan microcline with dendritic black uraninite without noticeable secondary yellow, etc. uranium minerals is known from Newry from the Yedlin collection. Morrill et al. (1958) noted: "100 Yds S of tunnels. Small cut. A bushel of sharp Uraninite Xls to 5". No specimens known. (Note: the size of the casually reported crystals would make them among the largest known. The size reported is unbelievable.)

The Hinkley prospect, **Pownal** has produced a few brilliant black cubic crystals (to 4 mm) of uraninite with small octahedral modifications. The matrix is a tan to brick-red feldspar near smoky quartz and biotite, along with an occasional monazite-(Ce) crystal.

The Black Mountain quarries in **Rumford** have yielded sharp uraninite cubes (to 5 mm) embedded in cleavelandite. Thin aureoles of brown "stain" have been called "uranium burns" and serve to demonstrate the radioactivity of the mineral. Some juxtaposed albite specimens are stained brick-red. Verrow (1941) wrote: "Uraninite - Is found as minute crystals in and on cleavelandite in the form of dendritic growths. These growths are not three-dimensional growths like those of Grafton Center, New Hampshire, but are made up of distinct crystals. ... Some of the uraninite shows that it has altered to gummite, autunite, uranophane and other secondary [uranium minerals]."

Uraninite/pitchblende from the Lower Colton Hill prospect, **Stow** is cubo-octahedral (to nearly 2 cm), but due to their being embedded in albite, only crystal sections are usually observed. The largest known specimen is internally fractured and dull in luster. Some small (to several mm) patches of crusty uranophane are present and some irregular olive colored patches of pitchblende suggest a partial mixture with uranophane. The albite is stained brick red to 1-3 cm away from the uraninite.

The Swamp #1 quarry, **Topsham** has produced a large number of world-class uraninite crystals (King, 1992b). The Swamp #1 quarry is a water-filled pit near an unnamed swamp immediately north of the Consolidated #2 quarry. The bright black uraninite crystals (up to 2 cm) are cubo-octahedra with relatively smooth, adamantine faces. The crystals were found in tan to red microcline and smoky quartz and were split out of the matrix. The crystals are generally interrupted in growth on one side where they apparently grew from their point of attachment with biotite and have a concentrically terraced "pagoda" appearance. Yedlin (1961) wrote of the uraninite: "But best of all were uraninite xls, also from Topsham. They occurred as individuals, from micro to almost 1 inch across, in a feldspar, heavily seamed with biotite. The crystals grew against the mica, and now present an interesting study. ... Biotite was first. The uraninite came next, and seemed to butt against the mica, and whenever this occurred the xls are flat and distorted at this contact point. For the rest, the uraninite formed in the .. spar, and formed perfect, brilliant, and highly lustrous [sic] [cubes and] octahedrons [in combination]. The spar cooled last, surrounded the now-formed uraninite, and acted as a protective coating. And this raises the question of alteration. There seems to be little, if any, halo, or radioactive 'sunburst' in the feldspar in contact with the pitchblende." The Swamp #1 quarry uraninites are among the least oxidized of uraninites in the world (Carl Francis, personal communication, 1989). Additional associated species include magnetite octahedra (to 1 cm), monazite-(Ce) (to 1+ cm), rare samarskite-(Y) crystals (to 5 mm), and brown zircon bipyramids (to 3 mm). The Swamp #1 quarry uraninites are elusive as they are frozen in rock near the margins of biotite and almandine. Fewer uraninites are present near muscovite and almandine associations. Excellent Topsham uraninite crystals were figured by Francis (1987). Many Swamp #1 quarry specimens are incorrectly labeled Consolidated quarry. The entire dump is very radioactive.

It had been rumored that the westernmost of the Russell Brothers quarries was the source of the fine Topsham uraninites [Roger Clapp, personal communication, 1969], but this is certainly not the location. The prospect was supposedly dewatered and uraninites were supposedly found with the aid of a Geiger counter. However, the westernmost of the Russell Brothers quarries has produced sooty pitchblende/uraninite crystals in large size (1.5 cm; HU collection)(King, 1981a).

An unnamed locality, easterly across the swamp from the Swamp #1 quarry and about 1.5 km from the Consolidated #1 quarry by land, which has been informally called the "Biotite Crystal prospect," Topsham has yielded broken cubes of

uraninite (to 8 mm) which are surrounded by fine-grained waxy uranophane and scaly autunite. Rounded black uraninite grains (to 4 mm) with an orange-brown halo in the cleavelandite matrix are found at the Fisher quarry, Topsham.

uranite = autunite?

Auburn - Maine Feldspar Q; Paris

Alger (1844) reported uranite from **Paris**. The name at the time apparently signified autunite. Fisher and Bernard (1934) noted uranite, apparently from the Maine Feldspar quarry, **Auburn**, but it is uncertain what mineral was intended.

URANOPHANE

Ca(UO₂)₂Si₂O₇·6H₂O

Albany - Wardwell Q; **Auburn** - Keith (= Towne) Q, Maine Feldspar Q; **Gray** - Hinkley P; **Greenwood** - Emmons Q, Tamminen Q; **Lovell** - McAllister P; **Newry** - Dunton Q; **Norway** - BB #7 Q; **Paris** - Mount Mica Q; **Phippsburg** - Thomas Q; **Poland** - Berry-Havey Q; **Rumford** - Black Mountain Q; **Stoneham** - Aldrich Q, Lord Hill Q; **Topsham** - Biotite Crystal P, Fisher Q

A yellow waxy gummite (to 1 cm) alteration containing mostly uranophane is found in lightly to extensively brick-red discolored microcline with smoky quartz and biotite. Indistinguishable specimens of this type have been found at the Hinkley prospect, **Gray**, Berry-Havey quarry, **Poland**, and the Biotite Crystal prospect, **Topsham**. Relict black cores of pitchblende can be present.

Starburst, yellow uranophane crystals (to 2 mm) are found interleaved with muscovite crystals (to 5 mm) at the Wardwell quarry, **Albany**. Free-standing uranophane sprays to 3 mm with short (1 mm and less) uranophane crystals are found in interstitial openings between muscovite and quartz grains. Some of the uranophane is powdery yellow with some fibrousness on graphic granite fractures, smoky quartz, and blocky albite. Beta-uranophane is not usually associated with uranophane, but these species have been found together at the Wardwell quarry.

Uranophane from an unspecified location on Mount Apatite, **Auburn** is powdery yellow with some fibrousness on fracture surfaces on graphic granite or smoky quartz and blocky albite. Welch (1952) noted uranophane at the Maine Feldspar quarry, Auburn. Fisher and Bernard (1934) wrote of the Keith (Towne) quarry, Auburn: "Uranophane occurs as a yellow coating on the feldspars."

Seaman (1975d) listed uranophane from the Tamminen quarry, **Greenwood** and Mount Mica quarry, **Paris**: "... as a yellowish stain as an alteration product of uraninite..."

McAllister (1955) said of his prospect on Oak Hill, **Lovell**: "Uraconite and Uranophane form coatings on large masses of

rock from this cut. There is good possibility of other uranium minerals that have not been identified as yet."

Uranophane was recognized at the Dunton quarry, **Newry** by Holman (1935) and Verrow (1941). Uranophane has been found on fracture surfaces in indicolite as pale yellow to white radiating sprays of needles (less than 1 mm) tightly clustered with other groups. Pale yellow fibrous mats of uranophane are found on cleavelandite near altered uraninite crystals (to 2 mm) associated with brown zircon crystals (to 2 mm), as well as being intergrown with fine-grained autunite with microcline and man-ganocolumbite.

Abundant bright yellow fibrous uranophane has been found on microcline, smoky quartz, etc. at the Thomas quarry, **Phippsburg**.

Verrow (1941) reported uranophane from the Black Mountain quarry, **Rumford**. The only observed uranophane specimen (untested) consists of a powdery yellow mineral with brownish black zircon crystals (to 3 mm) in rusty fine-grained cleavelandite.

Pale yellow to almost white uranophane crystals (to 1 mm), thickly grouped and flat-lying on smoky quartz, have been found at the Fisher quarry, **Topsham**. The flat-lying sprays of uranophane can be crenelate and can superficially resemble snow-flakes.

uranophilite? = uranophyllite? = misprints for uranopilite? or uranophane?

Newry? - Dunton Q; **Rumford?** - Black Mountain Q

Specimens of supposed "uranophyllite" in cleavelandite from the Dunton quarry, **Newry** and identified as such by Edmund Bailey (Noyes collection) are vanmeersscheite/metavan-meersscheite (this study).

Bailey (1930) listed "uranophilite" from Black Mountain quarry, **Rumford**. Herbert Haven noted in his diary (September 6, 1938) of the Black Mountain quarry (Morrill, 1966): "We found hyalite coating indicolite and Uranophyllite." No specimens known. This material may have been phosphuranylite.

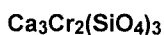
USHKOVITE (Paravauxite Group)



Newry - Dunton Q

Ushkovite is a member of the laueite group. Several specimens so far analyzed (this study) from the Dunton quarry, **Newry** show a variety of habits. The Dunton quarry ushkovite can be a somewhat milky amber or butterscotch-yellow mineral forming densely foliated masses (to 4 mm) showing some internal structure apparent only on close inspection. Several ushkovite crystals (to 1 mm) show the simple oblique morphology typical of the group along with internal pearly luster. The mineral is found in blue elbaite eyes associated with earthy to waxy olive-green mitridatite stained in patches by red-brown dull to resinous diadochite. Both ushkovite and laueite exist at the Dunton quarry.

UVAROVITE (Garnet Group)



Union - Harriman P

"Garnet was not recognized by earlier investigators, but uvarovite has tentatively been identified with the aid of G. Van der Kaaden of Heidelberg University" (Rainville and Park, 1976). No data given.

uvite? (Tourmaline Group)

Oxford County?

A single specimen labeled from an unspecified **Oxford County** location is identified as uvite (USNM B014693). Physical examination of the specimen shows it to be a dark amber-brown, translucent to gemmy, stubby doubly-terminated crystal fragment (to 3 cm) without matrix. The specimen in no way resembles any tourmaline currently known from Maine. Although the crystal does not specifically resemble any other American uvite/dravite, it does show a similar habit to tourmalines from marbles of northern New Jersey.

V

VAESITE (Pyrite Group)



Union - *Harriman P; Warren* - *Warren Nickel P*

Vaesite is a member of the pyrite group. The original material was named bravoite, but that material was only a variety of nickeloan pyrite. Bravoite was re-established for nickel-dominant material by Kalb and Meyer (1926). Bravoite was inappropriately discarded by Kerr (1945) when nearly end-member material was found, but bravoite had clear priority usage (King, 1985). Recently, the International Commission on New Minerals and New Mineral Names voted to reinstate vaesite in view of bravoite's earlier imprecise history (Michael Fleischer, personal communication, 1990).

Rainville and Park (1976) described bravoite from the Harriman prospect, **Union** and the Warren Nickel prospect, **Warren**:

"Bravoite occurs only as an alteration product of pentlandite. Bravoite formation generally starts along fractures in pentlandite and proceeds in some instances to a stage of nearly complete alteration of pentlandite ... The initial stages of bravoite development commonly appear as thin blotches in pentlandite. When no granular or flame pentlandites have been bravoitized, bravoite formation is restricted to pentlandite grains enclosed in chalcopyrite. This pentlandite-chalcopyrite association is common and may reflect a slightly different genesis for these pentlandites, probably of double exsolution of pentlandite and chalcopyrite out of monosulfide solid solution.

Bravoite in the Warren ore body disappears below a depth of about 50 m, which indicates that it is a product of supergene alteration. Enough samples from the Harriman body were not available to establish the same relation for this ore body. A low temperature of formation is compatible with the experimental results of Clark and Kullerud (1963), who showed that bravoite is stable only below 137° C."

valencianite (Feldspar Group) - albite (q.v.) with a blocky rhombic habit (cf. zygadite)

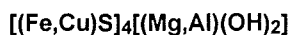
VALENTINITE



Linneus - *Drew Hill sulfide veins*

Valentinite occurs as small clear to milky gray to creamy pale yellow, striated patches of needle crystals and films (to 2 mm) on tannish yellow, earthy to waxy stibiconite admixed with kaolinite, on fracture surfaces in fine-grained stibnite in the sulfide veins on Drew Hill, **Linneus** (George Robinson, personal communication, 1991). Associated species include schafarzikite, metastibnite, and sulfur.

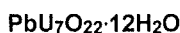
VALLERIITE



Brooksville - *Callahan M*

Park and Bastille (1973) reported valleriite without description as a "subordinate" portion of the ore at the Callahan mine, Harborside, **Brooksville**. The list of minerals investigated by them included: pyrite, chalcopyrite, sphalerite, galena, cubanite, pyrrhotite, mackinawite, chalcocite, marcasite, arsenopyrite, bismuth, and safflorite. Rainville and Park (1976) issued the caution: "As there has been much confusion in the literature regarding the identification of mackinawite, we employed the electron microprobe to determine chemical composition, because the optical properties of mackinawite merge imperceptibly with those of valleriite with the substitution of trace elements."

