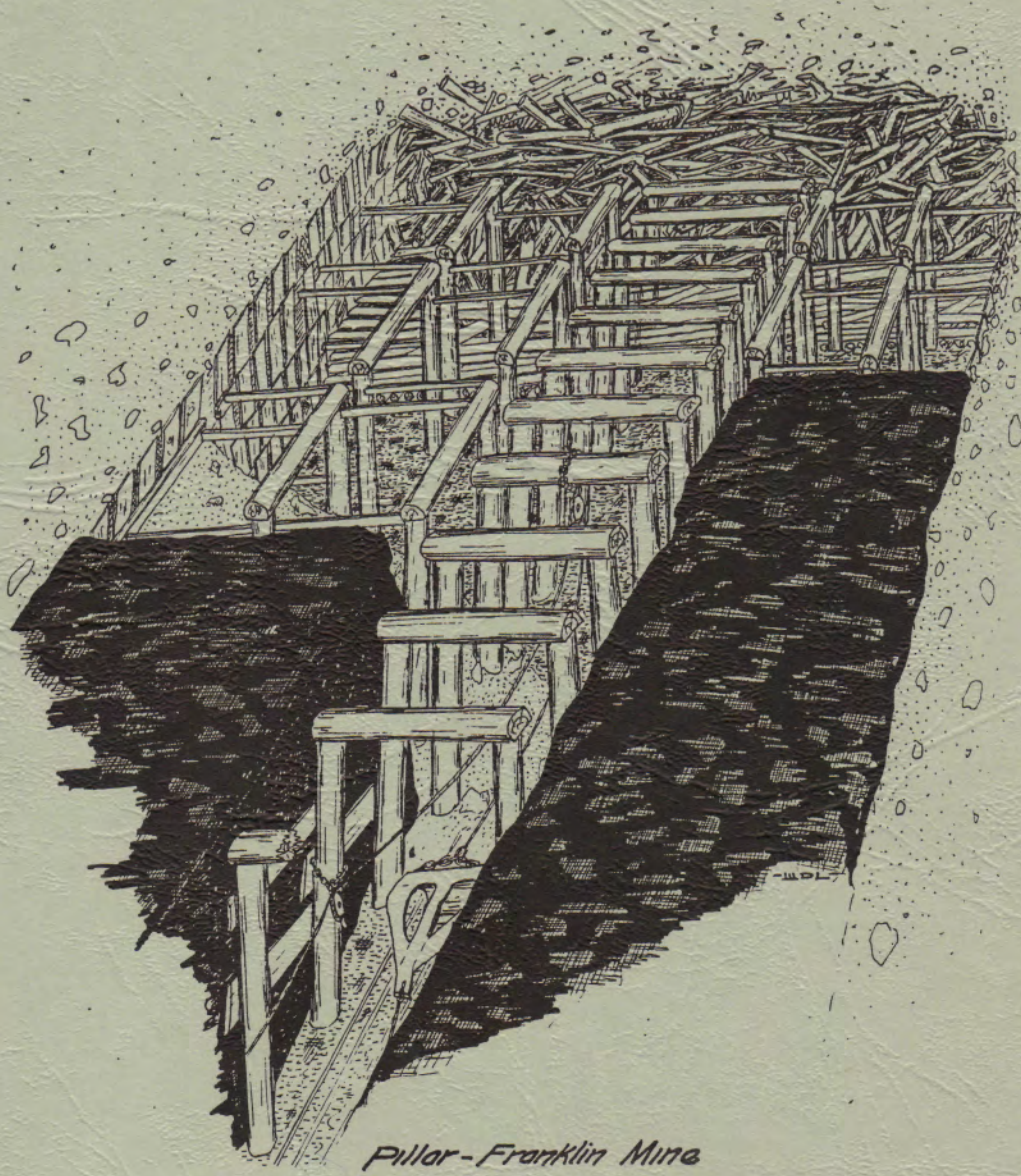
THE PICKING TABLE



Pillar - Franklin Mine

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THE PICKING TABLE

Journal of the Franklin-Ogdensburg Mineralogical Society, Inc.
Volume 32, Number 1

TABLE OF CONTENTS **Page**

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ABOUT THE COVER DRAWING

The drawing on the cover served as a frontispiece for a paper prepared for the New Jersey Zinc Company by one of its young engineers, William D. Lord, Jr. The paper was entitled "A Study of Top-Slicing at the Franklin Mine" and presented the results of a study, requested by Clarence M. Haight (Mine Superintendent), that was conducted between August 27 and October 4, 1946. The preface to that paper was dated 8/3/47. Please note Mr. Lord's initials in the lower right quadrant of the drawing and the caption "Pillar—Franklin Mine". The drawing and information are courtesy of the Franklin Mineral Museum archives.

* *

From the Editor's Desk

Omer S. Dean
10 Bumble Bee Lane
Norwalk, CT 06851-1404

A mini-editorial

The Picking Table is not intended to be a Society bulletin; clearly, it is the Journal of the Franklin-Ogdensburg Mineralogical Society—as stated on the cover. It is geared to the collector-community, both amateur and professional. The purpose of the journal is to provide the latest available information regarding minerals in the Franklin-Sterling Hill area, relevant current area news, certain collector-oriented peripheral topics, and choice historical tidbits. Many bulletins indicate they are not responsible for errors or misinformation; *The Picking Table* is responsible. Bulletins possess time-value. *The Picking Table*, however, has little time-value except for this column and the activity schedule. Bulletins are usually disposed of within months;*The Picking Table*, however, is usually retained indefinitely and a large percentage of members possess complete sets. Thus, the *PT* is meant to serve as a continuing source of material for the Franklin-Sterling Hill mineral collector.

