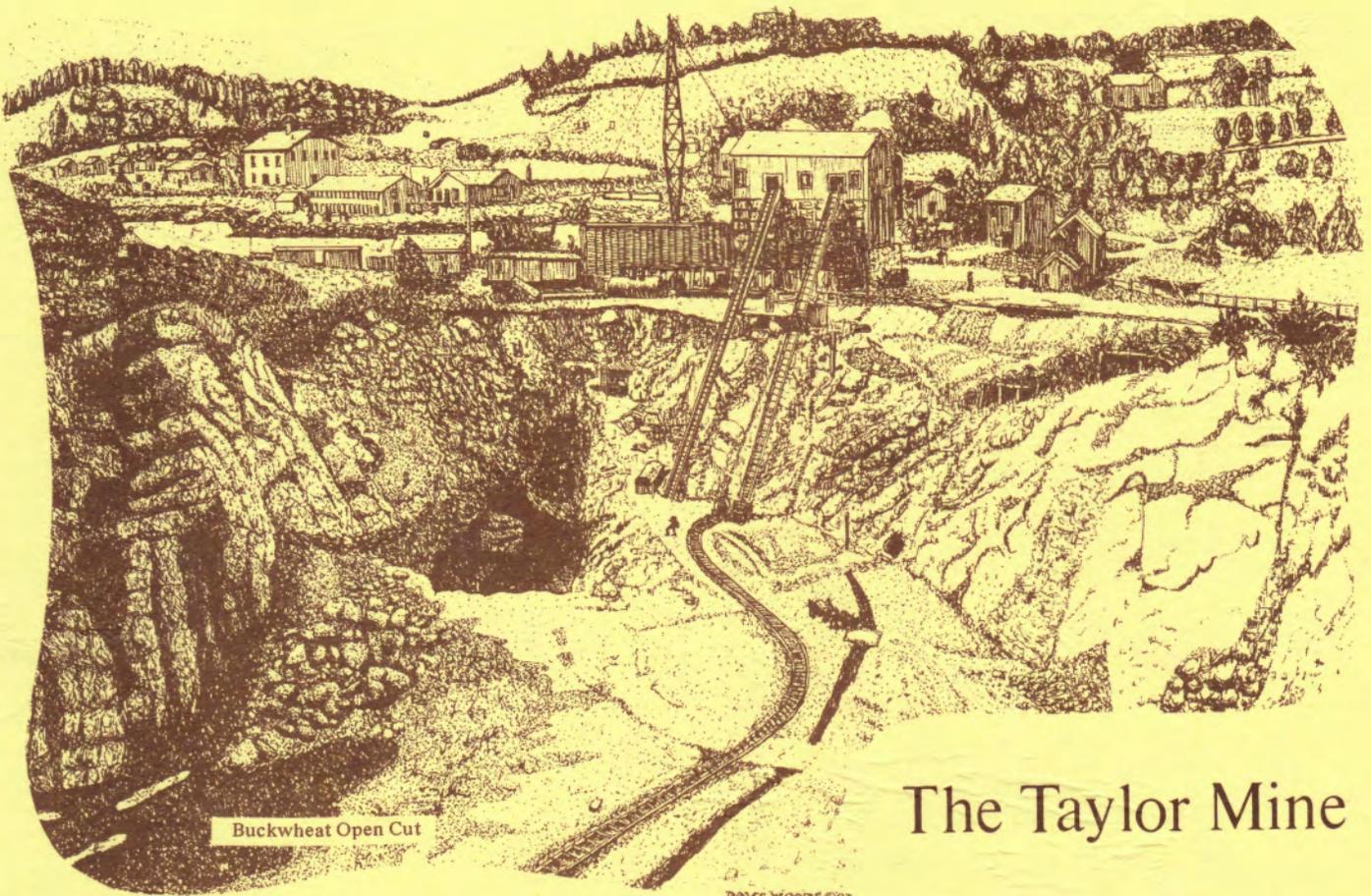


# THE PICKING TABLE



Buckwheat Open Cut

The Taylor Mine

DAVE WOODS ©83

Journal of the Franklin-Ogdensburg  
Mineralogical Society, Incorporated

Volume 24  
Autumn

Number Two  
1983

# from the Editor

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## 27th Annual FRANKLIN-STERLING HILL Mineral Show

The Franklin Show continues to demonstrate dramatic improvement as its popularity grows. The featured speaker of this year's show will be Professor Clifford Frondel of Harvard University, who will also be our guest speaker at our annual dinner Saturday evening.

Another highlight of this year's show will be an exciting gathering of mineral dealers from across the country, four of whom join the show for the first time.

## **FRANKLIN STERLING-HILL MINERAL SHOW**

AKE ANDERSON *Huntington, NY*  
ARTROX *El Paso, TX*  
AURORA MINERALS *Freeport, NY*  
LARRY CONKLIN *New York, NY*  
DAVID CRAWFORD *Rockford, IL*  
EXCALIBUR MINERALS *Dover, NJ*  
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GILMAN'S *Hellertown, PA*  
HOWARD MINERALS *Brooklyn, NY*  
JIM'S GEMS *Wayne, NJ*  
*The* LESNICK'S *Tucson, AZ*  
RON MARTIN *Willoughby, OH*  
MERKER'S MINERALS *Dayton, OH*  
*The* MINERAL SHOWCASE *Middletown, NY*  
RAINBOW GEMCRAFT *Richmond Hill, NY*  
ROBERTS MINERALS *Twain Harte, CA*  
*The* ROCKSMITHS *Tombstone, AZ*  
SCHMITZ LAPIDARY *Pompton Lakes, NJ*  
*The* SILVER PICK *Merrick, NY*  
UVP *San Gabriel, CA*

**SAT., OCT. 1,**

**SUN., OCT. 2,**

Tailgating at THE POND, again temporarily relocated at the Hardyston School grounds across from the National Guard Armory, returns. Here collectors have the opportunity to dispose of their excess specimens at a nominal fee to benefit the Franklin Mineral Museum.

## A SPECIAL WORD

In recent years the name Pete Dunn, of the Department of Mineral Sciences at the Smithsonian Institution, has become synonymous with Franklin and Sterling Hill, and for good reason. It is in large part, from here, that his remarkable scientific abilities have enabled him to vastly enlarge man's, and woman's, knowledge of mineralogy while contributing an unprecedented number of mineral species, new to science from these deposits.

Since our last issue we were very pleased to learn that Pete Dunn had successfully defended his thesis and has subsequently been awarded his Doctorate of Mineralogy.

On behalf of our members, officers and trustees, it is our particular pleasure to say,

Congratulations! Dr. Dunn.

## 25th ANNIVERSARY ISSUE

The Autumn 1984 issue of the *Picking Table* will appear shortly before the 25th Anniversary of our Society, which will actually coincide with the weekend of the Annual Franklin-Sterling Hill Mineral Show.

In order to commemorate the occasion, we are contemplating a special Anniversary issue.

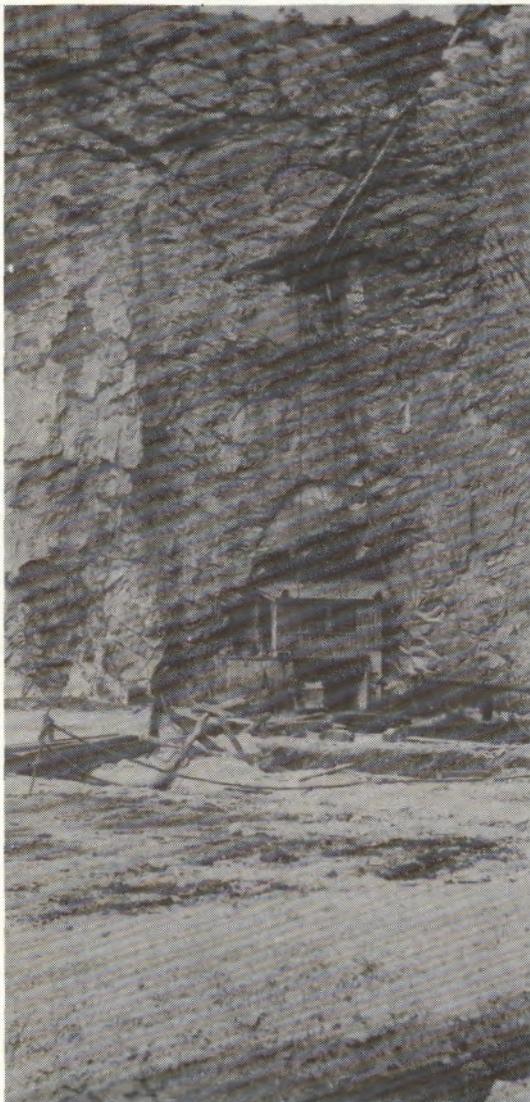
Work has already begun, slowly, and will soon hasten. We are in need of ideas, both practical and totally insane, in fact we may prefer the latter. Well developed articles are a must. We anticipate four to eight pages of color photography. Good photography, new and historical, along with period artwork will be invaluable. Most of all, we will need your assistance, so please volunteer or be drafted.

If you want it, we must do it together.

## A SIGNIFICANT REPRINT

With this issue, we include a reprint of an article on local mineralogy that was originally published in the May-June issue of the *Mineralogical Record*. We thank Dr. Wendell Wilson, Editor & Publisher of the *MR*, and Tom Peters, for consenting to our doing so. It should not be our habit to present such wholesale reprinting, however, to do less in this case would have represented a loss.

The PICKING TABLE is published semi-annually by the Franklin-Ogdensburg Mineralogical Society, Inc., P.O. Box 146, Franklin, NJ 07416; a non-profit educational organization. Editor - Bernard T. Kozykowski, 305 Avenue L, Matamoras, PA 18336. All rights reserved. Subscription: \$7.00 per year which includes membership in the Society. Contributed articles and news items are welcome. Acceptance is subject to the approval of the editor. ©



Adit to old Taylor Mine workings, through dike, showing ore contact with country rock, circa 1906.

# The PICKING TABLE

Journal of the Franklin-Ogdensburg Mineralogical Society, Incorporated



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# The TAYLOR Mine

by John L. Baum

---

The story of the Taylor mine, like those of the Trotter and Parker mines, is but a chapter in the chronicle of the Franklin, New Jersey ore body and its all encompassing Franklin mine. According to Charles T. Jackson, M.D. and geologist writing in Reports of the New Jersey Zinc Company, 1852, additional zinc ore had been recently discovered at Franklin in a buckwheat field a little to the east of the long observed ore vein which became the west vein. Indeed, the west or front vein had cropped out, boldly in places, and had been mined briefly many years before to supply zinc from zincite as Dr. Samuel Fowler's contribution to the U.S. Government's weights and measures in 1836 from a pit (Fig. 2) still to be seen in 1903 according to a term paper by Edgar Palmer at Princeton. Jackson further stated that this east vein was of unknown dimension, "only one place having been opened while I was on the spot."

A tunnel (Fig. 1) driven eastward from the Walkkill and now caved penetrated both veins leading to speculation that there were two independent veins. The tunnel encountered some spectacular gahnite crystals described by Brush in 1871 as referenced by Palache in his *Minerals of Franklin and Sterling Hill*. Surface excavation then proved the two veins to be connected by a northward plunging keel, the site of which is exposed across Evans Street from the Franklin Mineral Museum. On the surface, the east vein was traced some 600 feet to the great dike cutting the ore and yet visible at the far end of the open cut, beyond which the east vein's upward termination plunged to the north beneath the enclosing white marble. Workings in this east vein were early called the *Buckwheat* mine and subsequently the *Taylor* mine, according to Shuster in his *Historical Notes of the Iron and Zinc Mining Industry of Sussex County, New Jersey*.