VANDENDRIESSCHEITE



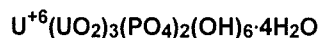
Greenwood - *Tamminen Q; Newry* - *Dunton Q; Phippsburg?* - *Thomas Q*

Bright orange vandendriesscheite has been shown to be a major component of orange variegated gummite from the Dunton quarry, **Newry**. Additional major components of Dunton quarry gummite include fourmarierite and wölsendorfite, but no specimens have been preserved from Frondel's studies (1956, 1958c).

Frondel showed that vandendriesscheite was found in New England orange-gummite localities. By analogy, orange gummite (HU collection) has been found with cinnamon-brown lithiophilite in cleavelandite from the Tamminen quarry, **Greenwood**, and this material might be vandendriesscheite.

"Vandendriesscheite" has been given as an identification of a specimen (Bjareby #2375) labeled Thomas quarry, **Phippsburg** occurring as a thin pale yellow film on muscovite and microcline. While the mineral on that specimen appears to be misidentified, and probably is uranophane, the specimen also appears to be the matching half of another vandendriesscheite specimen labeled Chandler's Mills, New Hampshire (Bjareby #2484) and therefore both specimens must be considered misidentified as well.

VANMEERSSCHEITE / METAVANMEERSSCHEITE



Newry - Dunton Q; **Rumford?** - Black Mountain Q

Vanmeersscheite (chemical analysis and X-ray diffraction, this study) occurs as earthy bright yellow globules (to 1 mm) and coatings (composed of minute scales) with uraninite in cleavelandite, quartz, pale lilac medium-grained (1-4 mm) lepidolite and massive montebrasite from the Dunton quarry, **Newry**. The vanmeersscheite is only faintly fluorescent in long and short-wave ultraviolet light. Specimens labeled "uranopilite" from Edmund Bailey in the H. Wallace Noyes collection (see King, 1977a) have proven to be vanmeersscheite, in addition to numerous recently collected samples.

Bailey (1930) listed "uranophilite" from **Rumford**, presumably Black Mountain quarry, but no specimens are known. Waxy yellow coatings from the Black Mountain quarry (this study) are phosphuranylite (q.v.) and, therefore, this Rumford use of "uranophilite" was not the same as the usage at Newry.

vayrynenite?

Rumford - Black Mountain Q

Pinkish brown striated "crystal" masses (to 2 cm) in golden brown granular siderite from the Black Mountain quarry, **Rumford** were determined by optical examination to be related to vayrynenite, the manganese analog of hydroxyl-herderite (King, 1987a). Chemical analysis and X-ray diffraction examination (this study) has shown the material to be eosphorite.

verd antique - white-veined serpentine

Deer Isle

verdelite (Tourmaline Group) = varietal name of green tourmaline

vermiculite (Mica Group) - a particular variety of biotite

Maine soils and glacially deposited sediments

Vermiculite is a group name for much weathered mica, usually having biotite as the starting material. In vermiculite, potassium ions, originally between the structural layers, have been replaced by magnesium, water molecules, etc. The water and interlayer cations can be varied by hydration/dehydration, and/or cation exchange. Many names have been proposed for vermiculite minerals, but most of the names refer to essentially the same material. While some vermiculite is chemically distinct from other micas and has unique properties, modern mineralogists have been reluctant to accept it as a *bona fide* mineral. "Rourke and Beck (1968) found similar minerals in soils developed from the glaciomarine sediment, as well as some vermiculite not identified from the glaciomarine parent material" (Kelley, 1989).

VESUVIANITE

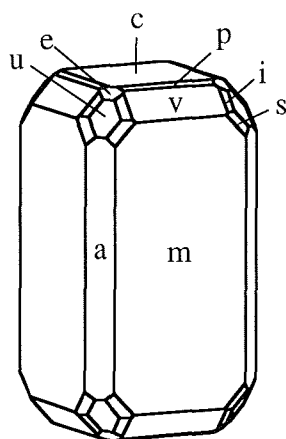


Alfred - ridge west of Shaker Pond; **Auburn**; **Bath**; **Belgrade** - near golf course; **Bethel**; **Blue Hill** - Black Hawk M; **Boothbay** - Linekin Neck Beach A; **Buxton** - Bar Mills road cut; **Casco** - Chute P; **Cornish** - Berry Ledge L, Day Hill L; **Farmington** - U. S. Route #2 road cut in Farmington Falls; **Greenwood** - Harvard Q, Tamminen Q; **Hebron** - Mount Rubellite Q; **Lewiston** - Robinson Mountain L; **Limerick**; **Litchfield?**; **Livermore Falls**; **Minot** - LaFlamme Q, Pitts-Tenney Q; **Newfield**; **Newry** - Plumbago Mountain A; **Paris** - near Whispering Pines quarry; **Parsonsfield** - Swett House locality; **Peru**; **Phillips** - Route #142 road cut; **Phippsburg** - The Basin L (not the Basin quarry); **Poland** - Berry-Havey Q; **Raymond** - Camp Hinds L, "north of Panther Pond"; **Roxbury** - drift boulders; **Rumford**; **Sanford** - Beaver Hill A, Webster P (Goodall Farm L), 200 meter L, 600 meter L; **Shapleigh**; **Woodstock** - Bryant Pond village A

During the early nineteenth century, Maine produced some of the better vesuvianite crystals known in the world. Succeeding time has diminished the significance of the crystals, but they are still very good examples of the species. While a number of localities are known, a few localities are especially important. Jackson (1838a) reported egeran, an early synonym of vesuvianite, from **Parsonsfield** and **Phippsburg**. Idocrase was also used as a common synonym for vesuvianite.

A smooth-faced lustrous brown vesuvianite crystal (3.4 x 2 cm) with simple prism, bipyramid, and "c" pinacoid was found in a contact zone with an unspecified pegmatite, Mount Apatite, **Auburn**.

Vesuvianite from the Chute prospect, **Casco** is generally brown. The crystals are dominated by first- and second-order



Vesuvianite, Chute P, Casco

bipyramids and prisms along with the "c" pinacoid and occasional rare faces. The vesuvianite occurs in typical association with grossular crystals (to 5 cm) and gemmy diopside crystals (to 1 cm), but the locality is not particularly known for vesuvianite. Grossular crystals (to 3 cm) and gemmy green diopside crystals (to 6 mm) are better known there. (Very large imperfectly exposed vesuvianite crystals to 5 x 7 cm have also been found.) When the locality was new, Dillingham (1955b) wrote: "In Casco, Maine, between routes 302 and the so-called Quaker Ridge Road, a metamorphic limestone outcrop contacts the country rock. Little work has been done at the prospect but the minerals that have been found show promise of better things to come. To date a few well terminated vesuvianite crystals have been recovered, with the mineral showing in other places in erratics and in place."

The Day Hill locality, **Cornish** has produced red-brown to greenish brown vesuvianite crystals (to 2 cm) with grossular crystals (to 3 cm) and gemmy green diopside crystals (to 4 mm). The crystals show large first-order prism, small second-order prism, "c" pinacoid, and very small pyramidal faces occasionally present.

Large gray-brown stellate sprays (to 20 cm) of unterminated vesuvianite crystals are found in a contact zone near a basalt dike at an inconspicuous road cut along U. S. Route #2, Farmington Falls, **Farmington**. A few slightly rounded, terminated, gemmy brown crystals (to 6 mm) were found.

Contact metamorphism caused by the intrusion of the Harvard quarry and Tamminen quarry pegmatites (Tamminen, 1952) into the Patch Mountain Member of the Sangerville Formation, **Greenwood** yielded brownish gray radial "starbursts" (to 8 cm) of fibrous vesuvianite layers near the pegmatite contact, along with rare scheelite.

Fisher (1948) reviewed the occurrence of vesuvianite in the United States and wrote of his discovery of vesuvianite on the "400-foot contour of the hill on the northwest facing slope" of Robinson Mountain, **Lewiston**: "Three distinct habits have

been found... Radially divergent prisms of very narrow width... The longest individual prisms are 7.2 cm. in length. ... In most of these 'fan-shaped' aggregates the VESUVIANITE is a light yellowish brown color. ... One generation is made up of closely packed parallel prisms - nondivergent - of clove brown color, each prism being about 1 cm. in width. ... A third type of occurrence is in areas of vugs or cavities in the marble. This is the only type of occurrence at Robinson Mountain in which separate and fairly good sized crystals of Vesuvianite are found. ... The largest single crystal found is 1 cm. in width and 5 cm. in length. On this particular crystal the free end shows a perfectly developed flat, basal face, and eight prismatic faces - faces of the first and second order prisms - each face being about equally developed." Fisher (1948) noted as associated minerals: actinolite, calcite in 7.5 cm "rhombs" (= cleavages?), "brilliant green diopside, in short stubby crystals," meionite, and purple fluorite patches. Titanite has also been observed.

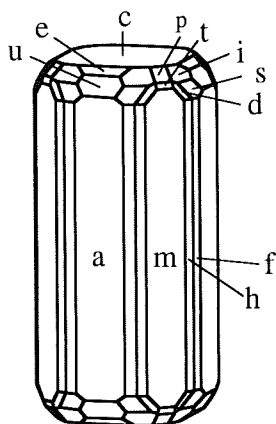
Excellent lustrous greenish brown prismatic vesuvianite crystals (to 5 x 2 cm) with first-order prism and bipyramid with a large "c" pinacoid were found at the LaFlamme quarry, **Minot**. Presumed blocks of the calc-silicate units of the Sangerville Formation are exposed in "low water seasons" in the LaFlamme quarry (Ray Woodman, personal communication, 1992). Massive grossular can be associated. True (1869) indicated of an unspecified locality: "Fine crystals have been obtained in Minot." Vesuvianite is only a curiosity at the Pitts-Tenney quarry, Minot.

Davis and Davis (1955) list of **Newry**: "Radial vesuvianite on granite, Plumbago Mt., Newry, Maine." No specimens known.

Large (to 5 cm) lustrous, but very slightly fragmented, dark greenish brown vesuvianite crystals were found in the contact zone with the Berry-Havey pegmatite, **Poland**.

Melville (1893) noted vesuvianite from **Raymond**.

The history of the Webster prospect, **Sanford** has been alluded to in King (in press). The prospect is still very small despite the 150 years that have elapsed since its discovery. Leavitt and Leavitt (1993) indicated that the prospect has been backfilled. The vesuvianite ledge is a compact aggregate of coarsely crystalline vesuvianite which sporadically contains cavities lined with vesuvianite crystals and calcite. The cavities also contain excellent diopside crystals (to 5 mm), molybdenite crystals (to 1 cm), grossular (to 1+ cm), and minor titanite, andesine, scheelite, and powellite. The vesuvianite crystals are up to 10 x 3+ x 3+ cm, but crystals over 7 x 2 x 2 cm are rare. Two satellite prospects in a nearly straight line northeast of the Webster prospect, at 200 meters and 600 meters distance, produced some excellent vesuvianite crystals as well. The crystallography of the Sanford vesuvianite has been illustrated by Dana (1854b). The crystals generally consist of a first-order prism and very small first-order bipyramid along with a dominant "c" pinacoid and a small second-order prism. Additional faces are not rare. The crystals are vertically deeply striated. A bronzy luster is seen on the "c" pinacoids of altered crystals, and basal



Vesuvianite, Webster P, Sanford (redrawn from Dana, 1854b)

parting can be developed in the bronzy lustered portion of the termination. The depth of bronzy vesuvianite is generally only measurable in millimeters. The general color is dark greenish brown. (Some crystals of high luster are found encased in quartz at this locality, unlike the other calc-silicate localities.)

Webster (1848) wrote of his discovery in Sanford:

"The idocrase composes a bed, (or vein?) extending upwards of two hundred feet in a direction north and south, projecting in several places a few feet above the soil. At one extremity it is bounded by granite, and at the other by trap. The thickness of this bed, or vein, could not be determined. The entire mass is idocrase in more or less perfect crystals, crossing one another and interlacing, or projecting into cavities. These cavities are here and there partially filled with white carbonate of lime and a few crystals of what will probably prove to be anorthite, with albite.

Since this discovery, further exploration has brought to light more perfect and brilliant crystals in white quartz, in the same field, at a distance of a few rods.

By action of an acid, the carbonate of lime has been removed from several masses, and the crystals of idocrase recovered present brilliant planes, and stand out in bold relief. The crystals are often finely terminated, and present the usual modifications of form; they vary in size from a tenth of an inch in diameter, to an inch and a half; part of one crystal that was unfortunately broken, is now two and a half inches in diameter, and four and a half in length.

Here and there I found molybdenum [molybdenite] and epidote in the masses."

Dana (1854b) added to the description and crystallographic knowledge of Sanford vesuvianite:

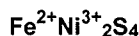
"The idocrase occurs massive or sub-columnar at that place, and there are often cavities of fine crystals. The crystals are sometimes thinly sprinkled over with dark green crystals of pyroxene, hardly a line long, which are loosely attached to the idocrase and are evidently of sub-

sequent origin, apparently a result of its alteration. The crystals of idocrase undergo ready alteration, and often the surface peels off in layers, over the whole summit; and the alteration has proceeded inward with such exactness that the removed layer leaves behind the same number of small secondary planes as in the complete crystal, and all equally brilliant in polish. This is the more wonderful since there are no cleavages parallel to all or any of these small secondary planes. The color of the idocrase is brown and greenish-brown. In one specimen having a columnar structure, the columns along a straight line two inches in length met at an angle of 56° to 60°, indicating composition parallel probably to the plane 4*i*."