Second point, *The Picking Table* needs articles—-possibly, your article. You may not be a professional writer but don't let that stop you; the Editorial Board can help. It all takes time, lots of time to get articles in final form. Remember many things come into play—readability, relevancy, accuracy, sensitivity, other articles which may appear in the same issue, space limitations, etc. Don't stand off and/or gripe, ask "what must I do to make this proposed article acceptable?" You will get an honest and helpful answer. Don't be offended by constructive criticism—after all, we share the same purpose as stated above in the first paragraph. The fact that we are a responsible educational publication warrants our time-consuming, fact-digging editorial process.

Twelfth Annual FOMS Dinner

The dinner held last October 6th had roughly eighty attendees. Among the notables in attendance were Peter Modreski and Earl Verbeek (both of the USGS, Denver), Don Newsome (founder of the Fluorescent Mineral Society), and Marcelle Weber (recent Past-President of the Friends of Mineralogy).

The speaker for the occasion was Earl Verbeek. His topic was "Structural environment of late-stage hydrothermal minerals at Sterling Hill—new work on old faults". Earl did a magnificent job of explaining the forces creating the Mud Zone at Sterling Hill and similar occurrences world-wide.

Two new minerals from the Franklin-Sterling Hill area were announced at the dinner: znucalite (the Sterling Hill occurrence is the second occurrence world-wide) and cianciulliite (new to science). John Cianciulli, for whom the latter mineral is named, was given a well-deserved standing ovation. Both mineral descriptions will appear in a future issue of *The Picking Table* .

Richard Bostwick, perennial Master of Cermonies at these dinners, did his usual fine job of structuring the affair. The auction was quite a success (thanks to Dick and Elna Hauck and others who contributed minerals, books and memorabilia) as was the catered buffet dinner itself (thanks to the efforts of Joe Cilen and Meyer's Bakery-Cafe, the caterer).

Dunn receives Lawson H. Bauer Award

Prior to the seminar held at the November FOMS meeting, FOMS President Omer Dean presented Dr. Pete J. Dunn, Department of Mineral Sciences, Smithsonian Institution, with the Lawson H. Bauer Award. This award honors Dr. Dunn for his efforts of the last fifteen years during which he has written more articles on Franklin-Sterling Hill mineralogy than any other person, living or dead. His work has done much to rekindle and nurture world-wide interest in Franklin-Sterling Hill. Finally, it has added some real zest to the life of the area's collector-community.

The Lawson H. Bauer Award had its beginnings in 1961 when the Society decided it wanted to sponsor an award for outstanding contributions to the understanding of Franklin mineralogy and geology. The award commemorates the late Lawson H. Bauer of the New Jersey Zinc Company who was renowned for his sharing of knowledge and minerals with both amateurs and professionals alike.

The award to Dr. Dunn was the fourth such award by the Society. Previous recipients of FOMS's Lawson H. Bauer Award were: Dr. Clifford Frondel, Harvard University, in June, 1961; Stanley G. Schaub, posthumously, in May, 1964; John L. Baum, Cura-

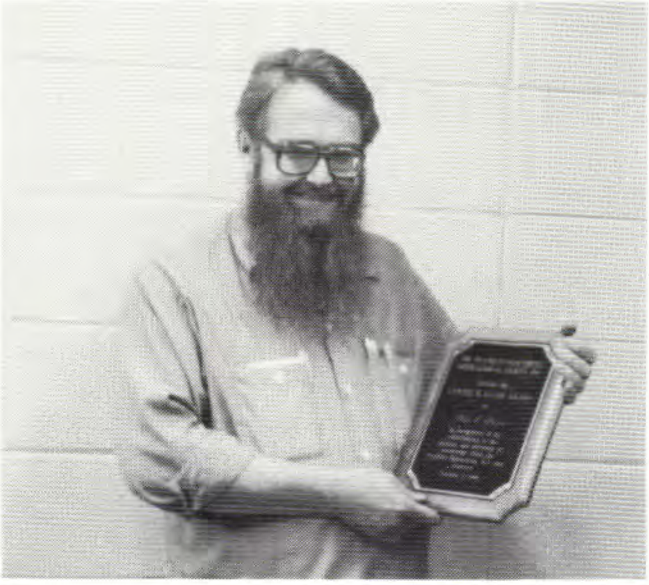


Figure 1. Dr. Pete J. Dunn, Smithsonian Institution, fourth recipient of the Lawson H. Bauer Award, Nov. 17, 1990. Omer Dean photograph.

tor, Franklin Mineral Museum, in October, 1981.