Property ownerships covering the Franklin ore body were complicated by an erroneous observation made by Samuel Fowler who dealt them out. At Sterling there was

a rich zincite-franklinite band next to a franklinite-willemite band, and from a few exposures at Franklin it appeared that a similar case would hold at Franklin also. It was so in a few places but not widely. Not knowing this, Col.



Figure 1. Tunnel from Taylor mine to mine dump and Walkill River.

Samuel Fowler parcelled out iron (*franklinite*) rights and zinc (*zincite*) rights. Willemite was useless to Fowler; despite all efforts, it wasn't until 1866 that anyone got zinc out of willemite commercially. In the end of course willemite proved to be the most important commercial mineral in the district. In 1848 Col. Samuel Fowler deeded the zinc mining rights in southern Mine Hill to the ancestral New Jersey Zinc Company, including the area that was to become the later *Buckwheat* then *Taylor* mine.

Initial exploration indicated that there was a great deal of easily mined rich zincite-franklinite ore at surface at Sterling and so the New Jersey Zinc Company confined its early mining there.

In 1850, Col. Samuel Fowler deeded the franklinite and magnetite mining rights of southern Mine Hill and vicinity to the New Jersey Franklinite Company. Meanwhile, at its Newark, New Jersey plant, the New Jersey Zinc Company roasted zinc oxide for paint manufacture from the Sterling mine ore and smelted the resulting clinker to produce manganese-iron which was much in demand for its wear resistance. The New Jersey Franklinite Company adopted the New Jersey Zinc Company's roasting and smelting methods, so that in essence the New Jersey Zinc Company with its rich zinc ore was making a zinc oxide with an manganese-iron by-product, and the New Jersey Franklinite Company was trying to produce economically an iron-manganese product with a zinc by-product. Unfortunately for the New Jersey Franklinite Company, manganese-iron sold by the ton and zinc oxide by the pound, such being the values of the two products.

The two companies got along well together for a few years. The New Jersey Zinc Company made no protest concerning the New Jersey Franklinite Company's zinc by-product until the latter sought to sweeten its furnace feed with more zincite. The New Jersey Franklinite Company discovered an area on the west vein at Franklin high in zincite content, mining shifted to this *Southwest Opening* as it was called, and the New Jersey Zinc Company sued for use of its zinc rights. Weakened by its expenditures and unable to continue, in 1860 the New Jersey Franklinite Company was sold at Sheriff's sale and bought by a group of which Oakes Ames was a principal investor. Ames had been attracted to Franklin from Boston by Franklin's manganese-iron potential for use in his tool business and in 1853 he had put \$50,000 into the New Jersey Franklinite Company. He called the successor company the Boston Franklinite Company and vigorously fought the New Jersey Company claim. Ames won in the first court but on appeal by the New Jersey Zinc Company his defeat put the Boston Franklinite Company out of business on Mine Hill. To recover his investment as best he could, in 1863 Ames had the Sheriff sell the surviving rights and other equities of the Boston Franklinite Company. One Edward Miller bought these interests and shortly thereafter sold them to Oakes Ames who thus established complete ownership of whatever could be salvaged.

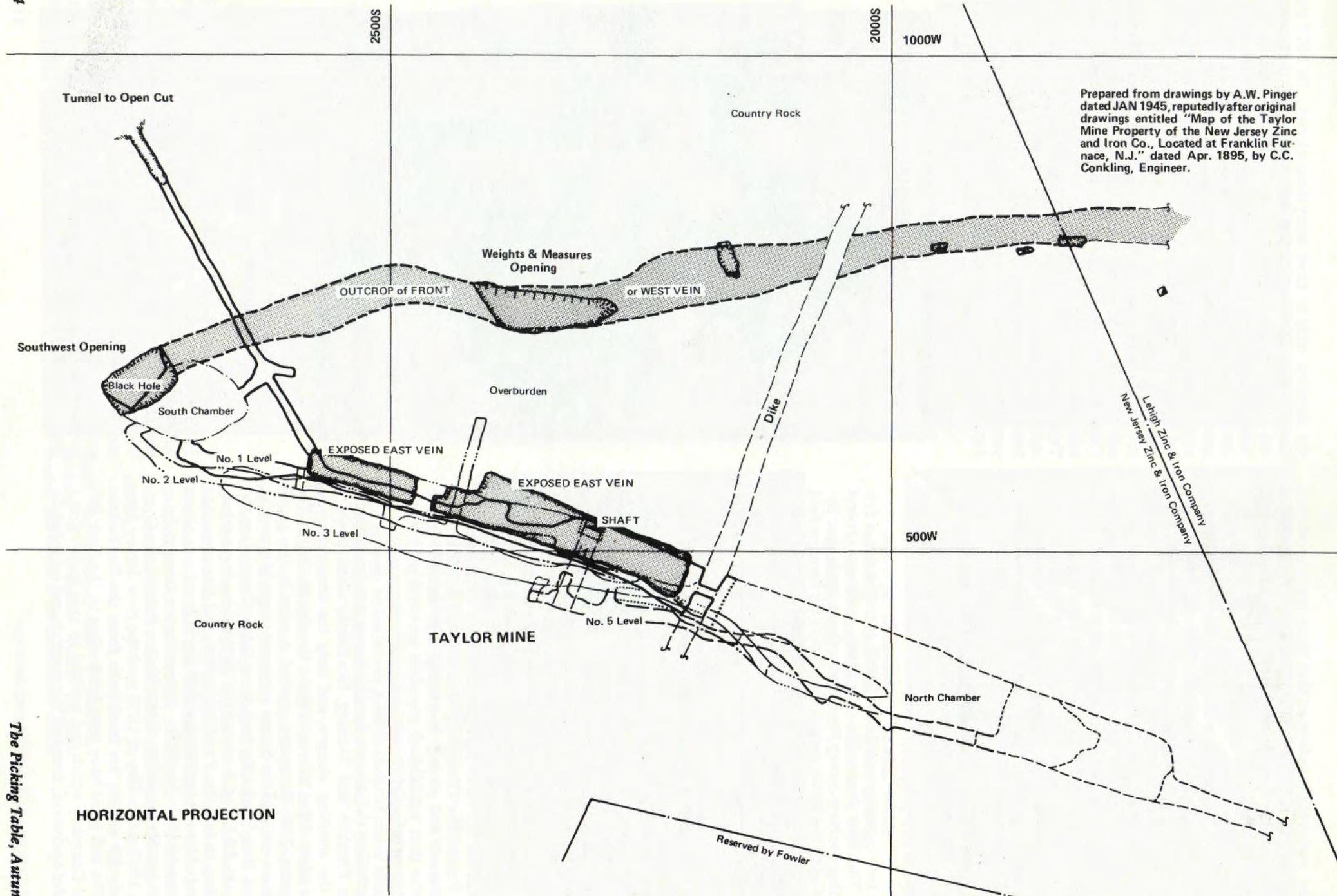
The shallow rich zincite-franklinite ore was running out at both Franklin and Sterling, franklinite alone was not worth the smelting charges, and only the discovery of a method of smelting willemite saved the day in 1866. The New Jersey Zinc Company opened a mine in the broad *Buckwheat* vein and the future appeared rosy. Meanwhile, out from New York City had come Moses Taylor (see the *PT*, 22, (2), 10-12, ed.), one of the sharpest business minds of the day, to buy the Franklin furnace and the magnetite vein, probably with knowledge that the railroad was about to be extended to Franklin. Moses Taylor bought from Oakes Ames the property of the Boston Franklinite Company in 1867 and in May of 1870 sued the New Jersey Zinc Company for mining his franklinite from the *Buckwheat* vein. The suit must have been frustrating to the New Jersey Zinc Company which had worked so long to develop a successful operation, doing all the research and establishing

the markets only to have everything at risk. In 1877 the Court ruled that following Col. Samuel Fowler's definition, the ore being mined was indeed not zinc ore, zincite not being a prominent constituent and willemite not being an ore of zinc to Fowler, nor was franklinite in 1848. Any more recent discoveries were ruled inadmissible. At the same time, the New Jersey Zinc Company was being sued by Samuel Wetherill over the New Jersey Zinc Company's use of Wetherill's furnace process. Because the value of the ore removed from the *Buckwheat* mine was over half a million dollars and because an appeal to the U.S. Supreme Court would require a deposit of several times that amount additional, the New Jersey Zinc Company accepted Moses Taylor's offer of a settlement. The number of Company shares was doubled, half going to Taylor, and he bought a few more to assure control and contributed \$100,000. The year was 1880, and the reorganized corporation the New Jersey Zinc and Iron Company.

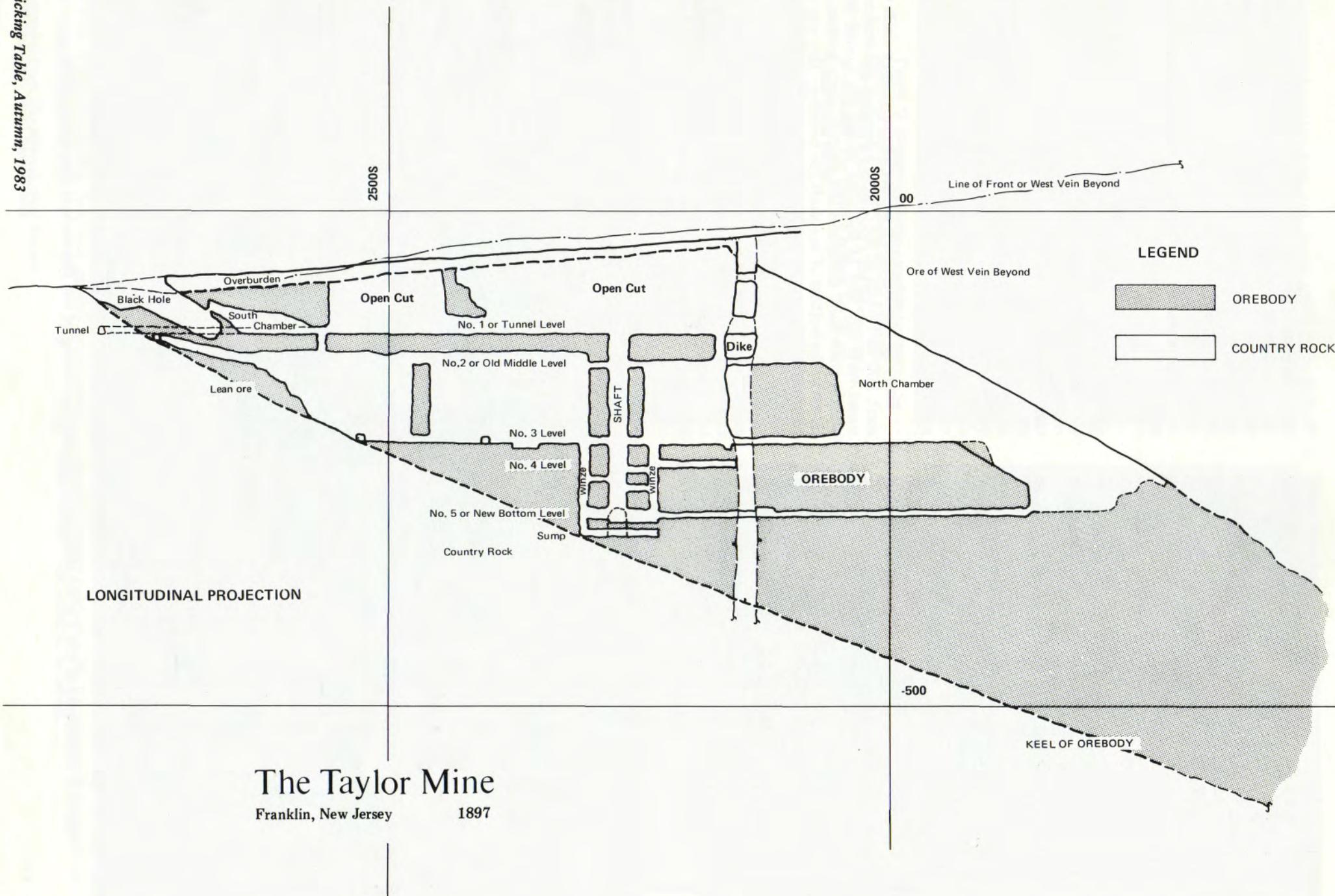


Figure 3. North face of Taylor mine at dike showing tunnels through to underground room beyond.