(Note: The removal of calcite, by etching, frequently reveals a brecciation of the vesuvianite crystals where a particular crystal in a group will be broken in several points along its length, but not be loose from the matrix. The rest of the crystals of a group might show no sign of fragmentation.)

Kunz (1892a) waxed enthusiastic: "About a mile and a half from Sanford, Me., idocrase occurs in unlimited quantities, one ledge, fully 30 feet wide, being made up entirely of massive idocrase, associated with quartz and occasionally with calcite, which fills the cavities containing the crystals. Some of the crystals are 7 inches long, and occasionally the smaller ones would afford fair gems." Haven (1934) wrote of the history of the Webster prospect. Vogel (1890) presented a chemical analysis of Sanford vesuvianite and Hlawatsch (1905) provided optical data. Doelter (1881) reported on the crystallography of a Maine vesuvianite, presumably from Sanford. Wherry and Chapin (1908) found small to trace quantities of boric acid in vesuvianite from **Woodstock and Litchfield** [sic]. No Litchfield vesuvianite is known.

VIOLARITE



East Moxie - Black Narrows A; The Forks - Black Narrows A; Katahdin Iron works - Katahdin Iron Works M; Union? - Harri-man P

Violarite is related to linnaeite (q.v.) and difficult to tell from the various members of this group of minerals. Violarite is obviously a microscopic intergrowth in Maine deposits, but if it were visibly present, would occur as light brassy metallic massive patches or streaks in matrix.

Houston (1954,1956) said of violarite: "This mineral occurs exclusively as a replacement of pentlandite. It is found to a minor extent in all of the nickel ores but is particularly common at St. Stephen [New Brunswick, Canada]. It replaces pentlandite by starting from the borders of the crystals and working inward. Some pentlandite crystals at the Rodgers Mine [New Brunswick, Canada] are almost entirely replaced. Small jagged remnants of pentlandite remain in the highly altered grains. The violarite may

also cut across the pentlandite in irregular veinlets which have numerous minute fingerlets extending into the pentlandite perpendicular to the trend of the veins (Plate 4, C)." This description covered the occurrences at Black Narrows, **East Moxie** and **The Forks**, Katahdin Iron Works mine, in the town of the same name, and at **Union?**, as well as from the Rodgers mine, Saint Stephen, New Brunswick, Canada.

The identification of the violarite from the Harriman prospect, **Union** by Houston (1956) was apparently in error. Mackinawite (q.v.), a closely related mineral, was reported by Rainville and Park (1976). These authors did not address the violarite problem directly, though they cited Houston's (1956) study on other topics.

virginite - rock name

Jim Pond

Virginite is a local rock name used in Newfoundland, Canada to signify a fuchsite-bearing carbonate rock. In Maine, this material was called arnoldite (Boudette, 1982) and later called virginite (Boudette, 1991). Mariposite and many other names are more or less similar in significance.

VIVIANITE



Auburn - Maine Feldspar Q; **Bath** - City Q; **Cushing** - Peg Claims Dike 1; **Georgetown** - Consolidated Q; **Greenwood** - Emmons Q, Harvard Q, Waisanen Q; **Madawaska?**; **Newfield?**; **Newry** - Bell Pit, Dunton Q, Nevel Q; **Norway** - B.B. #7 Q; **Paris** - Mount Mica Q; **Peru** - Lobikis Q; **Richmond** - marine clay; **Rumford** - Black Mountain Q, Goddards Ledge Q, Red Hill Q; **Standish** - Oak Hill road cut; **Stoneham** - Cole Q, Lord Hill Q; **West Paris** - Perham Q; **York?**

Many minerals have mistakenly been called vivianite. Vivianite has a blue color similar to blue tourmaline eyes (q.v.) found at several localities and which can also superficially resemble triphylite. Some triphylite has incipient thin films of vivianite alteration, which adds to the confusion of specimen identification. The prominent distinguishing feature of vivianite is its perfect micaceous cleavage, its softness, and its bright powder-blue streak.

Blue vivianite films (to several mm) have been found on white beryl from the Maine Feldspar quarry, **Auburn**.

Dark navy-blue clusters (3 x 3 mm and larger) of vivianite crystals (much smaller than 1 mm) were found at the City quarry in **Bath**. It has been presumed that the vivianite formed on a fracture surface on the granite. Herbert Haven noted in his diary (October 20, 1940) (Morrill, 1966): "... we went to the Bath City

Quarry where we collected corundum, hornblend [sic], vivianite, and pyrrhotite alterations. By that time it was dark but by the aid of a flashlight, we were able to get some quartz crystals."

Sundelius (1963) wrote of the Peg Claims (State Prison Farm prospect), **Cushing**: "... Mn-staining is common on the feldspars and spodumene. Vivianite was found in tiny fractures and along grain boundaries."

The Harvard quarry, **Greenwood** has produced the best vivianite crystals in Maine, but the mineral is so scarce that it has seldom been observed here. A doubly-terminated deep blue crystal, 8± mm, in a vug of albite crystals has been found.

Vivianite crystals (1-2 mm) are well-known with the fairfieldite from the Nevel quarry, **Newry**. The crystals are navy-blue and can be bladed to blocky. The vivianite is generally later than the fairfieldite, and it rests on the fairfieldite along with tiny siderite crystals (much less than 1 mm) and pyrite crystals (less than 1 mm), or can fill interstitial spaces in cleavelandite or even be found interleaved in muscovite. Unterminated cleavages to 1 cm have been seen in cleavelandite. Some vivianite crystals (to 3 mm) have been found on fracture surfaces of albite-muscovite pegmatite. A few samples of crystals and masses of vivianite (to 4 mm) are found in contact with unaltered gray triphylite.

Bell Pit, Newry midnight-blue transparent vivianite crystals (to 1 mm) developed at the contacts of siderite and massive white montebrasite with gray triphylite. Vivianite cleavages (to 2 mm) are found in cleavelandite along with gray triphylite.

Dark blue vivianite cleavages (to 3 mm) have been found with manganoan siderite and crandallite in blue tourmaline eyes at the Dunton quarry, Newry. Much confusion has resulted as some people have thought that all of the blue eye material was vivianite. Vivianite is a soft mineral with a perfect cleavage, in addition to being blue, while the eye material has no cleavage and is as hard as normal tourmaline.

Cleavages of blue vivianite (to 3x0.5 cm) have been found with siderite at the Mount Mica quarry, **Paris**.

Blue powdery vivianite has been found in "marine clay [glaciomarine clay of the Presumpscot Formation]," **Richmond** (Ray Woodman, Arthur Hussey, personal communication, 1992).

Verrow (1941) described a poor occurrence of vivianite from the Black Mountain quarry, **Rumford**: "*Vivianite* - Is one of the most common alteration products derived from triphylite, and occurs as thin films along the cleavage planes of the triphylite."

Large dark blue vivianite cleavages (to 7x3x1 cm) have been found as an alteration of triphylite associated with siderite from Red Hill quarry, Rumford (Jorgensen Collection, Maine State Museum).

Dolloff (1936) noted that vivianite occurred as thin films along cleavage traces of triphylite from the Oak Hill road cut, **Standish**.

Vivianite from the Perham quarry, **West Paris** is found as individual dark blue-gray crystals (to 2 mm) with siderite in pyrite and pyrrhotite nodules in "olive-drab" microcline (Neil Wintringham, personal communication, 1991).

Burr (1930) listed vivianite in **Newfield(?)**, while Smith (1882) noted it from **Madawaska** and **York**.

vorobeyevite = cesian beryl

Fairbanks (1928) noted: "... Caesium beryl or vorobyevite [sic], containing about 3% of caesium; it is a rare mineral found in the Urals, Madagascar, and in the Maine pegmatites." The pink beryl and morganite from the Emmons quarry, **Greenwood** has been called vorobeyevite by Maine collectors.

W

wad

**Blue Hill, Dover; Hodgdon; Oxford; Sumner; Thomaston -
Dodges Mount; York - Mount Agamenticus A**

Wad is a generic name for unidentified black sooty minerals presumed to contain manganese. A number of localities were indicated by Schrader et al. (1917).

WAGNERITE

(Mg,Fe²⁺)₂(PO₄)F

Blue Hill - Black Hawk M

Wagnerite has been found as tan grains (less than 1 mm) in cordierite- and gahnite-bearing quartzite in the Black Hawk mine, **Blue Hill** (Martin Yates, personal communication, 1991).

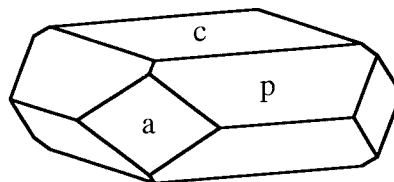
WARDITE

NaAl₃(PO₄)₂(OH)₄·2H₂O

Newry - Bell Pit, Dunton Q, Nevel Q; Poland - Berry-Havey Q

Wardite is an inconspicuous, usually colorless phosphate. The first known locality in Maine for the species was at the Dunton quarry, **Newry**. It was found as tetragonal, nearly equant bipyramids (2-6 mm) with horizontal striations, in cleavelandite vugs. The bipyramids are often irregularly complete. Indentations and clefts in the crystals give the suggestion that the wardite grew next to mineral grains which are now dissolved away. Associated minerals include quartz, cleavelandite, crandallite, perhamite, and botryoidal hydroxyl-herderite.

The Bell pit, Newry wardite has a very complex habit. The colorless, transparent crystals (to 2 mm) show a horizontally striated first-order bipyramid and small second-order prism and "c" pinacoid. The mineral is frequently clustered tightly together into a mounded to spherical cluster (to 5 mm) with others of its kind. The almost absolute transparency of the wardite here makes the species hard to view and identify. The matrix is composed of siderite, and associated species include clear to pale purple fluorapatite, eosphorite, fairfieldite, montebrasite, and rarely whitmoreite, perhamite, and other species of the siderite assemblage.



Wardite, Bell Pit, Newry

Wardite crystals (to 4 mm) from the Nevel quarry, Newry are white, simple bipyramidal with horizontal striations. The wardite was found on dark brown siderite crystal (low rhombohedra to 2 mm) clusters (to 2 cm) in vugs in massive quartz.

Wardite of extraordinary appearance occurs at the Berry-Havey quarry, **Poland** (chemical analysis and XRD, this study). A single mass of white wardite with the faintest hint of pink (about 3 x 5 cm) was found in quartz in association with white massive montebrasite (to 1 cm) and minor muscovite. The wardite has a poor cleavage and superficially resembles a cloudy pinkish white beryl mass. Some bipyramidal colorless translucent wardite crystals (to 2 mm) are embedded in the massive wardite along with a few quartz grains (to several mm).

watermelon tourmaline - see description under elbaite

wavellite? - misidentified radiating eosphorite?, hydroxyl-herderite?, or roscherite?

Newry - Dunton Q

Wavellite has yet to be found in Maine. It was reported by Morrill et al. (1958), but the name was an over-enthusiastic misidentification. Specimens observed have been misidentified "roscherite" (Bjareby #2700 and Roger Clapp collection) and eosphorite (Bjareby #4042).

wellsite? (Zeolite Group) = barian phillipsite (q.v.)

wernerite (Scapolite Group) = meionite in most cases

white garnet?

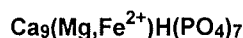
Rumford - Black Mountain Q

Bailey (1893) noted "white garnet" from Black Mountain quarry, **Rumford**. No specimens known.

white mica

Paragonite is an uncommon mica species. Dale (1907) and Smith (1923) suggested without substantiation that "white mica" equaled paragonite and was common in Maine granites. No paragonite identifications have been substantiated in Maine (Guidotti, 1968a; Thomson and Guidotti, 1989).

WHITLOCKITE

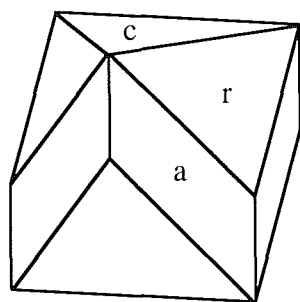


Newry - Bell Pit, Dunton Q, Nevel Q; **Poland?** - Berry-Havey Q; **Rumford?** - Black Mountain Q

The Dunton quarry, **Newry** whitlockite crystals are milky white steep rhombohedra thickly lining vugs in albite, occasionally with 1-2 mm white stubby hexagonal fluorapatite crystals and, rarely, with xanthoxenite and perhamite. The whitlockite crystals are generally 2-3 mm, but a few crystals over 1 cm were found. Gregory (1968b) noted Dunton quarry whitlockite. Some Dunton quarry whitlockite has a relatively high iron content (EDAX, this study).

Bell Pit, Newry transparent and colorless whitlockite crystals show the combination of the pseudocubic rhombohedron in combination with the "c" pinacoid and, in about half of the specimens, with the hexagonal prism. It is 2-3 mm and is found in the siderite assemblage (chemical analysis verification, this study). Some pseudo-rhombohedral cloudy quartz quartzoids (1-3 mm) can resemble whitlockite (this study). Bell Pit whitlockite can be very etched.