1991 Tucson Show Report

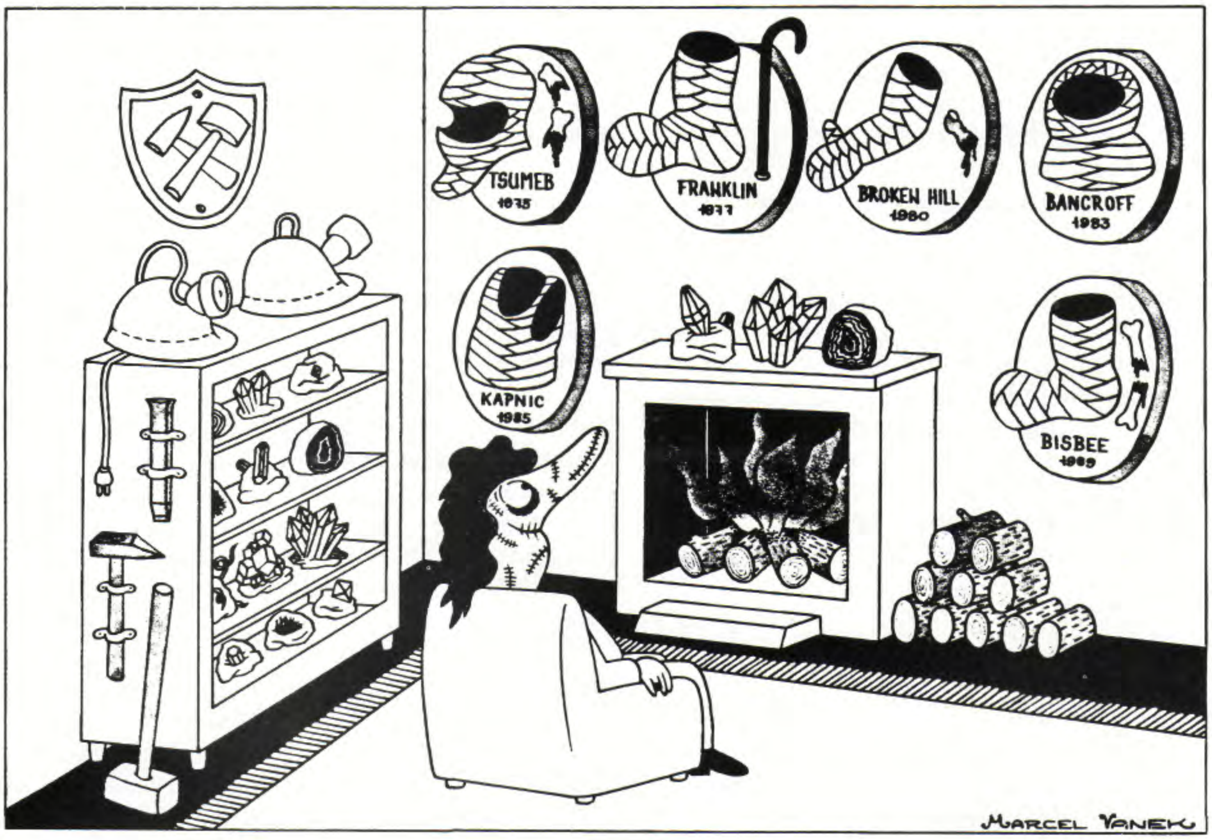
The FOMS and Sterling Hill minerals were both well represented at the Tucson Show this year. Numerous dealers were displaying excellent groups of franklinite crystals for sale. FOMS members (or members of the recent-past) obviously enjoying themselves in Tucson include (listed alphabetically): Betty and Omer Dean, Russ DeRoo, John Ebner, Curtis Glenn, Dick and Elna (with broken arm) Hauck, Bob Hawkins, Jim Kaufman, John MacDonald, Lenny Morgan, the Herb Obodda family, Fred Parker, Manny Robbins, Nora and Ralph Thomas, Bill Trost, Earl Verbeek, Dick Willis, and Neil Wintringham. I'm sure this list must be incomplete—therefore, my apologies to those members whose names have been omitted.

Were mineral prices up? Yes! Was there a "bell-ringer" mineral this year to match the anglesite, zunyite, and cavansite finds of the last few years? If so, I missed it! Parking was not a problem, the weather and the food were great, and the Executive Inn proved a good substitute for the Desert Inn as the mecca for "minerals only" type dealers prior to the main show activities at the Convention Center.

Not all the attractions at Tucson were minerals. Mineralogical cartoonist, Marcel Vanek, was present throughout the Show to autograph copies of his book, *Crystal Quest 1*. I received permission from Marcel and his publisher, Geoscience Press, to print the clever cartoon shown below. Its appeal to

(Continued on page 10—see **Editor**)

Figure 2 (below). Reprint authorized by Marcel Vanek and the Geoscience Press, Inc.



SUBSIDENCE AT THE FRANKLIN MINE

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Hamburg, NJ 07419

Subsidence, or caving of the surface, is characteristic of certain mining methods. One such method was employed at Franklin, New Jersey, to facilitate nearly complete recovery of the ore in the Franklin Mine. The method is called top-slicing and was being practiced in iron mines in Michigan. As the name suggests, it involves taking successive horizontal slices of ore from the top down. The practice, though effective, was an unusual one to use in an inclined orebody, as at Franklin, and here the system resulted in an inclined cavity with resulting foot and hanging walls. Figure 1 represents a vertical section or slice through the Franklin orebody. Imagine the ore removed resulting in loss of support beneath an enormous overhang many hundred feet high and thousands of feet long. Something is going to happen.

The mining method selected for the Franklin Mine in the 20th century involved dividing the orebody into vertical slabs or sections from footwall to hanging wall, and initially mining every other section by conventional means, proceeding upwards 100 feet at a time, and filling the resultant cavities, called stopes, with mill tailings from which the ore values had been recovered, so that support was maintained. In mining, as in any excavation, it is not necessary to hold back the entire world, but only the nearest rock. Keep that from moving, and you can stabilize the ground long enough to do the job. Figure 2 is a plan (map view) of a level in the Franklin mine showing how the orebody was segmented into stopes, mined initially, and pillars, or top-slices, mined later.

To recover the remaining ore following mining and filling the stopes, the top-slice method was used. A sketch of a top-slice is featured on the front cover. It is more timber than ore because the miners are finishing the slice, which is horizontal, ten feet high and as wide as the space between two filled stopes indicated by rocks and sand. The center is taken first, ideally from footwall to hanging wall, and then the miners retreat, taking out the sides, supporting the fill in the adjacent stopes with planks as shown. When the working place or pillar starts to talk (the timber creaks), or the fill sifts in or the hanging wall spalls, to relieve the pressure the empty far end of the slice can be blasted down by blowing the timbers out with a stick of "powder" in each timber, or alternatively a gradual collapse follows the mining of the slice from hanging wall to footwall. Collapse occurs atop a plank floor laid by the miners as they retreat to the entrance, and this floor becomes the roof of the next slice below. In this way a great thickness of timber called a mat accumulates overhead, and far above, fill is added to the subsiding mix to help support the hanging wall.