The *Buckwheat* mine, now the *Taylor* mine, started in 1866 or shortly thereafter in order to produce zinc from willemite and was developed initially from the surface, two elongated pits of unequal size, the more northern one being the longer, eventually being sunk to the level of the tunnel mentioned by Brush in 1871. The water level in the open cut today marks the level of the tunnel at an elevation above sea level of 522 feet. The tunnel west of the present pit is open for only a few feet, the remainder toward the



Prepared from drawings by A.W. Pinger dated JAN 1945, reputedly after original drawings entitled "Map of the Taylor Mine Property of the New Jersey Zinc and Iron Co., Located at Franklin Furnace, N.J." dated Apr. 1895, by C.C. Conkling, Engineer.



The Taylor Mine  
Franklin, New Jersey 1897



Figure 4. Taylor mine looking south.

Wallkill river being caved, but very early a large cast iron pipe was used to drain the *Taylor* mine and this now drains the abandoned workings of the Franklin mine, otherwise the open cut would overflow, its edge being the lowest surface point along the entire 4000 foot length of the now flooded Franklin mine. The water never freezes due to circulation below ground nor for the same reason does it ever get very warm. The tunnel was used for mule haulage of *Taylor* mine ore.

At the tunnel level a floor was left below which underground mining was carried out. Old pictures (Fig. 4) show this floor, the vertical walls of the two pits and the connecting tunnels. Safety conditions must have been hazardous because of the vertical rock walls; even recently since the Franklin mine closed and the pit flooded, neighbors could hear the splash as rocks fell from the walls into the water below. As a mineral locality the area may be noted as the source in 1874 of the species now known as *bostwickite* but erroneously described by Palache as *arseniosiderite*.

Early in the operation of the *Taylor* mine a shaft was sunk 100 feet south of the dike to a depth of 270 feet measured vertically and as the mine passed the tunnel level, winzes were sunk alongside the shaft to carry broken ore down to the bottom of the shaft for hoisting. Ore was not removed south of the dike below 195 feet by underground mining. As the northern pit was sunk, two successive tunnels were put through the dike to reach the ore beyond and an enormous room with a ceiling inclined northward was excavated. Dimensions of this room were formidable, its length being 400 feet on the incline and its height in places 100 feet or more (Fig. 2). Ultimately a quarry was established over the chamber for fill so that today a large area



Figure 5. Remnants of the Taylor mine, on right, during mining of the Buckwheat Open Cut, 1906.

open to the sky can be seen beyond the dike which itself was used for fill where convenient.

As an individual mine, the *Taylor* mine lost its identity with the consolidation of all mining interests on Mine Hill in 1897. Beginning in March of that year, stripping of earth overburden and the limestone was commenced between the two veins south of the dike, and thus was born the great open pit visible today. During the remainder of the year, over 100,000 tons of material were removed at a cost of over \$40,000, which brought a return of \$12,000 for limestone and ore recovered. As the pit grew even deeper in successive years (*Fig. 5*), the remnants of the old *Taylor* mine were consumed and the barren limestone was disposed of as furnace flux or was used as fill underground. Even-

tually, the entire keel of the ore body was cleaned out down to barren rock in a great pit nearly 350 feet deep, 600 feet long and 400 feet wide at the dike. As late as 1917 waste rock from this area was being used as fill in the open stopes of the mine to the north, as related in Haight and Tillson's *Zinc Mining at Franklin, N.J.*, in Bulletin 130 of the American Institute of Mining Engineers.

Thus was the *Taylor* mine consumed by twentieth century technology, but not before furnishing another chapter in local history.



*Figure 6.* The Buckwheat Open Cut showing mule wagons, inclined rail tram, aerial tram, and mill, 1906.

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**the Mineralogical Record**  
the bimonthly journal for mineral collectors

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*The Picking Table, Autumn, 1983*

# MINERAL NOTES

## New To Science

Scientific discovery continues to advance the number of known mineral species at a rapidly increasing pace. Franklin and Sterling Hill continue to be an important source of discovery for Dr. Pete J. Dunn of the Dept. of Mineral Sciences, Smithsonian Institution, Washington, DC, and his colleagues. Several new mineral species were announced by Dr. Dunn earlier this year, three of which follow. Subsequent to the publication of the describing papers, details will be abstracted in the *Picking Table*.

### KITTATINNYITE - formula in press.

"Kittatinnyite is a bright-yellow platy mineral associated with bostwickite. It is a very rare calcium-manganese silicate hydroxide hydrate from the Franklin Mine. Its name is derived from the algonquin word kittatinny, which means *endless hills*, an allusion to the topography of the Franklin area."

### WALLKILDELLITE - formula in press.

"Wallkilldellite is a dark-red platy mineral from Sterling Hill, related to kittatinnyite and is a calcium manganese arsenate hydroxide hydrate. It is exceedingly rare and the name is derived from the dell of the Wallkill River."

### LENNILENAPEITE - formula in press.

"Lennilenapeite is a black platy mineral from the Franklin Mine associated with nelenite, tirodite and rhodonite. It is the magnesium analogue of stilpnomelane and is named for the Lenni-Lenape Indians."

## New To The Deposit

### LAUMONTITE - $\text{CaAl}_2\text{Si}_4\text{O}_{12} \cdot \text{H}_2\text{O}$

by  
Fred J. Parker  
Linden, NJ

Laumontite is a member of the Zeolite Group whose structure is apparently not yet well-defined. Laumontite is meta-stable in atmospheric conditions as it tends to partially dehydrate to form leonhardite (starkeyite, *ed.*). Al-

teration causes the original laumontite to become chalky-white in color and crumbly.

Laumontite is commonly found as a late-stage species with other zeolites and associated minerals at Paterson, Prospect Park, and other New Jersey traprock locations; Nova Scotia; Poonah and Bombay, India, etc. The occurrence of large, well-formed crystals from the Pine Creek Mine at Bishop, California is unique.

An unusual specimen recently collected from the Sterling Mine in Ogdensburg, New Jersey, consisted of non-descript flattened radiating sprays of milky-white crystals not exceeding 2 millimeters. The matrix is an impure granular carbonate mineral. X-ray powder diffraction of a portion of the sample showed that it contained calcite and a series of peaks closely resembling that of the ASTM standard for labeled laumontite-leonhardite. The shift in the pattern was not intolerable in view of the metastability of laumontite. Table 1 gives the ten strongest peaks for the ASTM standard (15-276) and corresponding data from the Sterling Mine specimen. A crystal fragment was removed and shown by semi-quantitative EDAX analysis to contain Ca, Al and Si as major elements as well as a trace of iron. Gelatinization in HCL showed reaction typical for the zeolite. The sample was exposed to ultraviolet radiation, but no fluorescence was observed. Only one specimen was recovered, perhaps because its non-descript appearance did not make it an obvious collecting target.

Table 1. X-ray powder diffraction data.

ASTM 15-276		Sterling Mine Sample	
d(Å)	Intensity	d(Å)	Intensity (2)
9.49	100	9.70	vs
4.16	60	4.21	s
6.86	35	6.96	s
3.51	30	3.57	m
3.03	25	(1)	-
4.73	20	4.79	m-s
3.27	20	3.31	m
3.15	16	3.18	w-m
3.67	14	3.69	w-m
2.88	14	2.90	m

- (1) data unobtainable due to overlap with major calcite peak.  
(2) observed relative intensities are given as very strong - vs, strong - s, moderate - m, and weak - w.

Based upon the data provided, the author proposes that laumontite,  $\text{CaAl}_2\text{Si}_4\text{O}_{12} \cdot \text{H}_2\text{O}$ , be added to the list of verified mineral species from the Sterling Mine.

# Recent Discoveries

## A MAGENTA-FLUORESCING PEGMATITE from the Franklin Quarry, Franklin, New Jersey

by  
Philip P. Betancourt, PhD.  
143 Whitmarsh Way  
Delran, NJ

A small number of specimens from an interesting pegmatite were collected at the Franklin Quarry (*formerly the Farber Quarry*) on November 15, 1980, at the FOMS field trip. Since the stone had already been quarried and was only present as loose blocks, the minerals were not seen *in situ*. The primary minerals in the pegmatite are white feldspar (consisting of an intergrowth of microcline and albite), clear to smoky quartz, and phlogopite mica. The feldspar is of interest to collectors because it fluoresces magenta under shortwave ultraviolet light, much brighter in color than the red of some Franklin feldspar. No specimens were seen in later trips to the quarry.

Several different areas or zones were present in the pegmatite. The feldspar and quartz are sometimes in pure cleavages up to several inches across; in other specimens the quartz is in small smoky colored grains embedded within the feldspar, with the texture called "graphic granite." Occasionally the feldspar is fractured and altered, with veins of pyrite and later alteration products: goethite, hematite, and unidentified clay minerals. A rim of phlogopite is present at the contact with the Franklin Limestone (*Marble, ed.*) which enclosed the pegmatite, and phlogopite flakes also occur in seams in the pegmatite. A small amount of graphite is present in some specimens, and a few green fluorescent veins of a yet unidentified mineral are also present.

The different zones, which vary greatly in texture and size of crystals, suggest that a process called "retrograde boiling" may have played a role in the early stages of the pegmatite. This process was first investigated in detail by Jahns and Burnham (1969). Whatever the origin of the constituent minerals, the pegmatite would begin as a molten mass. As it cooled a fine grained rim would form, followed by fine grained quartz and feldspar. The crystallization of the quartz and feldspar would remove solid elements, leaving the melt with an increased percentage of water, causing it to boil. Since atoms can diffuse faster in a hydrous melt, the part of the pegmatite where the "retrograde boiling" took place would grow much larger crystals, with large cleavages of quartz and feldspar. The end result is a pegmatite with complex, different textured zones, with much fracturing as lighter and heavier areas were pushed about within the mass.

In the Franklin Quarry pegmatite the rock was subject

to later weathering as well. Pyrite probably entered the seams at some later period. The seams also admitted water, so that the pyrite is sometimes altered to goethite and other secondary minerals.

---

## References

JAHNS, R.H., and BURNHAM, C.W. (1969) Experimental Studies of Pegmatite Genesis: 1-A Model for the Derivation and Crystallization of Granitic Pegmatites, *Economic Geology*, **64**, 843-864.