The whitlockite from the Nevel quarry, Newry has been found in cloudy white crystals (to 2 mm) on black-stained granular siderite with golden brown eosphorite crystals (to 3 mm) all in quartz and sparse muscovite matrix. Orange-stained carbonatian hydroxylapatite is sometimes found in small (less than 1 mm), individually placed botryoids. The etched whit-



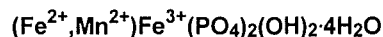
Whitlockite, Bell Pit, Newry

lockite crystals show the combination of the rhombohedron, prism, and "c" pinacoid.

Transparent colorless montebrasite crystals (to 2 mm) which superficially resemble whitlockite with a thin platy habit have been found in the siderite assemblage at the Berry-Havey quarry, **Poland**.

Some specimens which were formerly thought to represent whitlockite from the Black Mountain quarry, **Rumford** (King, 1987a) have proved to be a new mineral species, kosnarite (q.v.). Francis et al. (1993) reiterated the previous listing from Thompson et al. (1991). One remaining Black Mountain quarry specimen (untested) closely resembles whitlockite from the Bell Pit, Newry (pseudocubic rhombohedral (1 mm) with small hexagonal prism), but due to its faint smoky greenish amber tint, has been assumed to be kosnarite. Some kosnarite is morphologically indistinguishable from whitlockite and the shape could account for the late discovery of this species.

WHITMOREITE (Whitmoreite Group)



Newry - Bell Pit

The siderite assemblage at the Bell pit, **Newry** has produced a large number of secondary phosphates. Among the more unusual looking that may be mentioned include whitmoreite. This mineral occurs in various shades of red-brown to golden brown, as do many of the transition-metal phosphate species from the locality, but the habit of the material is distinctive. Whitmoreite frequently forms clusters of spike-like crystals projecting from a nucleus of compactly-grown whitmoreite. When the material had not yet been described, it was nicknamed *water-mines*, because of its resemblance to bombs with spikes protruding from them, that were formerly placed under water to destroy ships. The clusters are rarely larger than 1 mm. The clusters without projecting spikes have a particularly lustrous ribbed appearance, sometimes in a circular arrangement or sometimes in a short flat, fan-like spray. The mineral frequently rests on a thin avocado-green dusting of mitridatite on siderite crystals. Associated species can include fairfieldite, strunzite, stewarite, and quartzoid quartz.

williamsite (Serpentine Group) - a gem variety of antigorite

Alder Stream, Jim Pond

Lander (1955) reported that williamsite was found at **Alder Stream** and **Jim Pond**. Most of the samples seen are light to medium olive to yellow-green and translucent. Williamsite, which should be gemmy green to blue-green, is very scarce. Most of the samples which have been observed are retinalite (q.v.).

winchite? (Amphibole Group)

Sapling - Hurricane Mountain Formation mélange

Boone et al. (1989) indicated of the Hurricane Mountain Formation mélange, **Sapling**: "... but in one example, with a sodic-calcic amphibole close to winchite in composition... Hornblende compositions in M-17... are compositionally intermediate between aluminous actinolite ("common hornblende"), pargasite, and winchite." The analysis in question can be interpreted as a pargasite.

WODGINITE

MnSnTa₂O₈

Auburn; Buckfield - Bennett Q; **TD** - Bemis Stream Prospect; **Newry** - Dunton Q, Rose Quartz Crystal L; **Rumford?** - Black Mountain Q

Wodginite forms tiny patches (to several mm) as visually indistinguishable inclusions in manganotantalite at the Bennett quarry, **Buckfield** (Michael Wise, personal communication, 1990).

Wodginite forms bladed black prismatic crystals (to 6 mm) with large pyramidal forms embedded in cleavelandite and quartz, Bemis Stream prospect, **TD** (King, 1991b).

Red to red-brown, wedge-shaped wodginite crystals (to 5 mm) occur embedded in pollucite, lepidolite, and cleavelandite matrix at the Dunton quarry, **Newry**. The wodginite has nearly end-member composition (chemical analysis, this study). A single black crystal (about 6 x 10 mm) was found embedded in cleavelandite at the Rose Quartz Crystal locality, **Newry**. The wodginite has a submetallic luster and a modified rhombic cross-section with four symmetrically placed pyramidal faces. No striations were evident (King, 1991b).

So-called wodginite (King 1991b) from the Black Mountain quarry, **Rumford**, is manganian tantalum columbite, close to manganotantalite (this study).

wolframite = a group name but generally indicating ferberite (q.v.)

Blue Hill - Blue Hill Falls A, Candage Farm P, Trio M; **Bowdoinham?**; **Cornish?** - Berry Ledge; **Hollis** - Hollis Center road cut; **Topsham?**

WOLLASTONITE (Pyroxenoid Group)

Ca₂Si₂O₆

Cornish? - Berry Ledge L; **Cherryfield?** - Narraguagus M; **Digdeguash Formation** - **Big Lake quadrangle**; **Flagstaff** - Limestone Hill A; **Princeton** - Pocomoonshine Mountain A;

Rockland - outcrop; **Sangerville Formation** - **southern Guilford quadrangle**, **western Pittsfield quadrangle**, **central Skowhegan quadrangle**; **Upton** - unnamed hill; **Warren** - Lower Q, Upper Q

Wollastonite is a calcium-rich, pyroxene-related mineral where both metal sites are occupied by calcium. Some writers reduce the formula to CaSiO₃, but this reduced formula does not show the relationship of wollastonite to the pyroxenes. Common triclinic wollastonite is wollastonite-1T. (Wollastonite's structure is stacked differently, with tetrahedral units rotated slightly, with respect to the monoclinic structure of true pyroxenes.) Typically, wollastonite is nearly end-member in composition, except when in particularly manganese-rich associations, and can coexist with other pyroxenes (e.g. the diopside series).

A white splintery mineral (to several cm) from the Narraguagus mine, **Cherryfield** has been labeled wollastonite (BMS #X04.160). Specimen not tested.

Carpenter (1951a) listed wollastonite without comment from the Berry Ledge locality, **Cornish**. Trefethen et al. (1955) were accompanied by Carpenter, but they did not list wollastonite among the otherwise complete-appearing suite they published. No specimens known.

Ludman (1990a) noted wollastonite in the Digdeguash Formation, **Big Lake quadrangle**: "Well developed thermal aureoles surround the plutons of eastern Maine, particularly mafic bodies such as the Pocomoonshine gabbro-diorite. Contact effects range from a slight increase in grain size of muscovite and the appearance of biotite, to partial melting of the Digdeguash Formation at the contact with the gabbro. Intermediate conditions are indicated by the appearance of cordierite, andalusite, garnet, staurolite, and sillimanite in pelitic rocks; clinozoisite, actinolite, diopside, garnet, and wollastonite in calcareous rocks; and chlorite and actinolite in mafic metavolcanic rocks. The aureoles are mostly raised to conditions of the albite-epidote hornfels and hornblende hornfels facies, but the innermost zones of the mafic aureoles and xenoliths in the gabbros contain assemblages of the pyroxene hornfels facies."

Ludman (1986; and almost exactly in 1990a) wrote of **Princeton**: "Diopside appears near contacts with the Pocomoonshine pluton, and wollastonite has been identified in xenoliths of the Flume Ridge Formation near the base of Pocomoonshine Mountain."

Pankiwskyj (1970) reported wollastonite from Unit S₂ marble outcrops (# 1, 10, 11, 12, 21, 28, 50, and 76), Limestone Hill, **Flagstaff**. Outcrops on the southern limb of Limestone Hill, #50 and 76, had 30 % and 35 % by volume, respectively, of wollastonite. Pankiwskyj (1970) reported: "Polysynthetically twinned wollastonite is present in pure masses of fibrous crystals up to 0.3 mm long which are oriented parallel to the bedding in lenses up to 0.5 wide and 10 mm long. Wollastonite is also found as randomly oriented smaller grains associated with other minerals. A common association is as a jacket surrounding a fossil fragment. ... The above described calc-silicate granofels is associated

with bands, lenses, and beds of sugary marble. In this section this is seen to contain a few percent fossil fragments, but most of the calcite occurs as small untwinned grains ranging in size from 0.02 mm to 0.2 mm. Diopside, wollastonite, quartz, plagioclase, and traces of sphene and magnetite are found scattered between the calcite grains. Grossularite is also present as large poikilitic grains, up to 2 mm in diameter, enclosing grains of calcite, diopside, and wollastonite. Spongy idocrase forms grains up to 1 mm in diameter."

Ludman and Griffin (1974) listed wollastonite when they described the geology of the Sangerville Formation from the **Guilford, Kingsbury, and Skowhegan quadrangles**: "Ribbon limestone member (Ssl): Thinly interbedded silty micrite and non-calcareous siltstones, sandstones, and shales ('ribbon limestone') form several outcrop bands ... but also occur as isolated lenses at different levels within the Sangerville. In contact aureoles, this member is recrystallized to calc-silicate granulite containing, in increasing order of metamorphic grade, clinozoisite, actinolite, diopside, grossularite garnet and idocrase, and wollastonite." It was not stated how far from the contact of the plutons in the area that wollastonite was observed. It might be surmised that wollastonite was developed only on the northern and western borders of the Hartland pluton exposed in the Skowhegan quadrangle.

Bastin (1908b) reported extraordinary wollastonite from **Rockland**: "A rock outcropping between the Nellie Ulmer quarry and the 'hard rock' quarries next to the west and appearing less extensively at a few other points in the main Rockland belt is rendered valueless for lime-making purposes by the abundant development within it of silicate minerals. By the quarrymen it is called 'grasshopper rock,' from the fancied resemblance of some of the long prismatic or brushlike crystals to the legs of grasshoppers. The most abundant of these minerals is tremolite, occurring in brushlike aggregates of fibers averaging about one-half inch in length. Blue-gray diopside is present in square prisms one-half to three-fourths inch long and one-sixteenth to one-eighth inch in diameter. Wollastonite occurs locally in prisms some of which have a diameter of one-fourth to one-half inch. These prisms inclose much unreplaced calcite and are therefore softer than pure wollastonite and effervesce somewhat with acid."

Moench and Pankiwskyj (1988) noted of **Upton**: "Variegated white, pinkish, greenish, locally rusty-weathering calc-silicate rock and impure marble found by Milton (1968) and recently mapped by Moench below the Quimby Formation south of the Umbagog pluton. Thinly layered; primary features are largely masked by coarsely crystallized texture. Recognized minerals at different localities are quartz, calcite, calcic plagioclase, tremolite, diopside, grossular garnet, epidote, idocrase, and wollastonite; minor scheelite was found at one locality. This layer, no more than about 8 m thick, lies in sharp contact above metarhyolite, which is weakly to extremely hydrothermally altered and pyritized, and below unaltered metagraywacke, black schist, and local volcanic conglomerate of the Quimby Forma-

tion. The unit is tentatively interpreted to be a subaqueous, locally tungsten-bearing hydrothermal spring deposit on the flank of a dying volcano."

Bastin (1908b) discussed the occurrence of wollastonite at the so-called Lower and Upper quarries, western **Warren**: "The unusual coarseness of grain is plainly the result of contact metamorphism caused by the granite which intrudes the limestone and the surrounding gneisses as numerous dikes and irregular apophyses. The contact effect also manifests itself in the presence of wollastonite, talc, and small amounts of garnet, pyrite, bornite, sphalerite, and brown biotite in certain portions of the limestone. Wollastonite is the most abundant of these minerals and in places occurs in crystals $1\frac{1}{2}$ inches in length. The talc is abundant in small irregular veins." Rushton (1964) advertised: "Wollastonite - white massive with Diopside" from an unspecified Maine locality, but perhaps from the Upper and/or Lower quarries.

WÖLSENDORFITE



Greenwood - Tamminen Q; Newry - Dunton Q

The material called *gummite* is a mixture of various oxidation products of uraninite. In Frondel's (1956) study of this material from the Dunton quarry, **Newry** he found a component of this mixture which gave an unrecognized X-ray pattern, and he called the material *mineral C*. Subsequent study revealed the widespread nature of the mineral in orange-red gummite, and when wölsendorfite was described by Protas (1957), its identity with *mineral C* was recognized, with slight reservations, by Fleischer (1957). Wölsendorfite, when found at its type locations in Wölsendorf, Bavaria, Germany and Shinkolobwe, Shaba, Zaire is bright orange-red. Frondel (1956, 1958c) identified *mineral C* in orange gummite from the Dunton quarry, but no labeled sample remains to represent the original identification. One sample in the Harvard collection (HU unnumbered) with an external rind of orange-yellow gummite (to 10 x 1 mm) on a mass (3 x 3 cm) of uraninite is preserved from Newry, which could have participated in the identification. Gummite is very scarce at Newry.

An orange gummite nodule with a circular section (about 8 mm diameter), which is undoubtedly wölsendorfite-bearing, was found embedded in lepidolite at the Tamminen quarry, **Greenwood**.