Figure 3 shows the surface location of the 4000-foot long orebody in the center of Franklin. Pillar mining was under way as early as 1930, and in 1932 the firm of Yeatman & Berry, Consulting Mining Engineers of New York City, issued a report on the observed cracking of the surface due to loss of support below. Yeatman (after whom the Franklin mineral yeatmanite was later named) writes, "Except in a portion of the surface above the hanging wall of the vein occupied by buildings in the town proper, the caving has done no damage." He goes on to predict further subsidence and suggests that certain properties be traded for or purchased to obviate property damage. In 1933 he again recommended purchase of seven properties and stated, "It is found that in the main part of the town itself there has been no settlement to amount to anything, but as the ore is removed at the north end of the mine by further mining of pillars, there will be considerable danger of settling, resulting in sinking and cracks in the surface of the ground which would endanger certain of the buildings." He added that "no properties to the west of the outcrop, or east of the hanging wall, need be purchased." This was because such land was already controlled. Cracks had been observed in Washington Avenue, a concrete street servicing the school, and Shuster Park had been dedicated to avoid structural damage. Management had prepared for the worst.

On the night of May 2nd, 1937, when no one was underground in the working places, gravity had its way, and a large chunk of the hanging wall let loose. Prior to this, in a gentler way, the surface had cracked and settled for a distance of 1350 feet north of the north end of the open cut at the south end of the

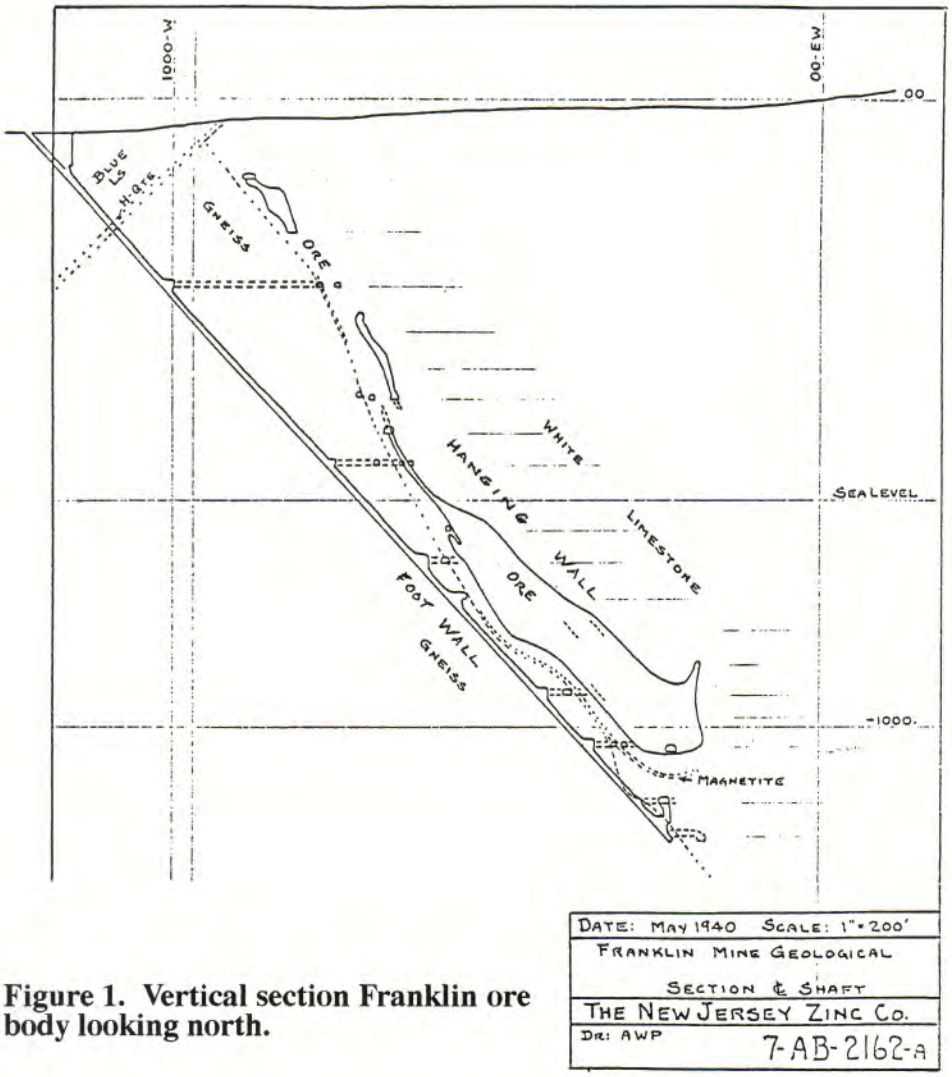
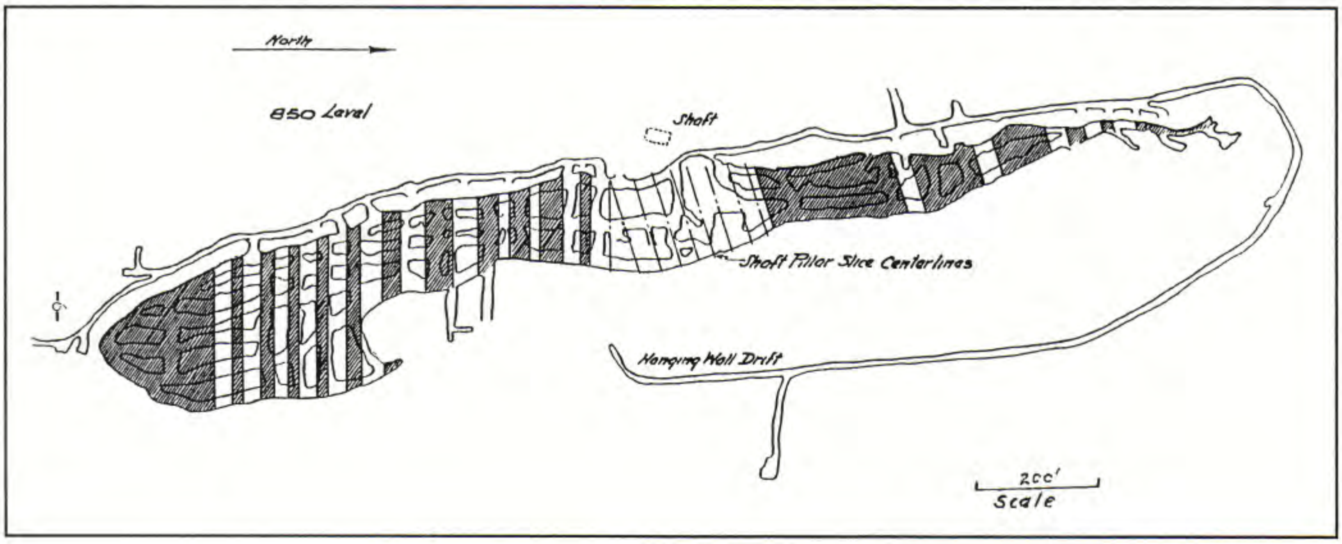