## HERCYNITE - $\text{Fe}^{+2}\text{Al}_2\text{O}_4$

by  
Fred J. Parker  
Linden, NJ

Some outstanding hercynite specimens associated with euhedral norbergite crystals were collected during the June, 1983 Franklin-Ogdensburg Mineralogical Society field trip to the Limestone Products Corporation of America Quarry (*formerly the Farber quarry*) in Franklin, New Jersey. The boulder containing the crystals was found by Bob Bolton of Mendham, New Jersey. The dark reddish-brown to black crystals, to one-half inch diameter, were rarely found undamaged due to the brittle nature of the mineral. The matrix was a coarse white calcite with plates of phlogopite and remarkably well-formed norbergite crystals, some of which approached one inch in length.

The hercynite crystals were distorted or modified octahedra which made visual identification difficult. Crystal fragments were analyzed by X-ray diffraction and were shown to have a spinel structure. However, several members of the Spinel Group have similar X-ray diffraction patterns. Therefore, a fragment of the same crystal was analyzed semi-quantitatively by EDAX methods to determine the principle elements and, unambiguously identify the spinel in question. Resultant EDAX scans showed a major aluminum peak along with a large iron peak and a small zinc peak. Only a trace of magnesium was observed. Based upon the X-ray data and the recognition of iron and aluminum as the major cations, the identification of hercynite,  $\text{Fe}^{+2}\text{Al}_2\text{O}_4$ , was made.

Hercynite had previously been recognized as a valid species from Sterling Hill (Dunn, 1982) as tiny crystals associated with corundum and margarite in calcite. This find of large crystals, associated with well-formed norbergite crystals, was thought to be of enough significance to merit a separate documentation.

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## References

DUNN, P.J. and STURMAN, B.D. (1982) Retzian (Nd), a new mineral from Sterling Hill, New Jersey and a redefinition of retzian, *American Mineralogist*, **67**, 841-845.

# minerals of the Buckwheat Dolomite franklin, new jersey

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**T***he world famous zinc deposits of Franklin and Sterling Hill (Ogdensburg), New Jersey, have been the subject of intense scrutiny by scientists for almost two centuries. Most research has centered on the origin of the Franklin–Sterling Hill orebodies and the unique mineral assemblages contained within them. However, one aspect of Franklin mineralogy which has received scant attention is the occurrence of well crystallized minerals filling cavities in porous masses of dolomitic limestone.*

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## INTRODUCTION

Dolomite limestone occurred as replacement bodies in the marble of the Buckwheat open pit. Collectors refer to this material as “sugary dolomite” but for the purposes of discussion only, we prefer to use the name “Buckwheat dolomite.” Our usage is strictly informal. We will use the term Buckwheat dolomite as a field term with no formal stratigraphic nomenclature applicable.

This article documents the minerals found in this occurrence principally through the use of scanning electron microscopy (SEM). Identification of species was verified by X-ray diffraction (Gandolfi) techniques. Additional data were obtained using an electron microprobe equipped with an energy-dispersive spectrometer (EDS). An updated list of the species found in the Buckwheat dolomite is provided in Table 1.

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## GEOLOGY

The geology of the Franklin–Sterling Hill area was described by Spencer *et al.* (1908) in the Franklin Furnace Folio included in the *Geological Atlas of the United States*. A reproduction of Spencer’s Geologic Map of the Franklin Mining District appeared in Charles Palache’s monumental work *The Minerals of Franklin and Sterling Hill, Sussex County, New Jersey* (1935) and is reproduced here in Figure 1. (*Deleted from this reprinting, ed. PT*).

A glance at this map shows that the Franklin–Sterling Hill orebodies are located at the contact between the Precambrian Pochuk gneiss, now known as the Median gneiss, and the Franklin marble. The orebodies are entirely enclosed within the marble. Frondel and Baum (1974) state that the Franklin marble is part of a series of sedimentary rocks which were intensely folded and regionally metamorphosed to the sillimanite grade during the late Precambrian, about 950 million years ago. They describe the geologic structure of the area as essentially an overturned isoclinal fold and the orebodies as synclinal hooks or pendants. The

reprinted from *The Mineralogical Record*

Franklin marble and associated gneisses were intruded in later Precambrian time by post-metamorphic granitic and pegmatitic dikes. The Precambrian metamorphics are overlain to the west by the Cambrian Hardyston quartzite and the Ordovician Kittatinny limestone. The area was subject to faulting and minor folding in the Late Paleozoic and by the intrusion of basic igneous dikes (camp-tonite dikes on the map).

Very little information is available on the geologic setting of the Buckwheat dolomite alluded to in this study. Referring to the point on Spencer's map labeled No. 6, Palache (1935) states, "In the west wall of the Buckwheat open cut was exposed a veinlike mass of grey dolomite containing in its cavities crystals of quartz, dolomite, albite, sphalerite, pyrite, millerite and goethite." This occurrence was mined out prior to Palache's study, but large boulders of the dolomite can still be collected on the Buckwheat Dump.

### MINERAL DESCRIPTIONS

The following are brief descriptions of the species which occur in cavities in the dolomite. The purpose of this investigation was to ascertain the species present as well as produce photo-documentation of these species. Presented in Table 1 is a list of species reported from this occurrence by various authors as well as those identified during the course of this study. Of 41 previously reported minerals, we have confirmed 22 species, 4 of which were visually identified due to paucity of material for analysis. Comments regarding this discrepancy of numbers will be discussed following the mineral descriptions.



Figure 2. Albite twinned on the albite law. Colorless, 2 mm long.

#### Albite $\text{NaAlSi}_3\text{O}_8$

Albite occurs as colorless to white crystals, always twinned according to the albite law (Fig. 2). Associated species: quartz and microcline.

#### Anatase $\text{TiO}_2$

Only a single specimen of anatase is known from the Buckwheat dolomite. It consists of a dark blue crystal, approximately 0.5

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millimeters along [001], on dolomite. The specimen is in the collection of Ralph Thomas. Identification was visual. It should be stated that many purported anatase crystals which we have examined from the Buckwheat dolomite can be identified undoubtedly as brookite on the basis of crystal morphology. We have seen blue brookite crystals, so color is not diagnostic.

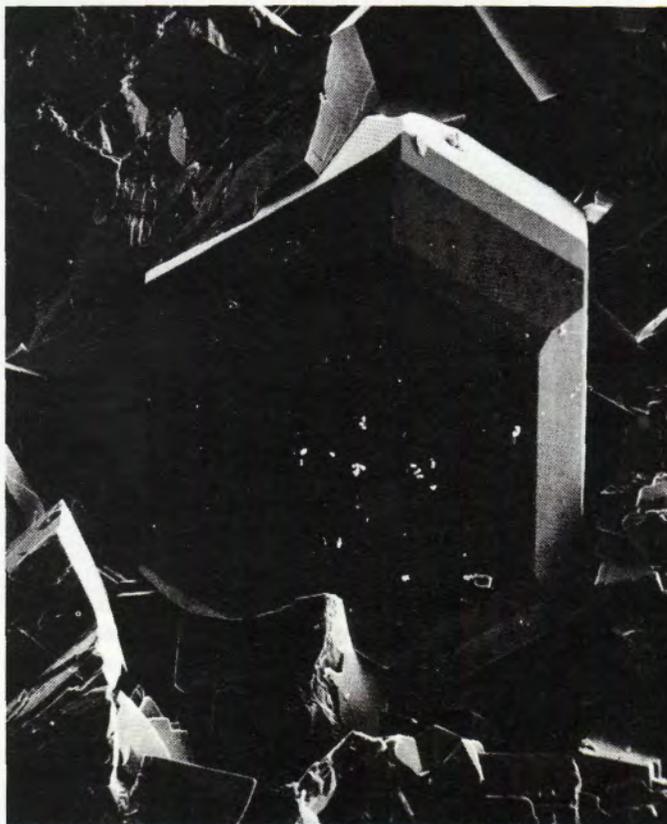
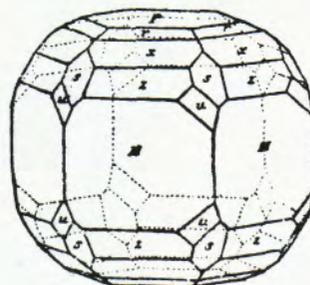


Figure 3. Apatite – tabular, hexagonal, colorless crystal, approximately 600 micrometers in diameter. Inset: crystal drawing exhibiting similar morphology (Goldschmidt, 1916–23).



#### "Apatite"

The exact species in the apatite group is unknown but is most probably fluorapatite,  $\text{Ca}_5(\text{PO}_4)_3(\text{F},\text{OH})$ . Palache (1935) reported the analysis of a Franklin apatite which is clearly fluorapatite. Apatite from the Buckwheat dolomite is found rarely as colorless to slightly pink to blue, tabular, hexagonal crystals. Associated species are usually chlorite in spherical aggregates and goethite needles enveloping rutile needles. Figure 3 shows a tabular crystal on dolomite.

#### Arsenopyrite $\text{FeAsS}$

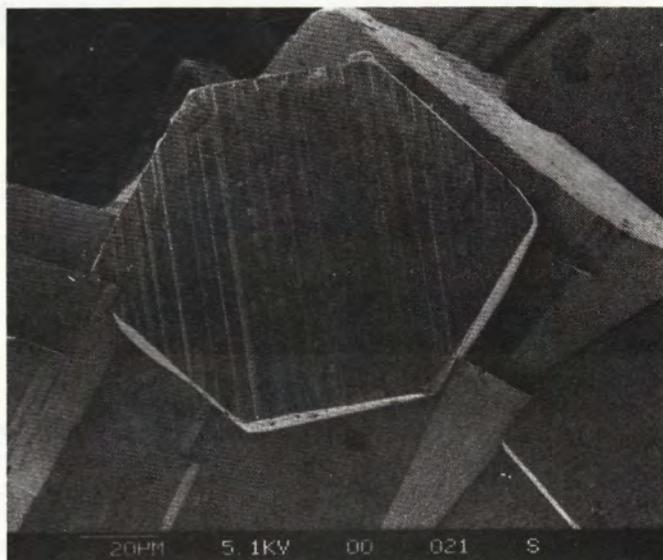
A prismatic crystal of arsenopyrite in dolomite was kindly provided for examination by Alice L. Kraissl. It is quite a rare occurrence. Identification was made visually.

#### Aurichalcite $(\text{Zn},\text{Cu})_5(\text{CO}_3)_2(\text{OH})_6$

Two specimens of aurichalcite are known, in the collections of Andrew Dilatush and Alice L. Kraissl. On both specimens the aurichalcite consists of extremely thin blue-green plates on dolomite. Due to the paucity of available material, only a visual identification could be made.



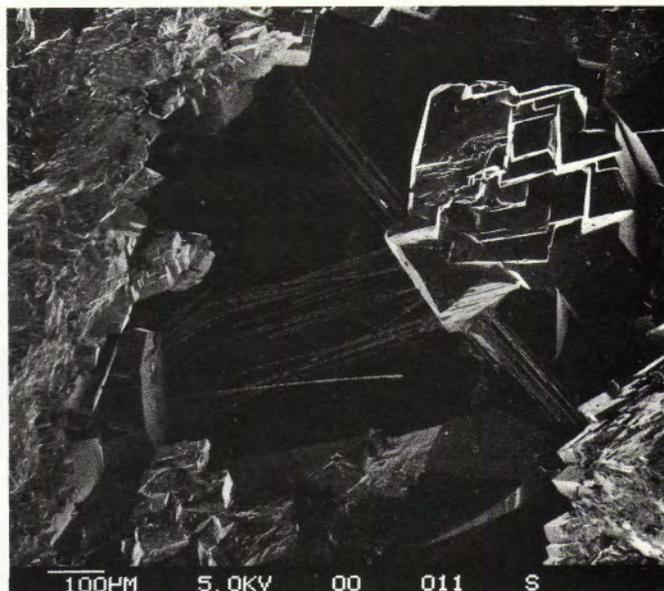
**Figure 4.** Brookite—two habits occur on this specimen. A preponderance of tabular, prismatic crystals up to 130 micrometers long with a few equant crystals in the lower right-hand corner.