WULFENITE



Lubec - Lubec Lead M; Stow - Upper Colton Hill P

Wulfenite is a species seldom encountered east of the Mississippi river. There is a well-known occurrence of excellent

crystals (to 1+ cm) in Easthampton, Massachusetts. The first occurrence of wulfenite in Maine was known from the Lubec Lead mine, **Lubec**. The crystals here are frequently no larger than 1 mm and are found on very fine-grained clinochlore-coated fracture surfaces of breccia fragments in the quartz matrix. The crystals have a typical, very thin-tabular habit. The transparent crystals are orange.

Wulfenite from a granite pegmatite is a rarity in the world. Small 1-2 mm simple blocky orange crystals have been found in albite vugs, sometimes with quartz crystals (to 5 mm), Upper Colton Hill pegmatite prospect, **Stow** (Henry Barbour, personal communication, 1991). The elongated wulfenite crystals show an unstriated square prism with asymmetric pyramid, and yellow (color-zoned cap) pedion, and are associated with light yellow-green massive pyromorphite.

WURTZITE

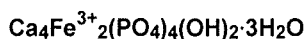
ZnS

Newry - Bell Pit

Tiny, 1-2 mm, bright gemmy orange wurtzite crystals have been found at the Bell pit, **Newry** (King, 1975b) (XRD and chemical analysis, this study). The matrix is crystallized siderite and the wurtzite crystals resemble the usual six-sided, corrugated stacking of platy crystals known from Thomaston Dam, Connecticut and other areas. The wurtzite also occurs as irregular intergranular masses (to 2 mm) in siderite. Sphalerite cleavages in Bell Pit siderite are generally yellow to brown.

X

XANTHOXENITE (Fairfieldite Group)



Newry - Dunton Q, Rose Quartz Crystal L; **Rumford** - Red Hill Q

Xanthoxenite (zan - thox - en - ite) was originally described by Laubmann and Steinmetz (1920). Moore and Ito (1978) suggested that the original material was stewartite and they redefined xanthoxenite. The original name xanthoxenite did not stay restricted to material we would now call stewartite, though stewartite is found at Newry. Members of the jahnsite group became part of the xanthoxenite nomenclature, and that material seems to be the basis for the previous listing of xanthoxenite at the Dunton quarry (King, 1975b). Recent samples of tan to light brown to light milky orange, fibrous to radiating blades or fans of xanthoxenite (to 2 x 0.1 cm) in aggregates (to 1 x 3 cm) have been found in enclosed in cleavelandite (Steve Garza, personal communication, 1990). Associated vugs sometimes contain stubby white fluorapatite crystals or whitlockite crystals. The recent Dunton quarry mineral conforms to the redefinition. Large dendritic triphylite crystals (to 10 cm) have been completely replaced by fine-grained greenish tan xanthoxenite (King, 1993a). The xanthoxenite can be orange-stained.

Creamy tan to buff xanthoxenite crystals (to 5 x 1 mm) (untested) occur at the Rose Quartz Crystal location, **Newry**. The xanthoxenite has a waxy luster and occurs in radial clusters (to 1 cm) of indistinctly terminated crystals in vugs in cleavelandite, sometimes associated with red or milky brown resinous diadochite and/or goethite botryoids (to 1mm).

One of the Red Hill quarries, **Rumford** has produced brick-orange, earthy-lustered xanthoxenite crystals in tightly clustered bundles (to 1 cm) in cavities in tan blocky microcline.

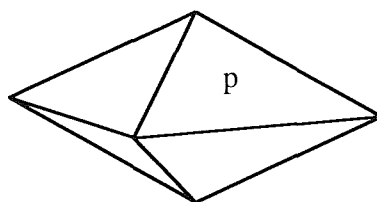
XENOTIME - (Y)



Newry - heavy mineral concentrate; **Topsham** - Fisher Q, Havey #1 Q, Havey #2 Q

Xenotime-(Y) has been reported as a component of heavy mineral concentrates in soil core-samples from an unspecified **Newry** location collected by the Vitro Company (Wintringham, 1962). The brown, sub-angular grains are up to 2 mm. Samples consist of rounded, granular, tan to brown translucent grains (to 1 mm). Additional heavy mineral concentrates obtained by Vitro contained ilmenite, zircon, rutile, and monazite-(Ce).

Bipyramidal light olive-green to greenish brown xenotime-(Y) crystals (chemical analysis, this study) (to 3 mm) occur at the junction of microcline and smoky quartz at both the Havey #1 and Havey#2 quarries on Schoolhouse Crossing Road, **Topsham**. Associated species include red to red-brown (rarely orange red) monazite-(Ce) crystals (to 2 mm), and thorogummite and other similar yellow minerals under study. Some of the xenotime-(Y) is brown with a greenish brown core.



Xenotime-(Y), Havey #2 Q, Topsham

Y

yedlinite - not found in Maine

This curious entry has to be included here, because of the unfailing belief in Maine that a particular unknown mineral from Newry proved to be this mineral. The erroneous belief was first based on a mention by Knoll (1957) and secondly by a list prepared by Whalen (1959) which said: "A new mineral, to be named for Neal Yedlin, its discoverer and past president of the New York Mineralogical Club, authority on micro-mount mineralogy, and conductor of the 'Micro-mounter' column in Rocks and Minerals magazine, is presently in the course of study. Found in 1941 in the lower pit at Newry, Maine, it is being worked on at the United States Geological Survey in Washington, D.C. Full publication of the findings will appear in The American Mineralogist at a future date. No mention of the details can be disclosed at this time, except that the mineral is purple in color, tetragonal, of pyramidal habit, minute in the size of its crystals, and occurs with the phosphates roscherite and eosphorite. An unusual rare earth mineral [sic], the minute quantity found (4 pieces $\frac{3}{4}$ " x $\frac{3}{4}$ ") has delayed chemical analysis." Perham (1959) further reported on the name. As Einar Whalen lived in Maine during his retirement years, he continued to spread the word to find more material for analysis. Eventually, Neal Yedlin found another, completely unrelated, purple mineral, this time from the famous copper, silver, and gold mine - Mammoth-Saint Anthony mine, Tiger, Arizona, and this mineral was named yedlinite by McLean et al.

(1974). The purple Newry mineral was later named gainesite (q.v) by Moore et al. (1983). There seems to be a virulence associated with the incorrect name of the Newry material, however.

yttrocerite? (Fluorite Group)

Auburn?; Newry? - Dunton Q; Paris? - Mount Mica Q

Yttrocerite was first reported from the Mount Mica quarry, **Paris** (Houghton, 1861). No samples have been found which support the report and the material must be regarded as misidentified, given the uncertain use of nomenclature during that time. Morrill et al. (1958) listed yttrocerite from **Auburn** while Seaman (1975d) listed yttrocerite, without substantiation, from the Dunton quarry, **Newry**. Verrill (1862) wrote of Mount Mica quarry, **Paris**: "*Yttrocerite*. This very singular and rare mineral has not before been noticed from Mt. Mica, but I have found a few good specimens. It is remarkable for containing the rare metals, Yttrium and Cerium, and has previously been found, in very small quantities only, in one or two localities in America. This occurs in small irregular masses, imbedded in Albite. Its color is dull violet, with a somewhat vitreous lustre; the hardness is less than that of feldspar, it being readily scratched by a knife." The mineral may have been purple damourite.

Z

ZANAZZIITE (Roscherite Group)



Newry - Bell Pit, Martin P

Zanazziite occurs at the Bell Pit, **Newry** (chemical analysis and XRD, this study) as somewhat radially splayed, nearly colorless to tan crystals (to 2 mm) on quartz crystals (to 3 mm). The specimen observed might be a broken botryoid.

Zanazziite from the Martin prospect, Newry (chemical analysis and XRD, this study) occurs as pale milky, slightly yellowish green, multiple-growth crystals (to 3mm) with an "axe-head" shape reminiscent of some prehnite. The matrix is cleavelandite and/or blue fluorapatite.

zeolite-like mineral

Bowmantown; Hurricane Mountain Formation mélange - **Brassua Lake quadrangle**; Sugar Loaf A - **Bridgewater, Monticello**

Zeolite signifies a group of minerals with a similar set of properties such as cation exchangeability, reversible water contents, etc., but which are otherwise quite diverse in other physical properties and crystal structure. The original name covered what is now called stilbite, but the confusion among early mineralogists resulted in a large variety of materials being included under the one word and zeolite was eventually used only as a group name.

Wing and Dawson (1949) reported of volcanic rocks in **Bowmantown**: "A thin section of the rock from the international boundary, close to the southeast border of the belt, shows zeolite amygdules of microscopic size."

Boone et al. (1989) noted of the Hurricane Mountain Formation mélange, **Brassua Lake quadrangle**: "Laminations and tiny phacoidal lenses of light buff very fine-grained white mica and unidentified zeolitic or feldspathic minerals (relict, felsic ash protolith?) are a common and characteristic feature of the matrix in many areas."

Pavlidis et al. (1965) wrote of the Sugar Loaf area, **Bridgewater and Monticello**: "Calcite, and most of the chlorite, typically occurs as alterations of other mineral grains. Epidote and a zeolitelike [sic] mineral are locally present."

zinc spinel = gahnite

ZINNWALDITE (Mica Group)



Buckfield - Bennett Q; Stoneham? - Lord Hill Q

Zinnwaldite is a trioctahedral mica with ferrous iron, lithium, and aluminum, with or without dominant fluorine (see Foster, 1960). Some low-iron "zinnwaldites" qualify as ferrous lepidolites and many zinnwaldites show highly variable composition. Historically, zinnwaldites show a gray to bronzy color, but can be present as dark zones in light colored micas. A compositional series also exists between zinnwaldite and "biotites," but zinnwaldite is a relatively scarce mineral by number of occurrences. For example, some bronzy micas which superficially resemble zinnwaldite have been found at the Mount Mica quarry, Paris, but these flakes in siderite-clay replacements within blue tourmaline eyes have proved to be iron-bearing muscovite (chemical and optical analyses, this study).

At the Bennett quarry, **Buckfield**, bronzy brown zinnwaldite flakes (to several mm) are found embedded in schorl-spessartine aplite matrix. Larger golden brown to bronzy zinnwaldite flakes (to 1 cm) also occur near arsenopyrite in pegmatite (Michael Wise, personal communication, 1991).

A specimen labeled "zinnwaldite" from the Lord Hill quarry, **Stoneham** has been shown (this study) to be ordinary yellow to greenish yellow muscovite.

ZIRCON



Albany - Bumpus Q, Fleck Q, Johnson Q, Stearns P; **Alfred** - Bennett M; **Auburn** - Groves Q, Maine Feldspar Q, Pulsifer Q; **Biddeford** - Andrews and Perkins M, Ricker M; **Blue Hill** - Stewart M, White M; **Bowdoin** - Coombs Q; **Bristol** - Round Pond Granite Q; **Brunswick** - Grant Q; **Buckfield** - Bennett Q; **Calais** - Mingo-Bailey and Company Q, Maine Red Granite Q; **Cooper** - Calais Mining company M, Cooper Mountain P; **Dedham** - 900 Foot Hill; **Farmington** - granodiorite; **Franklin** - T. M. Blaisdell Q, W. B. Blaisdell Q, Bradbury and Sons Q; **Gardiner** - syenite drift boulders; **Georgetown** - Consolidated Q; **Greenwood** - Harvard Q, Heikkinen Q, Tamminen Q, Witt Hill Chrysoberyl L; **Hallowell** - Stinchfield and Longfellow Q; **Hartford** - Ragged Jack Mountain L; **Hebron** - Mount Rubellite Q; **Litchfield** - Dennis Hill A; **Long**

Island Plantation - Black Island Granite Q; **Lovell** - Orman McAllister quarry; **Ludlow** - Ludlow Granite Q; **Marshfield** - Marshfield Q; **Monmouth**; **Mount Desert** - Campbell and Macomber Q; **Newry** - Bell Pit, Dunton Q, Nevel Q, Rose Quartz Crystal L, Scotty Q, Three Ledges P; **New Sweden**; **Norridge-wock** - Dodlin Hill Granite Q; **Norway** - Cobble Hill Q, Howe Chrysoberyl L, Tubbs Ledge Q; **Oxford**; **Paris** - Lower Hoopers Ledge P, Mount Mica Q; **Pownal** - Pownal Granite Q; **Rumford** - Black Mountain Q, Goddard Ledge Q; **Saint George** - Clark Q; **Sanford** - Webster P; **Searsport** - Bog Hill Granite Q; **Somerville Plantation**; **South Thomaston** - Sprucehead A; **Stoneham** - Lord Hill Q, Rattlesnake Mountain A; **Stonington** - Parker-Ryan Q; **Topsham** - Consolidated #2 Q, Fisher Q, Mount Ararat Q, Russell Brothers Q, South Standpipe Hill Q, Square Pit, Swamp #1 Q; **Tremont** - Carrol Q; **Tunk Lake pluton** - **Hancock County**; **Umbagog granodiorite** - (Pine Point A) **Magalloway**; **Union** - Harriman P; **Upton**; **Vinalhaven** - "Acid Volcanic" rocks, Hurricane Island Granite Q, Pequoit Q, Sands Granite Q; **Wells** - Lord Granite Q; **West Gardiner** - drift boulders; **West Paris** - Perham Q; **Whitefield**

Zircon is a common accessory mineral in many rock types, though usually inconspicuous. Granites, and granitic pegmatites in particular, frequently contain numerous small zircons. Zircon crystals are frequently found in groups or concentrations, rather than being widely distributed. The color varies from brick-red to brown, and almost black. The mineral is frequently implanted on earlier-formed species such as columbite, almandine, chrysoberyl, etc. or can be found as inclusions. Many authors have indicated zircon as a widespread accessory mineral in a variety of rock types (e.g. Dale, (1907); Dale et al. (1906,1914); Smith (1923); Boone (1955); Austin and Hussey (1958); etc.). Zircons in granite pegmatites are frequently found in cleavelandite as well as triphylite and lithiophilite. (Xenotime-(Y), while a phosphate, has the zircon crystal structure and can be confused with zircon.)