Figure 1. Vertical section Franklin ore body looking north.

ore body. Now, without warning, an additional 300 feet of surface was undermined in an instant. The happening was no secret to the inhabitants regardless of the hour, as a major shock resulted. There were no injuries or permanent damage other than to some underground passageways in the hanging wall used for introducing fill. The *Newark News* reported somewhat inaccurately on May 4th, "Traffic is being detoured off Washington Avenue through Shuster Park because of a cave-in of a section of the concrete road into an old mine shaft. One side of the street dropped Sunday and three sections of a 300-foot stretch caved in yesterday. At one place an area 18 x 25 feet sunk out of sight. Police are on guard."

Management viewed the situation without alarm. R.L. McCann, then Superintendent of the combined Franklin-Sterling operations and a man on the way up to Chairman of the Board, stated in his progress report covering April 1937 to the New York

Figure 2 (below). Plan of 850 Level at Franklin circa 1947, showing pillar layouts (unshaded area) and old mined-out workings (filled stopes shaded).



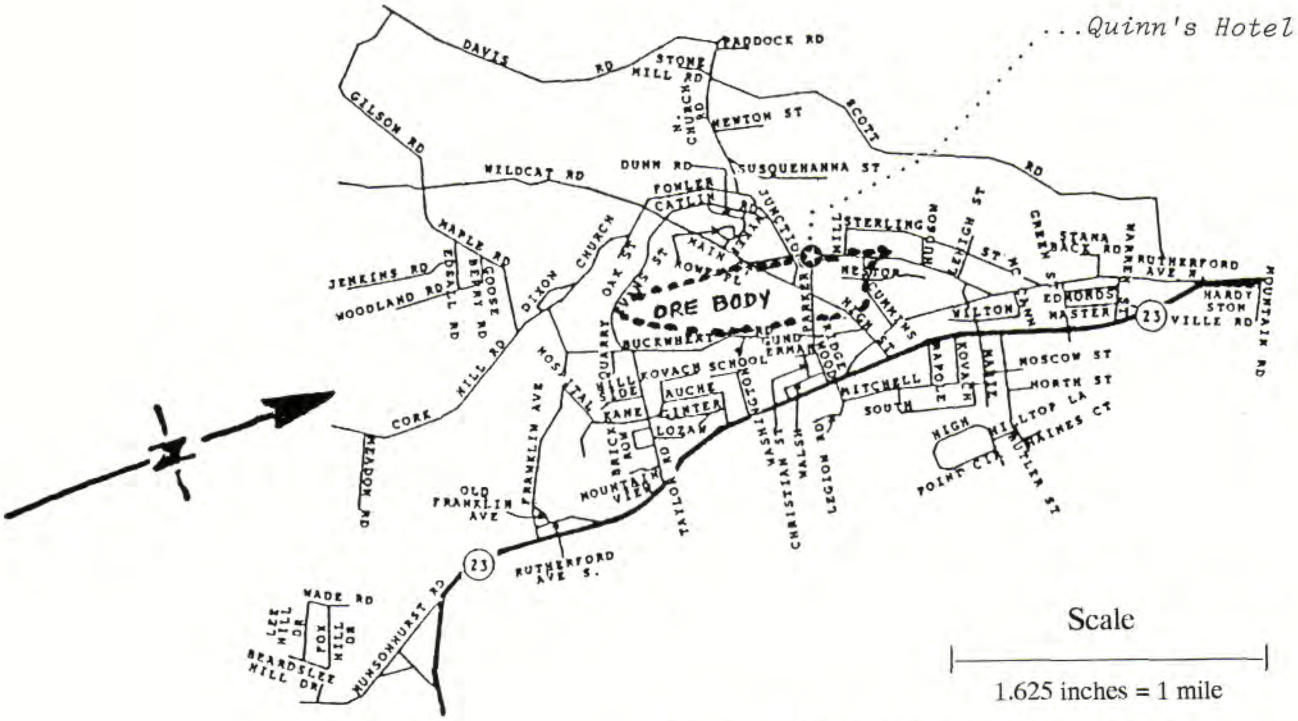


Figure 3. Orebody beneath Franklin, N.J.

office of the New Jersey Zinc Company, "Mine subsidence....is again under way....This subsidence is anticipated in line with the mining plans and is similar to that which occurred from time to time, starting years ago at the southernmost point of the rock wedge between the hanging wall and the footwall veins. Inasmuch as that area was fenced off from public view, there has been little comment about it. Now that the subsidence is affecting portions of Washington Avenue, High Street, and Shuster Park, a brief and inaccurate article recently appeared in some of the local newspapers."