**Figure 5.** Tabular, dark-brown brookite crystals exhibiting pseudo-hexagonal habit. The scale bar is 20 micrometers.

#### Brookite $\text{TiO}_2$

Brookite was first confirmed by Gordon (1951) on the basis of crystallographic measurements. He considered it quite rare. Recent collecting by Helen and Joseph Warinsky (Warinsky, 1979) has shown that brookite is not rare but only uncommon in occurrence. Because of the small crystal size (less than 0.5 mm) they are easily overlooked. They occur in black, brown, yellow, wine-red and dark blue crystals. The crystals are usually prismatic and striated (Fig. 4)

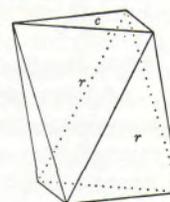


**Figure 6.** Brookite-rutile intergrowths, tabular brookite crystals nucleated around rutile needles. The scale bar is 100 micrometers.

but equant crystals are also known (Figs. 4 and 5). Much of the brookite is associated with its polymorph, rutile, in the form of needle-like crystals (Fig. 6). Although at some localities the polymorphs of  $\text{TiO}_2$  (namely rutile, brookite and anatase) have been found together on the same specimen, at Franklin only brookite and rutile are found to coexist. It is our observation that brookites are much more readily found in dolomite which is more weathered than the "normal" Buckwheat dolomite. This weathered dolomite is characterized by large amounts of green chlorite and goethite. Cavities in this type of material usually yield brookite as brilliant, opaque, black equant crystals. "Normal" Buckwheat dolomite which contains rutile needles and pink microcline crystals should also be carefully scrutinized for brookite.



**Figure 7.** Pseudo-octahedral crystals of calcite, 700 micrometers in diameter. The crystals are white in color. The octahedral aspect is the result of the combination of the rhombohedron and pinacoid. See inset (Palache, 1935).



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### Calcite $\text{CaCO}_3$

Calcite in dolomite cavities occurs in a myriad of crystal habits. Figure 7 illustrates crystals that resemble octahedrons but are actually a combination of the rhombohedron (6 faces) and the pincoid (2 faces) (Knoll, 1972). The two forms are nearly equal in their development, thus producing a pseudo-octahedron. These pseudo-octahedrons are almost always associated with graphite and dolomite. Calcite crystals are frequently found alone on dolomite rhombohedrons or commonly in pockets of dolomite rhombohedrons as disc-like crystals in which are included goethite sprays. Hemimorphite in radiating groups of platy crystals is also found in this assemblage.



Figure 8. Pseudo-hexagonal stacked plates of gray-green chlorite, 50 micrometers in diameter, with goethite needles.

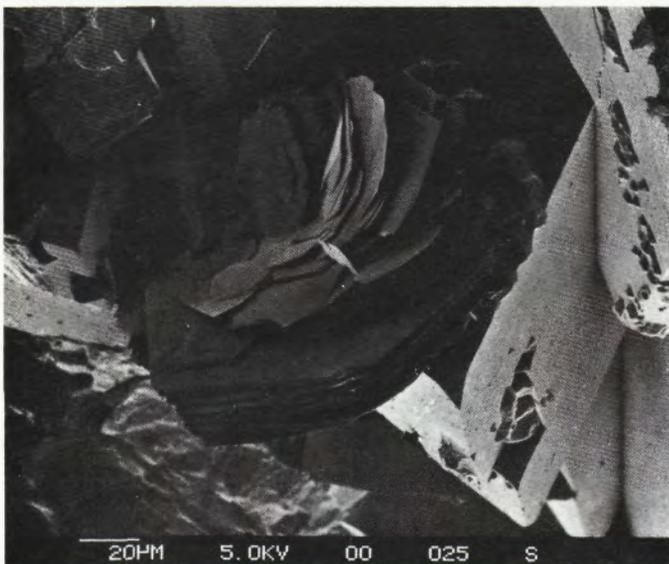


Figure 9. Chlorite, a rosette of intergrown, pseudo-hexagonal plates 100 micrometers in diameter.

### "Chlorite" complex iron-magnesium silicate

An unidentified member of the chlorite group is commonly found as exceedingly small, rosette-like aggregates of gray-green, pseudo-hexagonal plates (Figs. 8 and 9). Oxidation of the ferrous iron to the ferric state imparts a rusty, orange-brown color to some specimens. Typical associates include goethite, rutile, brookite, sphalerite, hemimorphite, calcite and quartz. Muscovite can easily

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Figure 10. Intergrown rhombohedrons of dolomite. Dolomite, usually white or colorless, is the host mineral upon which all other minerals crystallized. The scale bar is 40 micrometers.

be mistaken for chlorite, especially in assemblages containing brookite and rutile. The distinguishing factor is the stark white color of the thin muscovite flakes.

### Dolomite $\text{CaMg}(\text{CO}_3)_2$

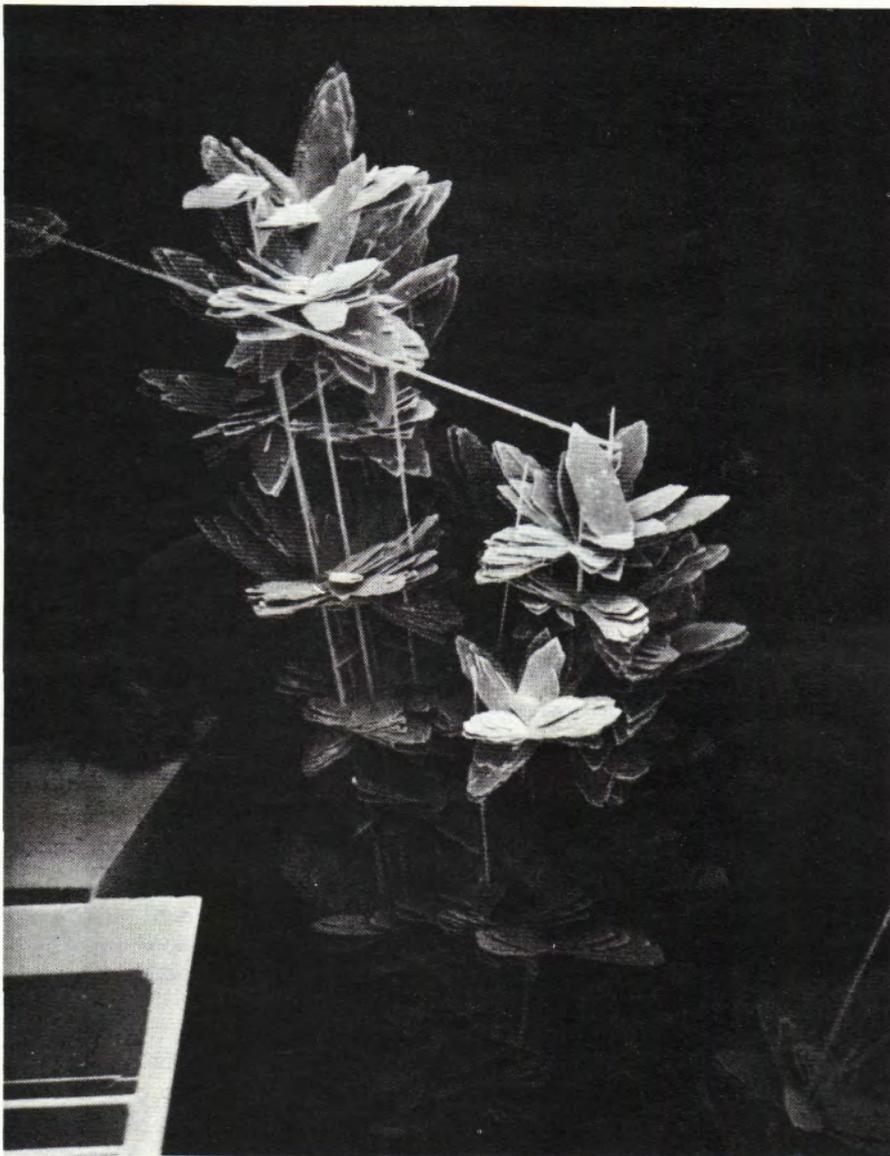
Dolomite crystals form the matrix for all of the species described here. While dolomite usually occurs as saddle-shaped, curved crystals, this is not the case at Franklin. Well-formed, isolated or step-like stacking of euhedral rhombohedrons are most commonly observed (Fig. 10).

### Fluorite $\text{CaF}_2$

We have found two specimens of fluorite. The first consists of a 1-millimeter transparent cube on dolomite in the collection of Andrew Dilatush. The second consists of 3- to 4-millimeter amethyst-colored crystals composed of the cube and hexoctahedron. This second specimen is in the Gerstmann Franklin Mineral Collection. Fluorite appears to be rare in the dolomite at Franklin.



Figure 11. Goethite—composed of slightly divergent platelets nucleated around rutile needles. Both species are perched on dolomite. The goethite is 120 micrometers in diameter. See inset (Goldschmidt, 1916-23).



**Figure 12.** Goethite — composed of light brown, divergent platelets nucleated on rutile. The rutile measures 600 micrometers long.

#### **Goethite** $\text{FeO}(\text{OH})$

Goethite occurs in a number of different habits: as slightly divergent platelets nucleated on rutile needles (Figs. 11 and 12), as radiating groups of bladed crystals forming around a sphere-like aggregate of hematite (Fig. 15), and as extremely fine, hair-like crystals surrounding a spherical hematite core (Fig. 14). Goethite is one of the most common minerals found in the dolomite.

#### **Graphite** C

Graphite crystals (sometimes pseudo-hexagonal in outline) are usually found in dolomite cavities without associated species; but quartz, hemimorphite, and pseudo-octahedral calcite are sometimes associated.

#### **Hematite** $\text{Fe}_2\text{O}_3$

Hematite most commonly occurs as spherules sprinkled on dolomite. The spherules are frequently surrounded by the hydration product, goethite. Hematite occurs uncommonly as isolated rosettes of platy crystals.

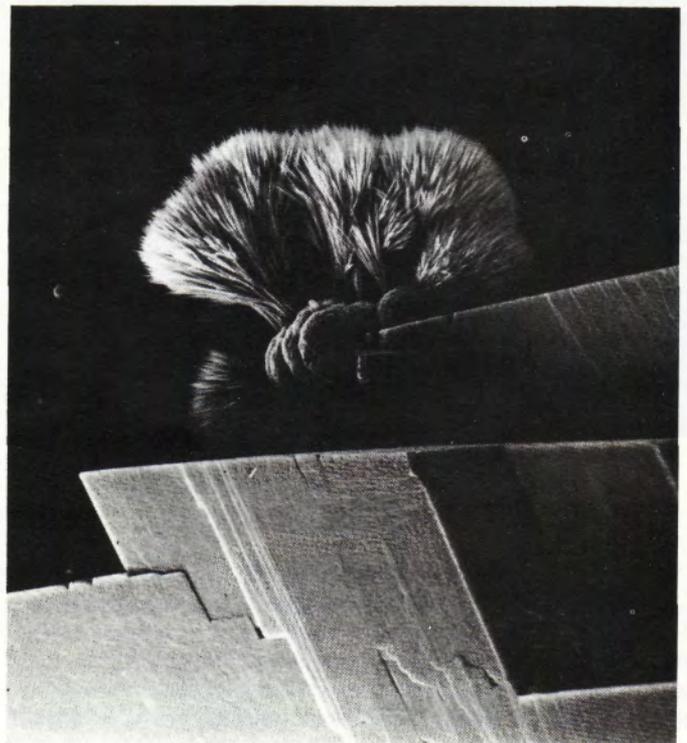
#### **Hemimorphite** $\text{Zn}_4\text{Si}_2\text{O}_7(\text{OH})_2 \cdot \text{H}_2\text{O}$

Hemimorphite typically occurs in radiating, divergent sprays of colorless, transparent crystals (Fig. 17). Only occasionally are isolated blades observed in which the hemimorphic nature is readily



**Figure 13.** Goethite — a radiating group of bladed crystals growing on a dolomite rhomb. The grouping is 200 micrometers in diameter.