Interesting prismatic zircon crystals are found at the Bumpus quarry, **Albany** which have a first-order pyramid and second-order prism in combination with a pronounced ditetragonal bipyramid. The crystals (to 3 mm) have a resinous luster and are frequently found embedded in reddish-stained albite, commonly with small (to 4 mm) gemmy almandine crystals and grains and occasional pale green, almost white, manganoan fluorapatite. Some of the zircons are represented only by casts in the albite with a powdery white coating partly filling the cavity.

Small zircon crystals have been found embedded in the surfaces of beryl crystals at the Fleck quarry, Flints Mountain, Albany (Woodrow Thompson, personal communication, 1994). Zircon (to 3 mm) from the Stearns prospect, Albany has a nearly equally developed first-order pyramid and second-order prism which mimics a dodecahedral garnet when partially exposed, but the color approaches brownish black. Zircon from the Johnson quarry, Albany is sometimes replaced with a white earthy mineral similar to that of the Bumpus quarry.

Zircon crystals (to 3 mm) have been observed as dark brown inclusions in lithiophilite from the Pulsifer quarry, **Auburn**. The zircon consists of a nearly equant first-order pyramid in combination with the second-order prism, and the resulting habit appears pseudocubic. The interior of the zircon shows a resinous metamict-looking smooth fracture, and the mineral is gray to brown on thin edges.

Forsyth (1955a) wrote of the Cooper Mountain prospect, "... 0.6 miles southeast of the Cooper Mt. fire tower...", **Cooper**: "In addition to the molybdenite, other accessories which occur in minor amounts are fluorescent zircon and scheelite."

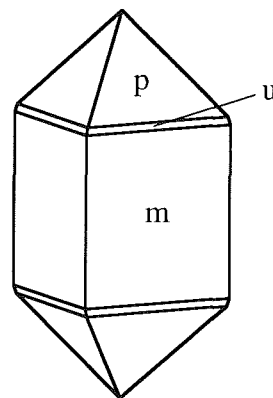
The Witt Hill chrysoberyl area, **Greenwood** has produced many 1-2 mm doubly-terminated zircon crystals of medium to dark brown color. The zircon is sometimes embedded in almandine crystals associated with the sillimanite-impregnated pegmatite or implanted on chrysoberyl crystal faces. (Zircons (to 2 mm) can be included in almandine at the Groves quarry, Auburn, while similar zircons can be found on the surface of chrysoberyl crystals from the Ragged Jack locality, Hartford.)

Tiny (less than 1 mm) zircon crystals are found enclosed in schorl crystals (to 8 mm) embedded in massive quartz and gemmy almandine crystal (to 5 mm) matrix at the Harvard quarry, Greenwood.

Tiny (1 mm and less) medium brown zircon crystals are found on columbite plates embedded in matrix at the Heikkinen quarry, Greenwood.

Equant tan zircon crystals (to 2 mm) are found sparsely implanted on clear quartz crystal clusters (individuals to 3 mm) from the Tamminen quarry, Greenwood. Similar equant, but nearly black zircon crystals are found embedded in cleavelandite associated with lithiophilite and rare gummite at the Tamminen quarry.

The largest zircons in Maine have come from cancrinite-bearing nepheline syenite rocks (litchfieldite) from the **Litchfield - Gardiner** area. Doubly-terminated, tan to medium-brown zircons, up to 3 cm, have been found embedded in the litchfieldite from Dennis Hill and vicinity. The litchfieldite that is commonly collected is found in a "boulder train" which was produced by



Zircon, Dennis Hill A, Litchfield

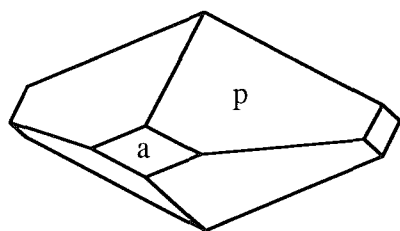
glacial erosion and dispersal. Rock walls and isolated boulders have produced excellent specimens. The zircons from this locality fluoresce light to dark yellow when exposed to long-wave ultraviolet light. Kunz (1892a) wrote of zircon: "Some fine ones, over an inch in length, have been found at Litchfield, Me., and all through the cancrinite and sodalite rocks near that place." Augustus Hamlin wrote to Joseph Leidy (January 22, 1871; CPL): "Dr. Chas. T. Jackson has the finest xl of zircon in this country. It came from Litchfield in this state, and I think 1¹/₂ inches in diameter (or more). He believes it to be the finest in the world." At the time, this specimen may have been an American record, but many European samples could have been better. The whereabouts of this specimen is unknown.

The Orman McAllister quarry, **Lovell** has brick-red bipyramidal zircon crystals (to 3 mm) embedded in quartz, frequently with a brick-red to dark red-brown iron stain or coating of nearby etched vugs. Some bipyramids are embedded in creamy yellow microcline with gray-brown "rods" of zircon (to 3 x 0.3 mm).

Green (1964) reported a zircon from the Umbagog granodiorite, Pine Point area, **Magalloway** which was analyzed by a "Lead alpha" method and was found to be 450 ± 50 million years old.

Zircon crystals from the Dunton quarry, **Newry** are frequently embedded in cleavelandite. The crystals are usually rounded and seldom exceed 5 mm in maximum dimensions, and are usually 1-2 mm. The color varies from medium brown through almost black. Sometimes the dominantly bipyramidal crystals, with small second-order prism, are intergrown with smaller "satellite" crystals which can be in parallel position. A few crystals show small second-order bipyramids along with small ditetragonal bipyramids. One specimen has been observed partly enclosing a bipyramidal cassiterite. The cassiterite is dark coffee-brown and has a more lustrous surface as well as a smoother set of faces. The shape, however, is almost identical. Pseudomorphism is common at the locality, with the zircon replaced by an external earthy brown iron-rich shell (hisingerite?) with a pale yellow dense fibrous uranophane interior (see unknown mineral #5).

Bell Pit, Newry zircon is found in siderite-quartz matrix, but with the typical bipyramidal habit. The color of the crystals (to 4 mm) is dark brown.



Zircon, Dunton Q, Newry

The Three Ledges prospect, Newry has brown intergrown zircons (to 3 mm) formed on the faces of columbite crystals embedded in matrix.

Shepard (1830) wrote of the Mount Mica quarry, **Paris**: "The *Beryls* occur in that part of the ledge which abounds more particularly with black Tourmalines, and are diffused among the imperfect crystals of this substance, common feldspar and quartz. ... In the same aggregate, occur the crystals of *Zircon*; and which were first pointed out to me by Mr. Nuttall of Cambridge. They are comparatively rare, and very minute, - requiring a microscope for their observation; by the aid of which, they are seen to be of a clove-brown color, and to be crystallized in four sided prisms, surmounted by four sided pyramids with rhomboidal faces, the planes of which correspond to the lateral edges."

Peculiar tannish gray doubly-terminated zircon crystals (to 1+ cm) are found at the Lower Hoopers Ledge prospect, **Paris**. The crystals show prism and pyramid, of the same order, nearly equally developed, with small "c" pinacoid. This zircon is generally found at the margin of schorl with blocky albite and might be completely enclosed in schorl.

Black Mountain quarry, **Rumford** zircon is brown to nearly black and is composed of crystals (to 3 mm) which have a dominant first-order pyramid with small second-order pyramid. The zircon is embedded in orange to brown-stained cleavelandite. Small brown zircon crystals are embedded in columbite plates at the lower Goddard Ledge quarry, Rumford (Woodrow Thompson, personal communication, 1994).

Zircon was listed without comment by Trefethen et al. (1955) from the Webster prospect, **Sanford**. No specimens known.

Bipyramidal brown zircon crystals (to 3 mm) occur embedded in albite near contacts with muscovite at the Lord Hill quarry, **Stoneham**.

Zircon from the South Standpipe Hill quarry, **Topsham** is found as brown, prismatic crystals (to 3 mm) with first-order pyramid and second-order prism. The crystals are found embedded in microcline, quartz, and even magnetite, with well-developed parting.

Zircon from the Fisher quarry, Topsham has been observed as light brown bipyramids (to 2 mm) embedded in quartz. One specimen from the Roger Clapp collection was composed of green to grayish green (not microlite!) zircon crystals (to 3 mm) in parallel intergrowth.

Tan through black bipyramidal zircon crystals (to 3 mm) have been found embedded in microcline in association with uraninite at the Swamp #1 quarry, Topsham. The black zircon can be mistaken for uraninite. Some of the zircons in association with biotite have a concentric pagoda-like set of steps similar to those seen on similarly associated uraninite.

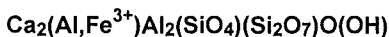
Karner and Helgesen (1970) made an extensive study of zircon and its variations in the Tunk Lake pluton, Hancock County, and published chemical analyses and illustrated various crystal shapes.

Zircon - Variety Cyrtolite

Auburn? - *Pulsifer Q*; **Newry?** - *Dunton Q*; **Rumford?** - *Black Mountain Q*; **Stoneham?** - *Lord Hill Q*, *Rattlesnake Mountain A*; **Topsham?** - *Fisher Q*

The variety cyrtolite has been found in granite pegmatites. It contains impurities of uranium, thorium, rare-earth elements, etc. and the color of these crystals can be dark brown to brownish black. Cyrtolite sometimes shows a surrounding brown aureole or halo, usually staining the host feldspar. The radioactive impurities can destroy the crystal's internal arrangement through time and the crystal becomes softer in hardness, brittle, and the luster changes to resinous to dull. Broken surfaces show a smooth undulating fracture. Crystals that have become altered by radioactivity are called *metamict*. Metamict minerals have usually reacted with water during their alteration and have expanded in volume. Radial cracks in host minerals, such as feldspar, indicate the forces due to the expansion. The zircons of Maine pegmatites are probably not true cyrtolites, despite the occasional chance association with uraninite or monazite-(Ce). Two chemical analyses (EDAX, this study) indicated relatively low uranium substitution (Dunton quarry, Newry; Black Mountain quarry, Rumford).

ZOISITE



Berwick - *Miniutti Q*; **Calais** - *U. S. Route #1 road cut*; **Castine**; **Cornish** - *Day Hill*; **East Moxie** - *Black Narrows*; **Fairfield** - *zoisite isograd - Fairfield Center A*; **Farmington** - *scheelite prospects*; **The Forks** - *Black Narrows*; **Grafton** - *Notch 2 A*; **Greenwood** - *Berry Ledge Formation, Patch Mountain Member*; **Hurricane Mountain Formation** - **Brassua Lake quadrangle**; **Hutchins Corner Formation** - **Albion, China, Freedom, Palermo, Pittston, Somerville, Whitefield, Windsor**; **Jim Pond Formation** - **Alder Stream, Jim Pond, Seven Ponds, Stetsontown, Tim Pond**; **Jonesboro** - *Booth Brothers Jonesboro Q, Fish Q*; **Lewiston** - *Robinson Mountain A*; **Newry?** - *Puzzle Mountain*; **North Haven** - *Thorofare Andesite*; **North Haven Formation** - **Deer Isle, North Haven**; **Norway** - *Berry Ledge Formation, Patch Mountain Member of the Sangerville Formation*; **Rockland** - *The Marsh A*; **schist of Columbia Falls** - **Centerville, Columbia Falls**; **South Berwick** - *Spence and Coombs Q*; **Wilton** - *U.S. Route #2 road cut*; **York** - *Cape Neddick A, Israels Head A, Spouting Rock A*

Zoisite is an orthorhombic polymorph of clinozoisite. It is a rock-forming mineral, not usually visible in hand specimens. It is dark green and can have a fibrous to splintery appearance, or appear as rounded blebs (usually no larger than 1 mm and frequently smaller).

Terzaghi (1946) noted zoisite in the "schist of Columbia Falls," **Centerville** and **Columbia Falls**.

The norite from Black Narrows, **East Moxie** and **The Forks** has zoisite described by Houston (1956): "Another alteration mineral is zoisite, which occurs in aggregates associated with chlorite and sericite, replacing the feldspars."

Ferry (1976) mapped a zoisite isograd in the Fairfield Center area, **Fairfield**: "Zoisite first appears overgrowing calcic plagioclase at the interface between plagioclase and calcite."

Trefethen et al. (1955) said of zoisite from some scheelite prospects near **Farmington**: "Two scheelite occurrences in the Farmington area were noted by Mr. Gary Boone in the course of his mapping in this region... The first of these is approximately two miles north of Farmington Falls on the West Farmington - Farmington Falls road, and the second one mile north of Farmington on Route Two. At the first locality, the scheelite occurs as minute grains disseminated sparsely in the lime silicate rock. At the second locality, the scheelite is associated with one inch veins of coarser grained calcite and zoisite."