For a management which might have misunderstood the published accounts, McCann explained: "As the ore is extracted from the pillars by top slicing, the mined out stopes and mats over the top slice operations are kept filled with waste rock and tailings. Since the stoping has been completed, and as the intervening pillar sections are mined away from the hanging wall, the hanging wall rock is left unsupported, and it is precautionary against falls of this hanging wall rock that the fill is placed on top of the mats in order to protect the workmen and the working places. The 'bumps' which are felt from time to time, are individual rock falls, and the surface subsidence which is now showing, represents the accumulated result of a number of 'bumps'."

"During the last week of April a block of rock dropped from below the 348 south crosscut on the 750 level and new cracks developed in the 401, 535, and 612 South crosscuts on the 750 level about 50 feet west of the hanging wall rock drift. These cracks gradually grew larger and more of them appeared, so that on the night of May 2, a considerably larger block of ground from over the extracted part of the east vein fell away from the hanging wall and temporarily damaged the pillars in this area from 348 to 669 south between the 650 and 1000 levels. Practically no damage was done in the Palmer Shaft pillar and repairs to the working places are under way, which repair work will cause a temporary cessation of production from the pillars amounting possibly to several thousand tons, — some of which will be offset by greater production from other pillars to which the mining crews were temporarily transferred. No loss of ore will result due to abandonment."

In hindsight we can say that there never was a "bump" like that one before and there never was one like that again. The 750 level sets (passage supports) were crippled and the working place on top of the sets was crushed down at the 348 South Pillar. At the 950 level, the center section (see drawing on front cover) was crippled from the footwall into the working place. McCann reported: "The sections, including the rock crosscuts, on the 750 level in the 348, 401, 451, 535 and 612 South Pillars, fell on the cushion of fill over the top slices below. Weight also acted on the footwall vein crushing some of the section below the 650 level and sliding the hanging wall part of the west vein ore downward several feet." Such pressure in the later years of mining helps explain why specimen hunting was better in the old days, B.C. (before crushing).

McCann detailed the damage done to raises, drifts and working places, items of interest to mining people but dry statistics to others. He closes with the observation: "In all probability, the additional expense entailed will be more than offset by the amount of fill automatically placed over these pillars by this fall of ground. In any event, from a mining standpoint, it is of considerable relief to have had the occurrence without injury to anyone and with a minimum of physical mine damage." In view of the extent of the damage done underground, it would seem that the news accounts dealt kindly with the incident.

An early incident related to subsidence involved Quinn's Hotel, which was located at the corner of Parker and Main Streets. The spot is now a dismal parking lot. Over the footwall of the orebody, the hotel seemed safely situated, especially since it was underlain by Kittatinny limestone. The problem was that the ore nearby had been weathered deeply in Precambrian time, water channels had converted the overlying rock to clay, and Quinn's was awaiting natural transport. All it needed was nearby mining to give the footings a place to go, and they reacted. Early complaints of the hotel owner were relayed to the Zinc Company which, following established policy, attempted to buy the property. Quinn, however, wasn't ready to sell until conditions were sufficiently impressive to justify popular support whereupon the destruction became a legal matter.

This area of town centers about the intersections of Parker, Nestor, and High Streets. It was in the vicinity of the old Hamburg Mine, which had minor surface expression, and was also over or close to the large Palmer Shaft pillar, which was not to be disturbed until late in the life of the mine; the area thus seemed ideal for building. The mine offices, the Company general store—later the Neighborhood House—and even the Borough Hall were in this area, once called Greenspot, before the mine drained the spring which had warmed the plantlife in winter and which probably had contributed to solution of the rock upon which Quinn's Hotel was founded. This was the area that was destined to descend gently but irresistibly. High Street today has two high points where initially it had but one, and these represent the edges of the mined-out orebody that diagonally crossed between them.

Where the hall of the Franklin Congregation of Jehovah's Witnesses presently is located was once a commercial center. In the early 1940s one of the old buildings taken over by the Zinc Company, and then used to house its real estate department, still bore a weathered barber pole, relic of an earlier time. Many homes along High Street already had been moved or torn down when Nestor Street between Parker and LaRue began to shift. The miners' homes along this street, too, were soon moved, as were the others on High Street. Watching the progression of the subsidence up Nestor Street was Meyer Rosen, the baker, whose shop was doomed. Indeed, Mr. Rosen was so worried about his shop that he drove his car into an opening that had appeared in Nestor Street, fortunately with no damage to Mr. Rosen and little to the car. The Zinc Company settled promptly.

The Borough Hall, a concrete building calculated to endure forever, was at the corner of High Street and Parker. Administration of the Borough was largely a Company concern and most of the Hall was dedicated to law enforcement. Here was the courtroom, presided over by an ancient retired shopkeeper named Clopper and called Judge although as justice of the peace he had no legal education and, in any case, slept a good deal during trials. Here too was the office of Chief Irons who attended to law and order in Franklin very efficiently, and here also was a jail, a room almost entirely occupied by a couple of cells made of woven strap-iron. When even the Borough Hall proved unable to resist the forces of subsidence, miners were sent to dynamite the building. When the dust cleared, there was the building, largely intact, resting on the jail cells.