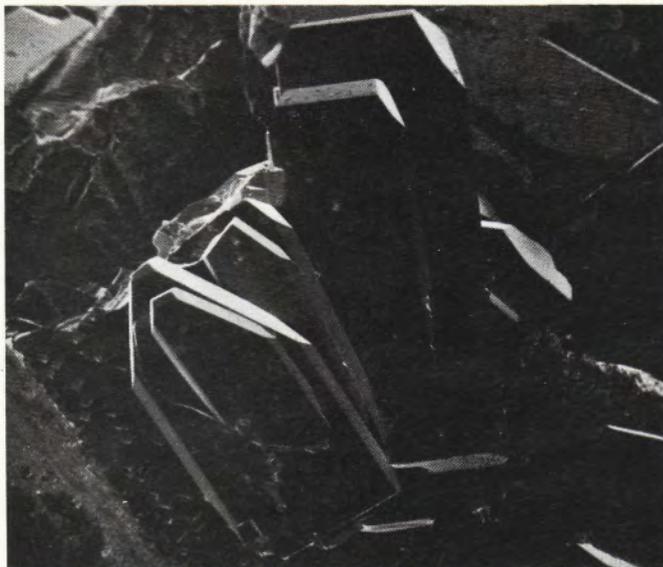
**Figure 14.** Goethite-hematite — a goethite spray composed of extremely fine, hair-like crystals, 100 micrometers in diameter, growing around a nucleus of botryoidal hematite (dark red to black).



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**Figure 15.** Goethite-hematite—goethite crystals somewhat coarser than those usually collected. The spherule is hematite and is 250 micrometers in diameter. The goethite crystals are 60 micrometers in length.



**Figure 16.** Hemimorphite—these hemimorphite crystals are notable in that their hemimorphic nature is readily apparent. These colorless crystals are a maximum of 350 micrometers long.

evident (Figs. 16 and 18). Associated species include sphalerite, quartz, chlorite and platy calcite crystals.

**Marcasite**  $\text{FeS}_2$

Marcasite is found in rosettes of pseudo-hexagonal platy crystals. Under high magnification an unknown mineral can be observed partially coating the crystals (Fig. 19). Marcasite is rather uncommon.

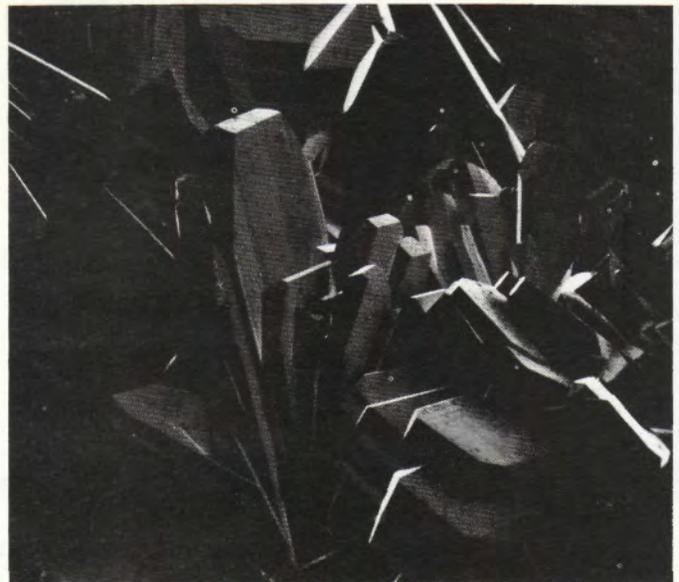
**Microcline**  $\text{KAlSi}_3\text{O}_8$

Microcline occurs in pink, parallel groupings of blocky crystals (Fig. 20). Associated minerals include sphalerite, rutile, brookite, quartz and albite.

**Muscovite**  $\text{KAl}_2\text{Si}_3\text{O}_{10}(\text{OH})_2$

Muscovite occurs as stark, snow-white, exceedingly thin plates coating cavities in dolomite. Associated minerals include rutile, brookite, sphalerite and pyrite.

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**Figure 17.** Hemimorphite—a divergent spray of bladed crystals. The longest is 700 micrometers.



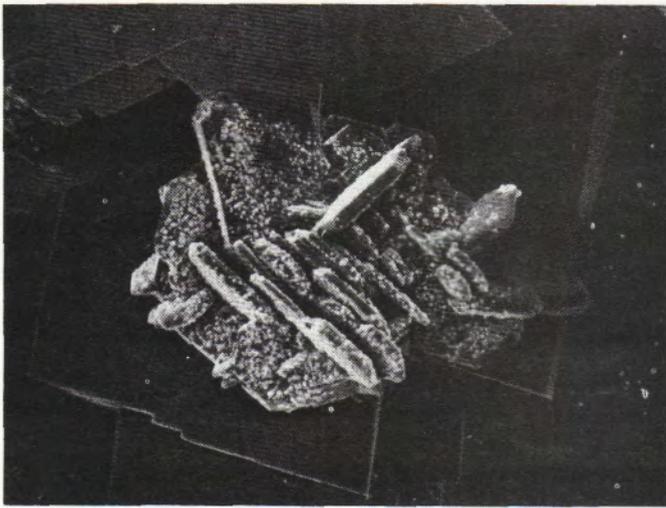
**Figure 18.** Hemimorphite—this crystal exhibits the hemimorphic symmetry. The crystal rests in "mountain leather." The exact mineralogical nature of this "mountain leather" has not been determined. The crystal is 15 micrometers long.

**Pyrite**  $\text{FeS}_2$

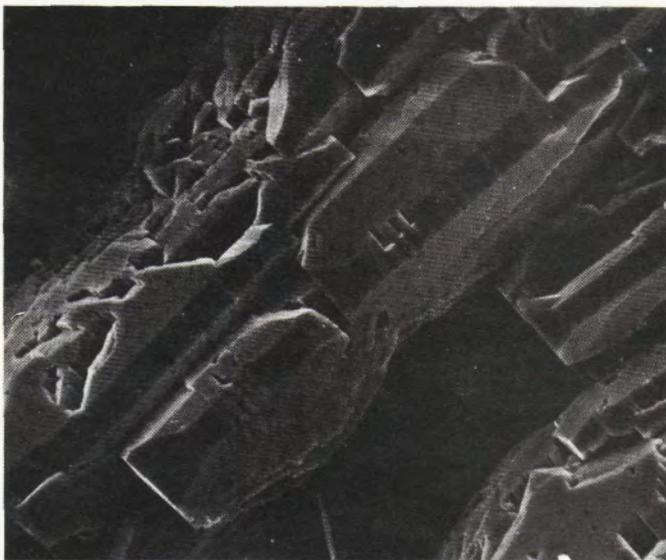
Pyrite is found as golden yellow crystals, frequently tarnished (in particular the pyritohedron face). They may be superficially altered to iron oxides (goethite and/or hematite). Crystal forms noted include the pyritohedron (with sphalerite), cube-pyritohedron, cube, dodecahedron (modified by the octahedron and trapezohedron) and octahedron. Of all the crystal forms noted, only the cube and pyritohedron occur on elongated crystals. Pyrite is almost always alone on dolomite, but may sometimes be found with sphalerite or quartz. Figures 21 through 24 illustrate the diversity of habits.

**Quartz**  $\text{SiO}_2$

Although quartz is one of the most common minerals found on earth, its occurrences at Franklin are limited primarily to the dolomite cavities, where it is quite common. Quartz is rarely found in the orebody. This species provides striking crystals, including some crystals with the rare "s" (11 $\bar{2}$ 1) faces (Fig. 25) and also beautiful rutilated quartz (Fig. 26). It is not unusual for some of the rutile needles in the quartz to be curved.



**Figure 19.** Marcasite—a parallel grouping of tabular plates of dark brown marcasite crystals with an unknown coating. The grouping is 160 micrometers in diameter.

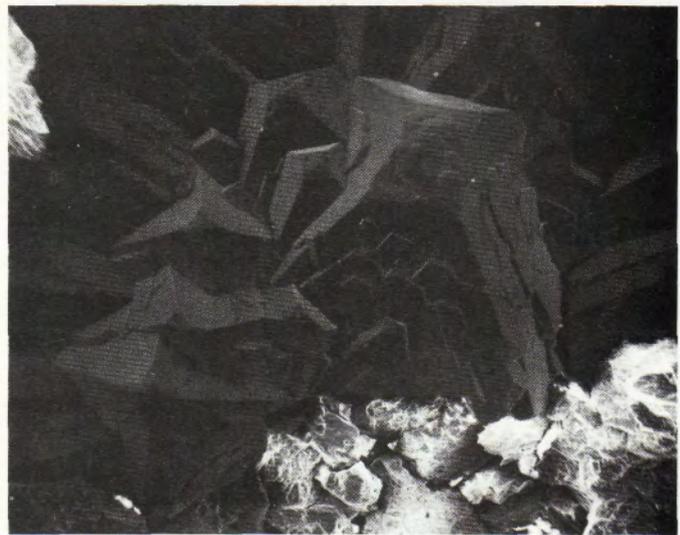


**Figure 20.** Microcline—a parallel grouping of microcline crystals. The crystals are pink and are approximately 10 micrometers long.

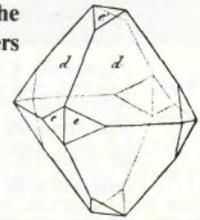
#### Rutile $\text{TiO}_2$

All metallic, radiating crystals found in the cavities, whether black, golden brass or bronze in color, have proven to be rutile, based upon X-ray diffraction examination of selected samples. No millerite has been verified from the dolomite cavities despite a careful search. Energy-dispersive analysis of rutile samples reveals, in addition to major titanium, small amounts (less than 1 percent by weight) of chromium. Rutile needles are usually terminated but the terminations are only visible at extremely high magnification (Fig. 28). Specimens containing rutile should always be carefully examined for the presence of its polymorph, brookite. Rutile apparently crystallized quite early in the sequence, as it usually is found not only directly upon but penetrating into the host dolomite. Quartz, smithsonite, brookite, goethite and muscovite are common associates.

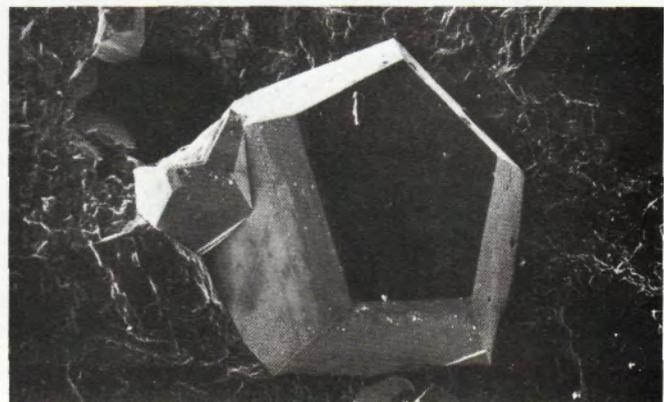
**Figure 23.** Pyrite—a pyritohedron. The crystal is 800 micrometers in diameter. See inset (Goldschmidt, 1916–23).