Guidotti (1965a) said of the Patch Mountain Member of the Sangerville Formation, **Greenwood** and **Norway**, Bryant Pond quadrangle: "Zoisite is locally present in small amounts and appears to be an alteration of the calcic plagioclase." Fisher (1948) noted zoisite in the Androscoggin Formation, Robinson Mountain, **Lewiston**, in what is now known as the Patch Mountain Member of the Sangerville Formation. Seaman (1975d) listed zoisite in pegmatite, **Lewiston**.

Osberg (1988) noted zoisite in the Hutchins Corner Formation, **Albion, China, Freedom, Palermo, Pittston, Somerville, Whitefield**, and **Windsor**; and Boone et al. (1989) noted zoisite in the Hurricane Mountain Formation, **Brassua Lake quadrangle**.

Boudette (1991) wrote of zoisite and other alterations of the mafic volcanic members of the Jim Pond Formation, **Alder Stream, Jim Pond, Seven Ponds, Stetsontown**, and **Tim Pond**: "Saussuritized and variously recrystallized to mixtures of chlorite-albite-epidote-actinolite±calcite±quartz, with minor amounts of sericite, zoisite, leucoxene, hematite, serpentine, talc, pyrite, and prehnite."

True (1869) offered the following report for **Newry**: "*Schiller spar?* An abundant mineral, corresponding the nearest to this, is found at Puzzle Mt. It may prove to be a Zoisite." No specimens are known and no further report has been made. The current use of the name Schiller Spar is for altered enstatite.

Emmons (1910) noted zoisite in the North Haven Formation, **Deer Isle** and **North Haven**. Smith (1901) had earlier observed the development of secondary zoisite in the North Haven Greenstone complex and had noted of the Thorofare Andesite: "In the thin section, these feldspars are seen to have suffered the usual alteration to epidote and zoisite, and the porphyritic darker constituents are also wholly altered."

Smith (1923) listed many zoisite occurrences in various quarried "black granites" in Maine such as the Spence & Coombs quarry, **South Berwick**: "This rock ... is a gabbro of very dark olive-brownish color and medium ophitic texture, consisting in descending order of abundance, of longitudinal crystals of gray-

ish olive-brownish lime-soda feldspar (labradorite) between which are particles of diallage, black mica (biotite), magnetite, and a little pyrite, together with secondary hornblende, analcite, zoisite, and calcite."

Bastin (1908b) reported from **Rockland**: "A specimen from the east side of 'The Marsh,' a short distance south of Dunton's quarry, consists largely of tremolite in prisms and needles which reach a length of one-eighth of an inch. With this mineral are associated zoisite, calcite, and titanite."

Gray rectangular zoisite prisms (to 1+ cm) are found embedded in calcite from a U.S. Route #2 road cut in **Wilton** (Donald Corson, personal communication, 1991).

Haff (1939) indicated that zoisite was present in dike rocks on Cape Neddick, **York** and that in some lamprophyres, the plagioclase was zoisitized. Keeley (1924) noted of a basalt dike near Spouting Rock, Ogunquit, York: "Ten feet further, toward the north, is a six-foot dike of diabase porphyrite with large phenocrysts of feldspar, in which as well as in the matrix, it is so much zoisitized [sic] as to be unidentifiable except in rare patches where albite twinning is apparent." See saussurite.

zwieselite? (Triplite Group)

Newry? - *Bell Pit*; **Stoneham?** - *Lord Hill Q*

An etched gemmy coffee-brown mineral (to 2 mm) in tan siderite at the Bell Pit, **Newry** is similar to zwieselite, but has not been assignable to the species based on its X-ray data and optical properties (see unknown mineral #6).

Kunz (1884a₂) noted of Lord Hill quarry, **Stoneham**:

"Triplite is scattered all through the rock in pieces from one gramme to one kilo in weight, staining all the other minerals, especially the quartz and cleavelandite.

One mass that may have been a large rough crystal furnished over fifty kilos of this mineral. The color is a light chocolate brown, streaked

with almost transparent veins of a lighter colored variety of the same mineral, and is remarkably pure in character, translucent in small pieces, possibly the Var Zweiselite[sic]."

The high manganese content of the Stoneham triplite (Vandall King and David Pope, unpublished data, 1976) seems to preclude the zwieselite suggestion.

zygadite (Feldspar Group) - a steeply rhombic platy crystal habit of albite

Albany - *Pingree Ledge Q*; **Buckfield** - *Bennett Q*; **Greenwood** - *Harvard Q*, *Tamminen Q*; **Lincolnton** - U.S. Route #1 road cut; **Newry** - *Dunton Q*, *Nevel Q*, *Rose Quartz Crystal L*; **Paris** - *Mount Mica Q*; **Rumford** - *Black Mountain Q*

Particularly flat thin albite (q.v.) crystals with a rhombic cross-section are called zygadite, while thick, blockier albite crystals of similar habit are called valencianite. The distinction between the two varieties is only one of degree. Similar crystal shapes which are found in K-feldspars are called chesterlite. Zygadite crystals are found in Maine pegmatites in late-stage crystal pocket formations and can be found as pocket-lining crystals or as crystals in vugs in blocky albite, vuggy lepidolite, etc. Opaque white blocky zygadite crystals can be associated with and mistaken for rhombic platy bertrandite. Bertrandite is usually clear and zygadite usually is white.

Particularly large tan albite crystals of the zygadite variety (to 10 cm) in large pocket-lining clusters (to 30 x 30 cm) were found in the late 1940's at the Mount Mica quarry, **Paris** and were so unfamiliar in this size that they were suspected to be a new mineral by the miners (Nestor Tamminen, personal communication, 1989). These zygadite crystals were particularly unusual in that they showed a coarsely corrugated aspect of the polysynthetic twinning.

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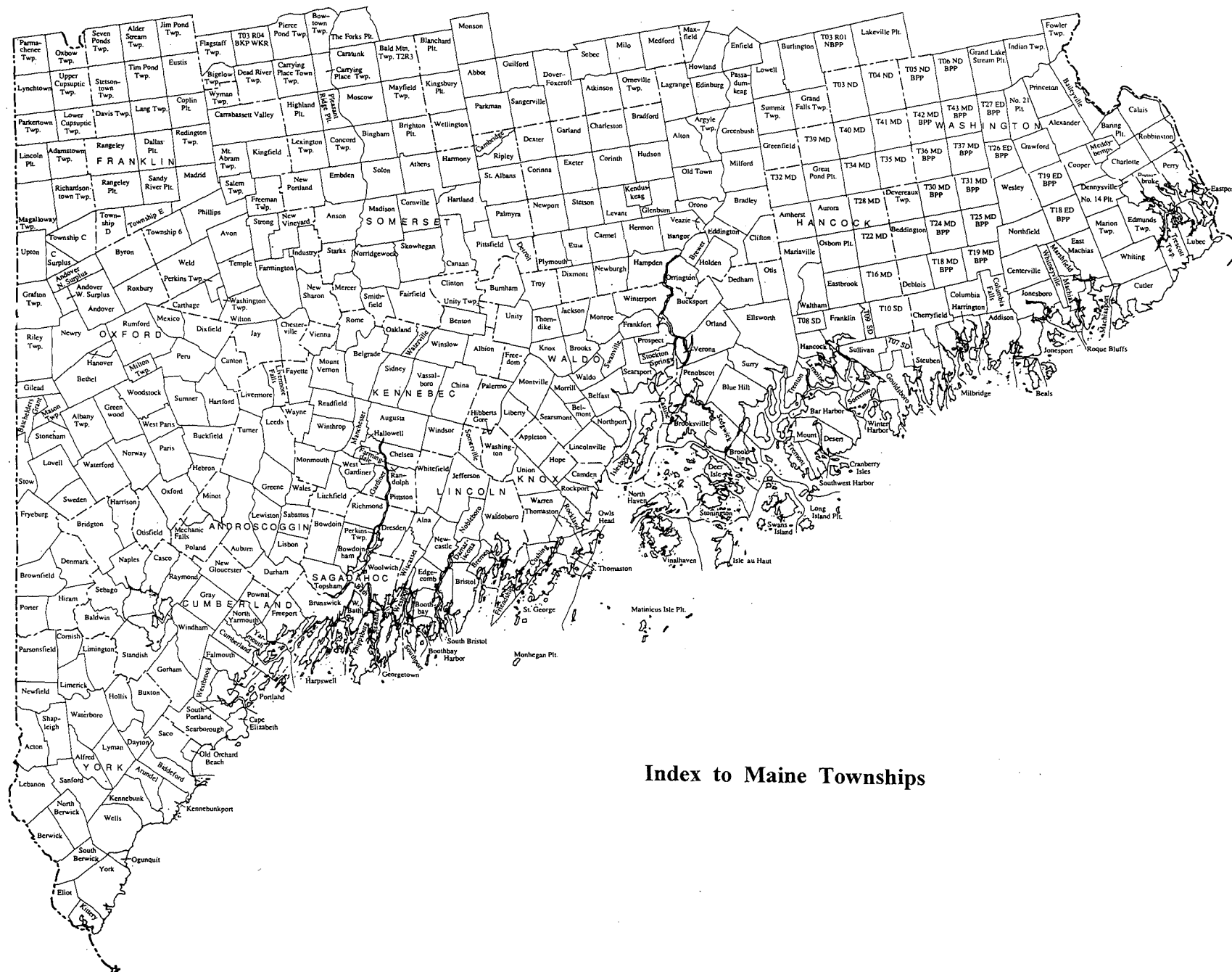
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Alphabetical List of Cities, Plantations, Towns, Townships, and Settlements in Maine

(This list is not comprehensive for settlements which have no status as political entities. See Attwood [1974].)
All portions of Maine have been assigned to a political unit. There are no regions which should be referred to
by county name only, as is the case in many other states.

Abbot	Bald Mountain	Bowdoin	Canton Point (Canton)
Acadia (Connor)	(T4 R4 NBKP)	Bowdoin College Grant East	Cape Elizabeth
Acton	Baldwin	Bowdoin College Grant West	Cape Neddick (York)
Adamstown	Bancroft	Bowdoinham	Cape Rosier (Brooksville)
Addison	Bangor	Bowerbank	Caratunk
Albany	Bar Harbor	Bowmantown	Caribou
Albion	Baring	Bowtown	Carmel
Alder Brook	Barnard	Bradford	Carrabassett Valley
Alder Stream	Batchelders Grant	Bradley	Carroll
Alexander	Bath	Bradstreet	Carrying Place
Alfred	Beals	Brassua	Carrying Place Town
Allagash	Beattie	Bremen	Carthage
Alna	Beaver Cove	Brewer	Cary
Alton	Beddington	Bridgewater	Casco
Amherst	Belfast	Bridgton	Castine
Amity	Belgrade	Brighton	Castle Hill
Andover	Belmont	Bristol	Caswell
Andover North Surplus	Bemis (Rangeley Plantation)	Brooklin	Centerville
Andover West Surplus	Benedicta	Brooks	Chain of Ponds
Anson	Benton	Brooksville	Chapman
Appleton	Berwick	Brookton	Charleston
Appleton Township	Bethel	Brownfield	Charlotte
Argyle	Biddeford	Brownville	Chase Stream
Arrowsic	Bigelow	Brunswick	Chelsea
Arundel	Big Six	Bryant Pond (Woodstock)	Cherryfield
Ashland	Big Squaw	Buckfield	Chester
Athens	Big Ten	Bucksport	Chesterville
Atkinson	Big Twenty	Burkettville (Appleton)	Chesuncook
Attean	Big W	Burlington	China
Auburn	Bingham	Burnham	Chisholm (Jay)
Augusta	Black Point (Scarborough)	Buxton	Clifton
Aurora	Blaine	Byron	Clinton
Avon	Blake Gore	C Township	Coburn Gore
Ayers Junction (Pembroke)	Blanchard	Calais	Codyville
Bailey Island (Harpwell)	Blue Hill	Cambridge	Columbia
Baileyville	Blue Hill Falls (Blue Hill)	Camden	Columbia Falls
Bald Mountain	Boothbay	Canaan	Comstock
	Boothbay Harbor	Canton	Concord