The same force that broke the Borough Hall gradually lowered High Street and the parallel railroad spur that ran from the main line, in the valley, up to the Trotter yard to service the south end of the mine and the coal and lumber yard nearby. The Zinc Company owned a few cars and rented a locomotive, whose crew must have faced each trip with interest in view of the sagging roadbed. It was a constant battle to elevate the rails and fill beneath them, and the train ran on a kind of dike above the adjacent surface. Even so, it must have been a thrilling ride.

It was a fact that most "bumps" seemed to take place when the mine was unoccupied. However, not all movement was accompanied by tremors noted on the surface. In one working place, the miners fastened a ring in the hanging wall to secure a pulley for the scraper. When they finished the slice, fired it down and drove the center of the next slice below to the hanging wall, the ring was waiting for them. A more impressive indication of hanging wall subsidence was seen by the wanderer who followed a drift in the hanging wall which formerly entered the ore from the east, only to encounter a smooth wall of white marble. This required some meditation, which

(Continued on page 10—see **Subsidence**)

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An Uncommon Margarite/Corundum Assemblage from Sterling Hill, New Jersey

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INTRODUCTION

The occurrence of corundum in the Franklin Marble formation was first noticed at Franklin, in Sussex County, New Jersey, by Vanuxem and Keating (1822) and from Newton, in Sussex County, by Fowler (1832, 1836). It was also reported from two localities in Orange County, New York: near Amity (Shepard, 1832), and in Warwick (Fowler, 1829). During the late 1800's additional occurrences were found, notably in that portion of the Franklin Marble cropping out along the Wallkill Valley between the mine workings at Franklin and at Sterling Hill, a distance of approximately 3 miles. Most of the corundum occurrences in Sussex County were noted by Charles Palache in Spencer *et al.* (1908), and in Palache's U.S.G.S. Professional Paper 180 (1935) on the mineralogy of Franklin and Sterling Hill.

The initial occurrence of corundum at Sterling Hill was recorded by Palache in 1906 in his personal field notebooks, which are preserved in the Harvard Mineralogical Museum: "red corundum occurred in various pockets along to the west of the vein at Sterling, within 50 feet [of the orebody]." This information apparently had been gained from J. J. McGovern (died 1915), a well-known early collector of Franklin minerals. A corundum specimen labeled "west of the vein at Sterling Hill" in Palache's handwriting was acquired during the 1920's and presumably represents a later discovery.

In 1952 and a few years thereafter, several notable finds were made of corundum pockets in the Franklin Marble adjacent to the orebody at Sterling Hill. The initial occurrence was adjacent to the 430 level, near the West Shaft, to the west of the orebody at Sterling Hill. This occurrence was a small one, approximately a cubic meter in size, and formed an isolated pod.

Some years later, the assemblage described here was found in pods in the Franklin Marble, 28 meters above the 340 level. This, too, was partially preserved, in part by miners and in part by geologists and mine management. This second occurrence was in a "room" cut in the Franklin Marble, 12 meters from the orebody on the 340 level at Sterling Hill, in Ogdensburg, New Jersey. The "room" was excavated to serve as a charging station where transformers recharged the batteries of small locomotives which were used to haul ore trains. The discovery of the suite of minerals described here was fortuitous. At least three pods were found, possibly more, and all were in the footwall under the orebody. These occurrences paralleled the plunge of the ore and it is highly likely that others existed between these or above or below them, but were not encountered.

Because the specific occurrences were accessed through the Sterling mine, most specimens have been labeled as coming from Sterling Hill. Although, strictly speaking, this is true, we wish to emphasize that the minerals did not come from, and were not in direct contact with, the famous zinc orebody there. They were hosted by the Franklin Marble, which envelops the orebodies at both Franklin and Sterling Hill. There were local reports of differences in the mineral content of these two occurrences, most notably in the relative abundance of arsenopyrite and corundum, but we have no firsthand information about such differences.

This paper documents the dozen or so minerals that characterize the assemblage from the 1950's occurrence, and includes unusual species such as goldmanite, thortveitite and chromian gahnite. All minerals were verified using X-ray powder diffraction and microprobe analyses, except where otherwise noted. Specimens are presently available in the mineral marketplace. We have not examined the geologic relations personally; the above locality information is in large part as obtained from miners and geologists who did observe the *in situ* occurrence, and to whom we are grateful.

MINERAL DESCRIPTIONS

The host mineral in this coarse-grained assemblage is white calcite, but the relative amount of the other minerals varies from specimen to specimen; calcite, however, is always present. Next in abundance is red corundum, platy crystals of phlogopite, and blue-green margarite. These are described below, together with the rare and unusual minerals.

Anorthite $CaAl_2Si_2O_8$

Snow-white plagioclase occurs in relative abundance with margarite and corundum. It has not been studied in detail. The optical properties indicate that it is very close in composition to the Ca-rich end-member, anorthite.

Arsenopyrite FeAsS

Superb arsenopyrite crystals to several millimeters are found in insoluble residues which remain after dissolution of the calcite matrix in dilute acetic or hydrochloric acids. Most of these resemble other arsenopyrite crystals from Sterling Hill, as illustrated by Dunn (1979).

Clinochlore $Mg_5Al(Si_3Al)O_{10}(OH)_8$

Clinochlore was found as pale brown, soft aggregates among the insoluble residues.

Corundum Al_2O_3

Corundum occurs as subhedral to euhedral, almost barrel-shaped crystals. The crystals have curved faces but are discernibly dipyramidal in habit, with a prominent {0001} pinacoid. Crystal size varies; most are near 1 cm and the crystals are roughly equant in habit. Anhedral crystals are also found. The color is dull red to pinkish red, and the luster of the crystals is dull in general. Parting lamellae are evident, parallel to {0001}.