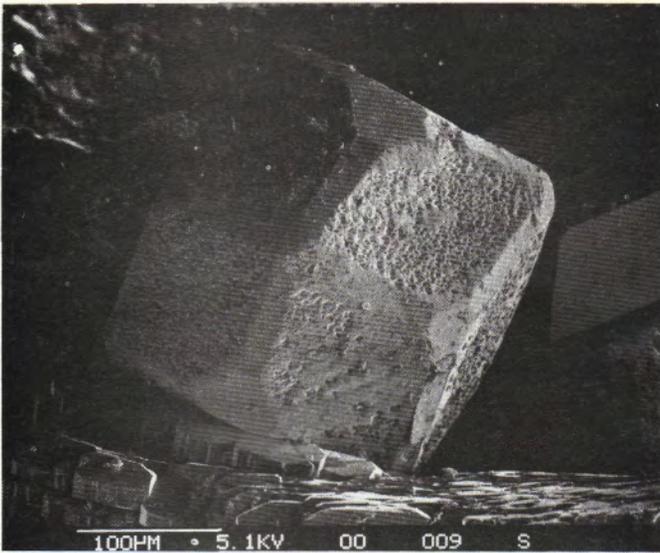


**Figure 21.** Pyrite—octahedron modified by the pyritohedron. The crystal is 500 micrometers across. See inset (Goldschmidt, 1916–23).

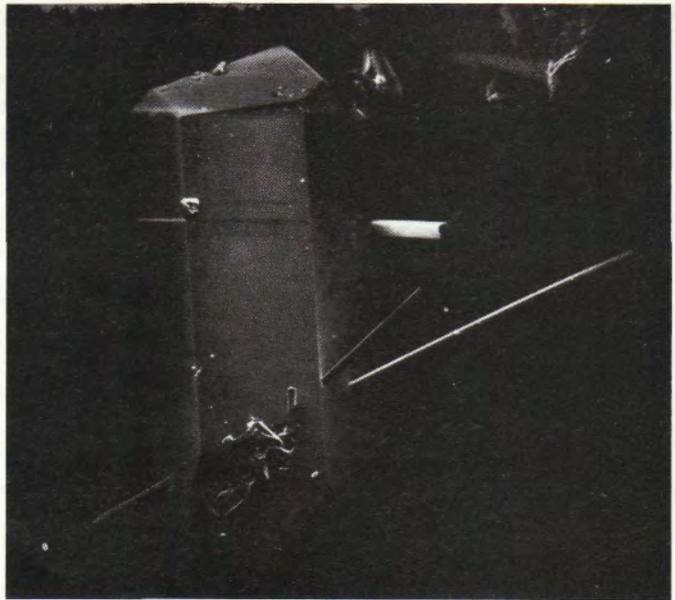


**Figure 22.** Pyrite—an intergrowth of two individuals. The crystals are dominantly octahedrons modified by the cube and dodecahedron. Crystals of this type are usually embedded in the edges of dolomite rhombohedrons.





**Figure 24.** Pyrite—a rare dominant form for pyrite is the dodecahedron. It shows octahedral and trapezohedral modification. The scale bar is 100 micrometers.



**Figure 26.** Quartz—doubly-terminated, prismatic quartz crystal with rutile inclusions (rutilated quartz). The quartz is 370 micrometers long.



**Figure 25.** Quartz—a typical prismatic crystal showing the *s* face (parallelogram) which is typical for specimens found in this dolomite. The quartz is 100 micrometers tall.

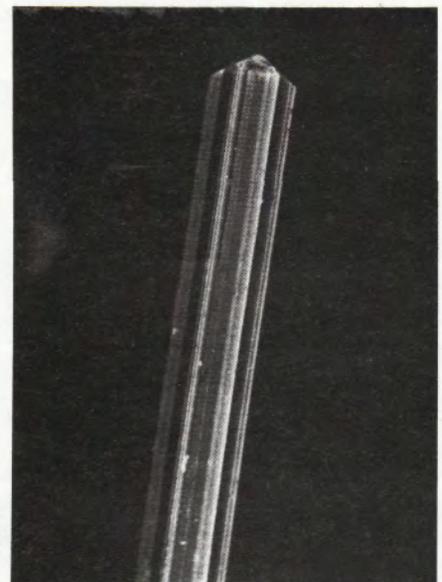


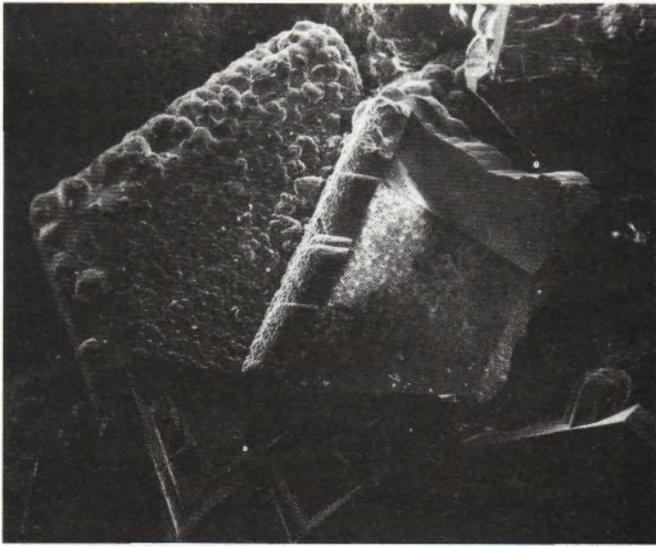
**Figure 27.** Smithsonite overgrowth on a quartz crystal. The quartz is approximately 1 mm in diameter.

**Smithsonite  $ZnCO_3$**

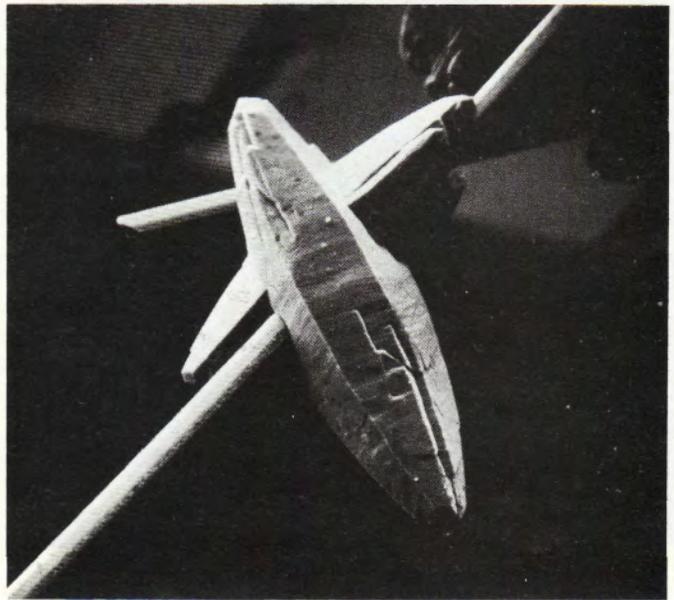
Smithsonite occurs in several different habits: (1) as “caps” or overgrowths on dolomite (Figs. 29 and 30) (the dolomite may break away, revealing a smithsonite mold or cavity after dolomite); (2) as rosettes or hexagonal single crystals growing around rutile needles (Figs. 31 and 32); and (3) as coatings completely covering and par-

**Figure 28.** Rutile—a terminated, prismatic black crystal of rutile. The rutile is 140 micrometers long.





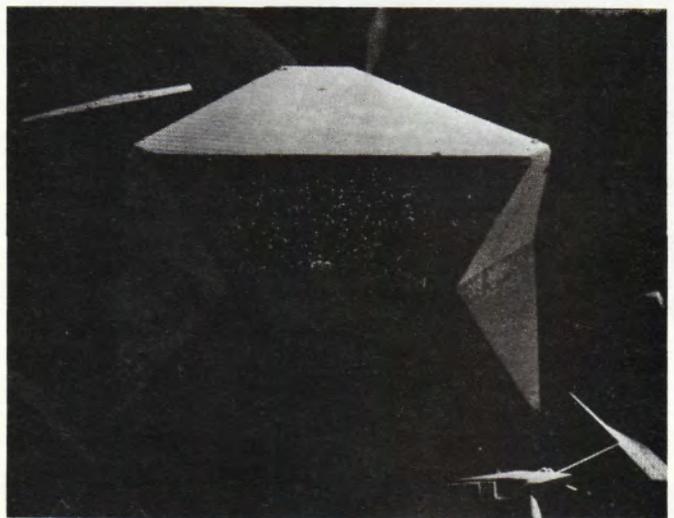
**Figure 29.** Smithsonite—smithsonite overgrowths on dolomite rhombohedrons. Illustrated here is a cavity after dolomite which formed when the dolomite core broke away. The smithsonite crystals are colorless and are 1 mm in diameter.



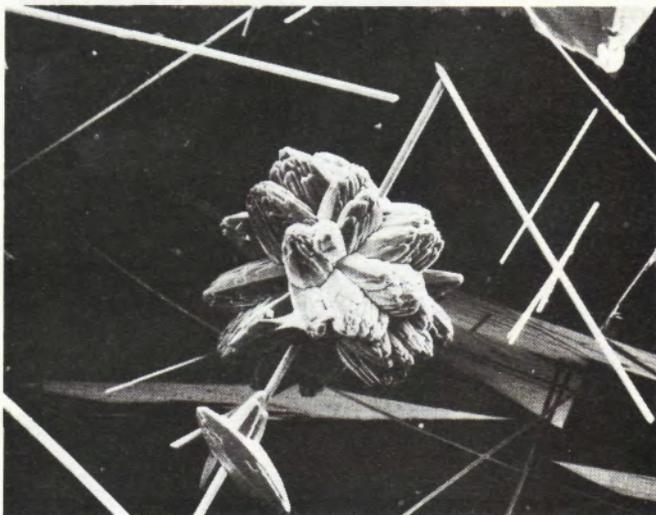
**Figure 32.** Smithsonite—a tapering, doubly-terminated crystal of smithsonite growing around a rutile needle. The smithsonite is 100 micrometers long.



**Figure 30.** Smithsonite—a parallel grouping of smithsonite in sheave-like aggregates as overgrowths on dolomite. Each smithsonite aggregate is 600 micrometers long.



**Figure 33.** Sphalerite—a spinel-law twin. The twin is 1.4 mm across.



**Figure 31.** Smithsonite-rutile—a rosette-like grouping of smithsonite crystals on rutile needles. The rosette is 130 micrometers across.

tially replacing crystals of sphalerite. This alteration is only a thin veneer, however; broken crystals reveal an unaltered core of sphalerite. Smithsonite is also observed as an overgrowth on quartz (Fig. 27).

#### **Sphalerite ZnS**

Sphalerite is considered to be one of the most esthetic species to be found in this occurrence. It is of particular interest mineralogically as well, because it commonly exhibits vivid spinel-law twinning, sometimes in complex groupings. It is found in light to dark brown, orange, reddish orange, oil-green and almost black single or twinned crystals up to 5 mm. Sphalerite has been found as cavernous crystals; others have been collected that are round due to partial dissolution. Associated species are dolomite, quartz, rutile, pyrite, microcline, brookite, calcite and hemimorphite (see Figs. 33 and 34).