Index to Maine Townships

Connor	East Machias	Gorham	Howland
Cooks Corner (Brunswick)	East Middlesex Canal Grant	Gorham Gore	Hudson
Cooper	East Millinocket	Gouldsboro	Iceboro (Richmond)
Coplin	East Moxie	Grafton	Indian Stream
Corea (Gouldsboro)	Easton	Grand Falls	Indian Township
Corinna	Eastport	Grand Isle	Island Falls
Corinth	Eddington	Grand Lake Stream	Isle au Haut
Cornish	Edgecomb	Gray	Islesboro
Cornville	Edinburg	Great Pond	Industry
Cove Point	Edmunds	Greenbush	Jackman
Cox Patent	Eggemoggin (Deer Isle)	Greene	Jackson
Cranberry Isles	Egypt (Hancock)	Greenfield	Jay
Crawford	Eliot	Greenville	Jefferson
Criehaven	Elliotsville	Greenwood	Jim Pond
Crystal	Ellsworth	Grindstone	Johnson Mountain
C Surplus	Elm Stream	Guilford	Jonesboro
Cumberland	Embden	Hallowell	Jonesport
Cushing	Enfield	Hall Quarry (Mount Desert)	Katahdin Iron Works
Cutler	Etna	Hamlin	Kenduskeag
Cyr	Eustis	Hammond	Kennebago (Stetson town)
D Township	Exeter	Hammond Township	Kennebunk
Dallas	Fairfield	Hampden	Kennebunkport
Damariscotta	Falmouth	Hancock	Kezar Falls (Parsonsfield)
Danforth	Farmingdale	Hannibals Crossing (Lobster)	Kibby
Danville (Auburn)	Farmington	Hanover	Kineo
Davis	Fayette	Harborside (Brooksville)	King and Bartlett
Day Academy Grant	Flagstaff	Harfords Point	Kingfield
Dayton	Forest	Harmony	Kingman
Dead River	Forest City	Harpswell	Kingsbury
Deblois	The Forks	Harrington	Kittery
Dedham	Forkstown	Harrison	Knox
Deering (Portland)	Forsyth	Hartford	Kokadjo (Frenchtown)
Deer Isle	Fort Fairfield	Hartland	Kossuth
Denmark	Fort Kent	Haskell Corner (Auburn)	Lagrange
Dennistown	Fowler	Haynesville	Lakeville
Dennysville	Frankfort	Head of the Tide (Belfast)	Lambert Lake
Detroit	Franklin	Head Tide (Alna)	Lamoine
Devereaux	Freedom	Hebron	Lang
Dexter	Freeman	Hermon	Lakeview
Dixfield	Freeport	Hershey	Lebanon
Dixmont	Frenchboro	Hershey Town	Lee
Dole Brook	Frenchtown	Hibberts Gore	Leeds
Dover-Foxcroft	Frenchville	Highland	Levant
Dresden	Friendship	Hinckley (Fairfield)	Lewiston
Drew	Frye (Roxbury)	Hiram	Lexington
Ducktrap (Lincolnville)	Fryeburg	Hobbs town	Liberty
Dudley	Gardiner	Hodgdon	Lily Bay
Durham	Garfield	Holden	Limerick
Dyer	Garland	Holeb	Limestone
E Plantation	Georgetown	Hollis	Limington
E Township	Gilead	Hope	Lincoln
Eagle Lake	Glenburn	Hopkins Academy Grant	Lincoln Plantation
Eagle Lake Township	Glenwood	Houghton (Byron)	Lincolnville
Eastbrook	Goose Falls (Brooksville)	Houlton	Linneus

Descriptive mineralogy of Maine minerals

Lisbon	Milford	Northport	Plymouth
Lisbon Falls (Lisbon)	Millinocket	North Turner (Turner)	Plymouth Township
Litchfield	Milo	North Yarmouth Academy	Poland
Little Deer Isle (Deer Isle)	Milton	Grant	Poland Spring (Poland)
Little Squaw	Minot	Norumbega (Brooksville)	Portage Lake
Littleton	Misery	Norway	Porter
Little W	Misery Gore	Oakfield	Portland
Livermore	Molunkus	Oakland	Pownal
Livermore Falls	Monhegan	Ogontz (Big W)	Prentiss Township
Lobster	Monmouth	Ogunquit	Prentiss Plantation
Locke Mills (Greenwood)	Monroe	Old Orchard Beach	Presque Isle
Long A	Monson	Old Town	Pretty Marsh (Mount Desert)
Long Pond	Monticello	Onawa (Elliottsville)	Princeton
Lovell	Montville	Oquossoc (Rangeley)	Prospect
Lowell	Moose River	Orient	Prospect Harbor
Lowelltown	Morrill	Orland	(Gouldsboro)
Lower Cupsuptic	Moro	Orneville	Quimby (Winterville)
Lower Enchanted	Moscow	Orono	Rainbow
Lubec	Mount Abram	Orrington	Randolph
Ludlow	Mount Chase	Orrs Island (Harpwell)	Rangeley
Lyman	Mount Desert	Osborn	Rangeley Plantation
Lynchville (Albany)	Mount Katahdin	Otis	Raymond
Lynchtown	Mount Vernon	Otisfield	Readfield
Machias	Moxie Gore	Otisfield Gore	Red Beach (Calais)
Machiasport	Naples	Owls Head	Redington
Macwahoc	Nashville	Oxbow Plantation	Reed
Madawaska	Nesourdnahunk	Oxbow Township	Richardsontown
Madison	Newburgh	Oxford	Richmond
Madrid	New Canada	Palermo	Ridlonville (Mexico)
Magalloway	Newcastle	Palmyra	Riley
Maine (Caribou)	Newfield	Paris	Ripley
Manchester	New Gloucester	Paris Hill (Paris)	Ripogenus Dam
Mapleton	New Harbor (Bristol)	Parkertown	(T3 R11 WELS)
Mariaville	New Limerick	Parlin Pond	Robbinston
Marion	New Meadows (Brunswick)	Parkman	Rockland
Marshfield	Newport	Parmachenee	Rockport
Mars Hill	New Portland	Parsonsfield	Rockwood Strip T1 R1
Masardis	Newry	Passadumkeag	Rockwood Strip T2 R1
Mason	New Sharon	Patten	Rome
Massachusetts Gore	New Sweden	Pejepscot (Topsham)	Roque Bluffs
Matinicus	New Vineyard	Pemaquid (Bristol)	Roxbury
Mattawamkeag	Nobleboro	Pembroke	Rumford
Mattamiscotis	Nobles Corner (Norway)	Penobscot	Rumford Center (Rumford)
Maxfield	Norridgewock	Perham	Rumford Corner (Rumford)
Mayfield	North Berwick	Perkins	Rumford Falls (Rumford)
Mechanic Falls	North Deer Isle (Deer Isle)	Perry	Rumford Point (Rumford)
Meddybemps	Northeast Carry	Peru	Russell Pond
Medford	Northeast Harbor (Mount	Phillips	Sabattus
Medway	Desert)	Phippsburg	Saco
Mercer	Northfield	Pierce Pond	Saint Agatha
Merrill	North Haven	Pittsfield	Saint Albans
Merrill Strip	North New Portland	Pittston	Saint Croix
Mexico	(New Portland)	Pittston Academy Grant	Saint Francis
Milbridge	North Paris (West Paris)	Pleasant Ridge	Saint George

Saint John	Squapan	Verona	Wyman
Saint John Plantation	Squaretown	Vienna	Wyttopitlock (Reed)
Salem	Stacyville	Vinalhaven	Yarmouth
Sandbar Tract	Standish	Wade	York
Sandwich Academy Grant	Starks	Waite	TA R2 WELS
Sandy Bay	Stetson	Waldo	TA R7 WELS
Sandy River	Stetsontown	Waldoboro	TA R10 WELS
Sanford	Steuben	Wales	TA R11 WELS
Sangerville	Stockholm	Wallagrass	TB R10 WELS
Sapling	Stockton Springs	Waltham	TB R11 WELS
Sargentville (Sedgwick)	Stoneham	Warren	TC R2 WELS
Scarborough	Stonington	Washburn	TD R2 WELS
Scotland (York)	Stow	Washington	TX R14 WELS
Searsmont	Stratton (Eustis)	Washington Township	T1 R6 WELS
Searsport	Strong	Waterboro	T1 R8 WELS
Seawall (Southwest Harbor)	Sullivan	Waterford	T1 R9 WELS
Sebago	Summit	Waterville	T1 R10 WELS
Sebec	Sumner	Wayne	T1 R11 WELS
Seboeis	Surry	Webbertown	T1 R12 WELS
Sedgwick	Swans Island	Webster	T1 R13 WELS
Seven Ponds	Sweden	Weld	T2 R3 NWP
Shapleigh	Talmadge	Wellington	T2 R4 WELS
Shawtown	Taunton and Raymond	Wells	T2 R8 WELS
Sherman	Academy Grant	Wesley	T2 R9 NWP
Shirley	Temple	West Bath	T2 R9 WELS
Sidney	The Forks	West Bethel (Bethel)	T2 R10 WELS
Silver Ridge	Thomaston	Westbrook	T2 R12 WELS
Skinner	Thorndike	Westfield	T2 R13 WELS
Skowhegan	Thorndike Township	West Forks	T3 IP
Small Point (Phippsburg)	Tibbettstown (Columbia	West Gardiner	T3 ND
Smithfield	Falls)	Westmanland	T3 R1 NBPP
Smyrna	Tim Pond	West Middlesex Canal Grant	T3 R3 WELS
Soldiertown	Tomhegan	Weston	T3 R4 BKP WKR
Solon	Topsfield	West Paris	T3 R4 WELS
Somerville	Topsham	Westport	T3 R5 BKP WKR (=Spencer
Soper Mountain	Trap Corner (West Paris)	Whitefield	Stream)
Sorrento	Tremont	Whiting	T3 R7 WELS
South Acton (Acton)	Trenton	Whitneyville	T3 R8 WELS
South Arm (C Township)	Trescott	Williamsburg	T3 R9 NWP
South Berwick	Trout Brook	Willimantic	T3 R10 WELS
South Bristol	Troy	Wilton	T3 R11 WELS
South China (China)	Turner	Windham	T3 R12 WELS
South Paris (Paris)	Union	Windsor	T3 R13 WELS
Southport	Unity	Winn	T4 IP
South Portland	Unity Township	Winslow	T4 ND
South Thomaston	Upper Cupsuptic	Winter Harbor	T4 R3 WELS
Southwest Harbor	Upper Enchanted	Winterport	T4 R5 NBKP
Spencer Bay	Upper Molunkus	Winterville	T4 R7 WELS
Spencer Stream	Upton	Winthrop	T4 R8 WELS
Spears Corner	Van Buren	Wiscasset	T4 R9 NWP
(West Gardiner)	Vanceboro	Woodland	T4 R9 WELS
Springfield	Vassalboro	Woodstock	T4 R10 WELS
Springvale (Sanford)	Veazie	Woodville	T4 R11 WELS
Squa Pan (Ashland)	Veazie Gore	Woolwich	T4 R12 WELS

Descriptive mineralogy of Maine minerals

T4 R13 WELS	T7 R19 WELS	T11 R3 NBPP	T15 R13 WELS
T4 R14 WELS	T7 SD	T11 R4 WELS	T15 R14 WELS
T4 R15 WELS	T8 R3 NBPP	T11 R7 WELS	T16 MD
T4 R17 WELS	T8 R3 WELS	T11 R8 WELS	T16 R4 WELS
T5 ND BPP	T8 R4 NBPP	T11 R9 WELS	T16 R5 WELS
T5 R1 NBPP	T8 R5	T11 R10 WELS	T16 R6 WELS
T5 R6 BKP WKR	T8 R6 WELS	T11 R11 WELS	T16 R8 WELS
T5 R7 BKP WKR	T8 R7 WELS	T11 R12 WELS	T16 R9 WELS
T5 R7 WELS	T8 R8 WELS	T11 R13 WELS	T16 R10 WELS
T5 R8 WELS	T8 R9 WELS	T11 R14 WELS	T16 R11 WELS
T5 R9 NWP	T8 R10 WELS	T11 R15 WELS	T16 R12 WELS
T5 R9 WELS	T8 R11 WELS	T11 R16 WELS	T16 R13 WELS
T5 R11 WELS	T8 R14 WELS	T11 R17 WELS	T16 R14 WELS
T5 R12 WELS	T8 R15 WELS	T12 R7 WELS	T17 R3 WELS
T5 R14 WELS	T8 R16 WELS	T12 R8 WELS	T17 R4 WELS
T5 R15 WELS	T8 R17 WELS	T12 R9 WELS	T17 R5 WELS
T5 R17 WELS	T8 R18 WELS	T12 R10 WELS	T17 R12 WELS
T5 R18 WELS	T8 R19 WELS	T12 R11 WELS	T17 R13 WELS
T5 R19 WELS	T8 SD	T12 R12 WELS	T17 R14 WELS
T5 R20 WELS	T9 R3 WELS	T12 R13 WELS	T18 ED
T6 ND BPP	T9 R4 WELS	T12 R14 WELS	T18 R10 WELS
T6 North of Weld	T9 R5 WELS	T12 R15 WELS	T18 R11 WELS
T6 R1 NBPP	T9 R7 WELS	T12 R16 WELS	T18 R12 WELS
T6 R6 WELS	T9 R8 WELS	T12 R17 WELS	T18 R13 WELS
T6 R7 WELS	T9 R9 WELS	T13 R5 WELS	T19 ED
T6 R8 WELS	T9 R10 WELS	T13 R7 WELS	T19 MD BPP
T6 R10 WELS	T9 R11 WELS	T13 R8 WELS	T19 R11 WELS
T6 R11 WELS	T9 R12 WELS	T13 R9 WELS	T19 R12 WELS
T6 R12 WELS	T9 R13 WELS	T13 R10 WELS	T21
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Note to readers: These indexed entries include some misidentified Maine "minerals." It is not a list of only correctly identified Maine species.

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