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Figure 34. Sphalerite—a complex, multiply twinned fowling of sphalerite crystals, twinned by the spinel law. The largest plate is 2 mm wide.

#### COMMENTS

Table 1 presents an attempt to collate all previous lists of Buckwheat dolomite minerals in order to compare and contrast them with the results of this study. It lists all minerals previously listed from the Buckwheat dolomite, and also the authors of each list. We report 18 X-ray verified species as well as an additional 4 identified visually. Of the additional 19 species cited in the literature, we feel that six (barite, celestite, greenockite in massive coatings, gypsum, stilpnomelane and talc) are likely future additions to our list. All of these minerals have been found in other assemblages within the deposits. The remaining 13 minerals seem doubtful for the following reasons: anglesite is unlikely to be found due to the absence of galena; bornite and chalcopyrite are unlikely because of a decided lack of availability of copper; heulandite and stilbite are probably misidentifications of the mineral hemimorphite; orthoclase is likely misidentified microcline; millerite has been diligently searched for and has yet to be verified; siderite seems unlikely due to the fact that the carbonates appear in large quantities as the minerals dolomite and calcite; finally ilmenite, manganite, pyrrhotite and zircon are unlikely on the basis of chemistry and mineralogical environment.

#### CONCLUSION

Extremely well-crystallized, millimeter-sized minerals are currently available on the Buckwheat dump, located on Evans Road in Franklin, Sussex County, New Jersey. Once the collector is familiar with the Buckwheat dolomite, he can easily collect a sackful of material which can later be taken apart to find exquisite minerals tucked away in hidden cavities. The reader is urged to visit the Franklin-Kiwanis Mineral Museum on Evans Road, where a fee of \$1.50 is charged to collect on the dumps. A tour of the museum and its mine replica will be very rewarding. The museum is open to the public on Fridays and Saturdays from 10 a.m. to 4 p.m. and Sundays from 12:30 to 4:30 p.m. Summer hours are Wednesday through Sunday. It closes for the season on November 15th. In addition, a visit to the Gerstmann Franklin Mineral Museum, located at 14 Walsh Road (near Franklin High School), will provide additional mineralogical pleasures.

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Table 1. Minerals occurring in dolomite veins, Franklin, New Jersey.

Species	Palache (1935)	Gordon (1951)	Fronzel (1972)	Thomas (1967)	Kraissl (1979)	Present Study
Albite	X	X	X	X	X	X
Anatase			X			X
Anglesite				X		
"Apatite"		X		X		X
Arsenopyrite					X	X
Aurichalcite					X	X
Barite				X		
Bornite				X		
Brookite			X	X	X	X
"Byssolite"				X		
Calcite	X	X		X		X
Celestite				X		
Chalcopyrite				X	X	
"Chlorite"				X	X	X
Dolomite	X	X	X	X	X	X
Fluorite						X
Goethite	X		X	X	X	X
Graphite			X	X	X	X
Greenockite				X		
Gypsum				X		
Hematite	X		X	X	X	X
Hemimorphite		X		X	X	X
Heulandite			X	X		
Ilmenite				X		
Manganite				X		
Marcasite	X				X	X
Microcline					X	X
Millerite	X	X	X			
Muscovite						X
Orthoclase		X				
Pyrite		X	X	X	X	X
Pyrrhotite				X		
Quartz	X	X		X	X	X
Rutile			X	X	X	X
Siderite				X		
Smithsonite					X	X
Sphalerite	X	X	X	X	X	X
Stilbite			X	X		
Stilpnomelane				X	X	
Talc				X	X	
Zircon			X	X		

#### ACKNOWLEDGMENTS

We take this opportunity to thank our colleagues, Russell Titus of the Paterson Museum; George Harlow of the Department of Mineral Sciences of the Museum of Natural History, New York; and Pete Dunn of the Department of Mineral Sciences, United States National Museum of Natural History, Washington, D.C., for critical reviews.



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1983

Regular Society activities consist of field trips, micro-mineralogy study sessions, and lecture programs. Field trips vary as to time and location according to schedule. Morning micro-mineralogy study sessions take place from 10:00 a.m. to noon in Kraissl Hall at the Franklin Mineral Museum. Afternoon lecture programs begin at 2:00 p.m. at the Hardyston Township School, Route 23, Franklin, New Jersey. Pre-meeting activities begin at 1:00 p.m. - Lectures open to public.

Saturday  
**September 17, 1983** FIELD TRIP: Trotter Mineral Dump - Main Street, Franklin, NJ - 9:00 a.m. to noon.  
MICRO-GROUP: Kraissl Hall - Franklin Mineral Museum, Franklin, NJ - 10:00 a.m. to noon.  
LECTURE: **Bill Butkowski**

Saturday  
**October 1, 1983** ANNUAL DINNER of the Franklin-Ogdensburg Mineralogical Society, Inc. - The *GLENWOOD* Inn, Rt. 23 North, Sussex, New Jersey - Social Hour begins at 6:30 P.M. - Guest Speaker - Prof. **CLIFFORD FRONDEL**, *Harvard University* - Reservations are Requested - Prime Rib Dinner \$15.50 - Turkey Dinner \$13.00 - contact Mrs. Helen U. Warinsky, 695 Suffern Road, Teaneck, NJ 07666 - (201) 836-4048

Saturday and Sunday  
**October 1 & 2, 1983** 27th ANNUAL FRANKLIN-STERLING HILL MINERAL SHOW - This is IT! The best in the EAST - sponsored by the *Kiwanis Club of Franklin* - at the National Guard Armory, Route 23, Franklin, NJ - 9:00 a.m. to 6:00 p.m. Saturday; 10:00 a.m. to 5:00 p.m. Sunday - Admission: Adults \$2.00, Children \$1.00. - Fabulous Exhibits - Mineral Dealers from Across the Country - Guest Speaker: Prof. **CLIFFORD FRONDEL**, *Harvard University* - Mineral Collecting, and more.

Saturday and Sunday  
**October 1 & 2, 1983** THE *Dry POND* - The Legendary Mineral Collectors Meet at Franklin - sponsored by the *Franklin-Ogdensburg Mineralogical Society, Inc.* to benefit the Franklin Mineral Museum - Opposite the National Guard Armory, Route 23, Franklin, NJ - 9:00 a.m. to 5:00 p.m. Saturday; 10:00 a.m. to 4:00 p.m. Sunday - contact: Mrs. Elna Hauck, 8 Rowe Pl., Bloomfield, NJ - (201) 743-1030

Saturday  
**October 15, 1983** FIELD TRIP: Rudeville Quarry - Quarry Rd. (off Rt. 517), Franklin, NJ - 9:00 a.m. to noon.  
MICRO-GROUP: Kraissl Hall - Franklin Mineral Museum, Franklin, NJ - 10:00 a.m. to noon.  
LECTURE: to be announced.

Sunday  
**October 16, 1983** FIELD TRIP: Limecrest Quarry - Limecrest Rd. Sparta, NJ - 9:00 a.m. to 3:00 p.m.

Saturday  
**November 19, 1983** FIELD TRIP: Franklin Quarry (formerly Farber) - Cork Hill Rd., Franklin, NJ - 9:00 a.m. to noon.  
MICRO-GROUP: Kraissl Hall - Franklin Mineral Museum, Franklin, NJ - 10:00 a.m. to noon.  
LECTURE: to be announced.

**MEMBERSHIP FORM**

**New Membership or Renewal**

I would like to (apply for/renew my) membership in the Franklin-Ogdensburg Mineralogical Society, Inc. Individual membership payment in the amount of \$7.00 is enclosed or Family membership payment in the amount of \$10.00 is enclosed. It is understood that family membership permits family participation in all Society activities. Receipt of the Picking Table is understood to be limited to one copy per family.

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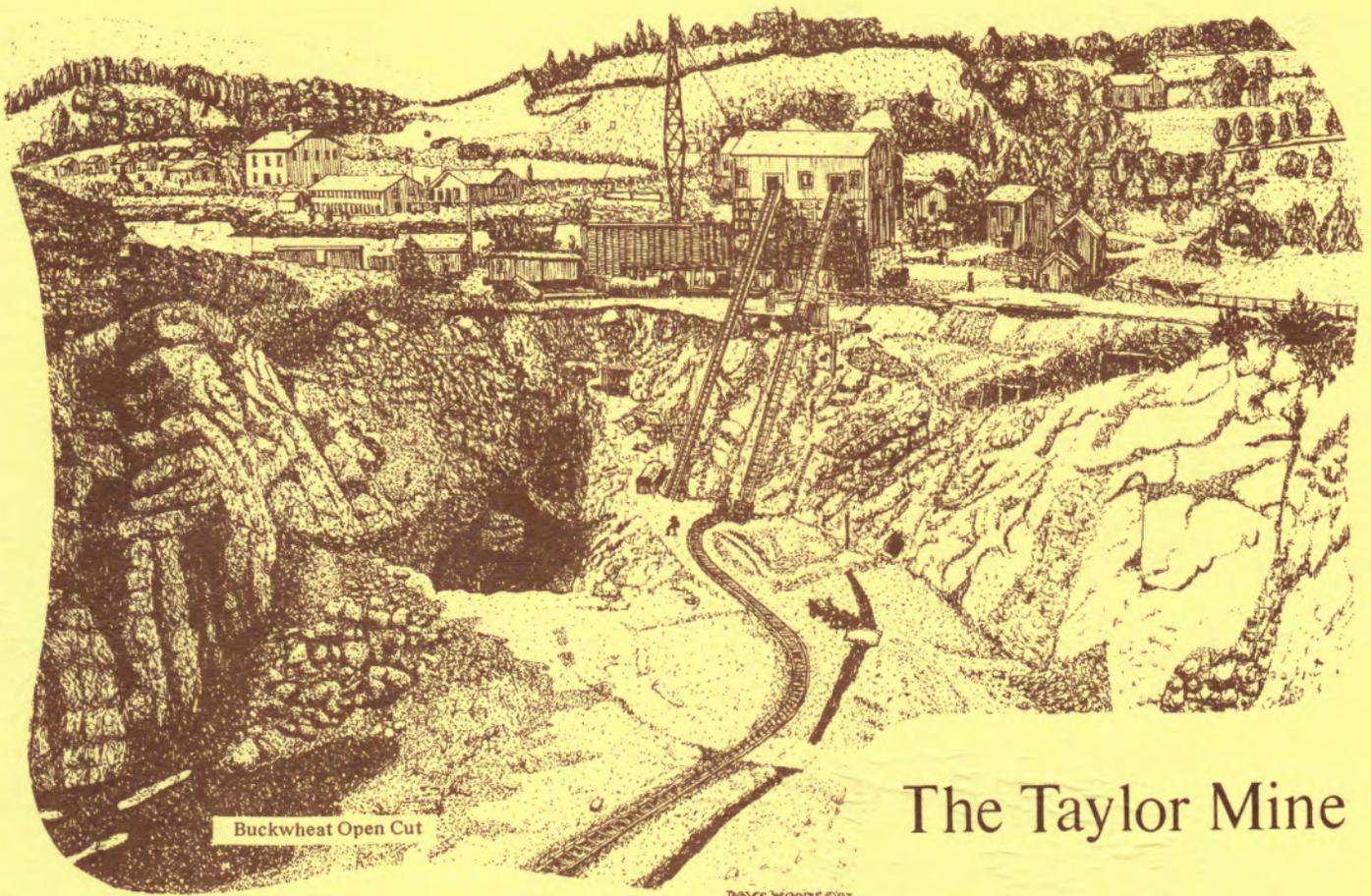
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