Gahnite $ZnAl_2O_4$, **Hercynite** $FeAl_2O_4$

Very small (0.5 mm) violet-red octahedra were isolated from this assemblage by the late Lawson H. Bauer, who recognized the uniqueness of their composition, containing both Cr and Zn, in a deposit containing only traces of chromium. For a while, they were locally thought to be grimaldiite (Frondel, 1972), but our subsequent investigation has shown that they are zoned spinel-group minerals, consisting of a core of chromian-zincian hercynite of composition $(Fe_{0.43}Zn_{0.39}Mg_{0.18})(Al_{1.60}Cr_{0.38}Fe^{+3}_{0.02})O_4$, surrounded by an outer zone of chromian-ferroan gahnite of composition $(Zn_{0.55}Fe_{0.35}Mg_{0.10})(Al_{1.61}Cr_{0.36}Fe^{+3}_{0.03})O_4$.

Goldmanite $Ca_3(V,Cr,Al)_2(SiO_4)_3$

Goldmanite was found as very small (0.5 mm) dodecahedral crystals in insoluble residues. It was originally thought to be uvarovite (Frondel, 1972), but our subsequent study has shown these crystals to be vanadium-dominant and thus goldmanite. These goldmanite crystals are associated with vanadian grossular and vary from a goldmanite of composition $Ca_3(V_{1.6}Cr_{0.2}Al_{0.2})(SiO_4)_3$, to a vanadian grossular of composition $Ca_3(Al_{1.4}V_{0.5}Cr_{0.1})(SiO_4)_3$.

Graphite C

Graphite crystals are numerous in the assemblage, forming minute 0.5–1.0 mm, sharp, platy crystals, tabular on {0001}. An anecdote from Sterling Hill's history is linked to these crystals: the late Lawson Bauer, chief chemist of the New Jersey Zinc Company, entertained visitors by immersing these graphite crystals in a special solution; they absorbed the solution and, upon heating, greatly exfoliated, creating long wormlike forms.

Margarite $CaAl_2(Al_2Si_2)O_{10}(OH)_2$

Margarite occurs as platy aggregates resembling mica. Its appearance led to early and erroneous reports of kyanite and "mariposite" in some local lists of minerals, but these minerals are not known from these deposits. The most visible characteristics of this margarite are its blue-green color and its decidedly pearly luster, not unlike that of talc. The margarite lamellae attain sizes of 2–3 cm, are commonly warped, and irregularly distributed within the matrix. Because of its significance, it was studied in detail. A chemical analysis of this margarite was made in 1964 by the late Dr. Jun Ito and given by Cook (1973), but this, as published, was given partly in error; the correct analysis by Ito is given in Table 1, together with other data obtained on this material. This analysis, calculated on the basis of 12 oxygens, yields: $(Ca_{0.83}Na_{0.16}K_{0.004})(Al_{1.84}Li_{0.06}Fe^{+3}_{0.02}Cu_{0.02}Mg_{0.01}Ti_{0.01}Cr_{0.004}V_{0.004})(Si_{1.96}Al_{2.04})(O_{9.54}(OH)_{0.46}))(OH)_2$. This is in good agreement with the usual composition of margarite, although the contents of Na, Fe^{+3} and Mg are lower than are ordinarily found, and there are noteworthy contents of Cr, V, Ti and Cu. Margarite is commonly associated elsewhere with corundum, notably in emery deposits. It often occurs as an alteration product of corundum, but this is not the case at Sterling Hill, where the two minerals are separately crystallized.

Rutile TiO_2

Lustrous rutile crystals occur up to a centimeter in length, but most are much smaller. They are generally prismatic in habit, but some are equant. Most are dark red in color (black megascopically). Rutile is locally abundant in this assemblage, and fine specimens have been preserved.

Thortveitite $(Sc,Y)_2Si_2O_7$

Thortveitite was found as tiny 20-micron crystals with lath-like habit, within the gahnite/hercynite crystals described above. Microprobe analysis found it to be nearly pure scandium silicate, with small amounts of yttrium, as is common for this mineral. Frondel (1970) reported the major hosts for scandium in the orebodies, and the thortveitite noted here suggests that spinel may host Sc in the Franklin marble.

Titanite $CaTiSiO_5$

Titanite was found as small brown crystals in insoluble residues.

Zircon $ZrSiO_4$

Zircon was found as rounded, prismatic, 1-mm crystals, in insoluble residues.

DISCUSSION

The margarite-corundum pods along the footwall of the western leg of the orebody at Sterling Hill may represent the recrystallization of a once-continuous, highly aluminous bed in the original limestone, close to and conformable with the orebody, and later broken into boudinage structure by the intense dynamothermal metamorphism that has affected the region. This structure is typical of the thin sandstone/quartzite and gneissic beds that occur locally in the Franklin Marble as noted by Hague *et al.* (1956). There is, however, no field evidence that the corundum pods occurring elsewhere in the Franklin Marble are of this origin.

A related occurrence, in part chemically and mineralogically different, was found in 1982 by collectors in the Franklin quarry (a.k.a. the Farber quarry) on Cork Hill Road in Franklin, a bit north of Sterling Hill. This occurrence, on the upper bench on the west side of the quarry, was of simpler mineralogy, having no corundum and none of the rarest minerals. Phlogopite, margarite and calcite are the dominant minerals; dolomite, rutile, clinochlore, muscovite and titanite are also found. Material from this 1982 occurrence has been preserved by Richard Bostwick and others, and studied by Yau *et al.* (1984) who interpreted it as a retrograde assemblage; the parent rock is assumed to have been composed of feldspars and/or scapolite.

In his notebooks of 1906 Palache states, in reference to the corundum pockets at Sterling Hill, that "this line of pockets ran all the way

Table 1. **Analytical and physical data for Sterling Hill margarite.**

SiO_2	29.70	Optically negative, 2V = moderate.
Al_2O_3	49.96	α = 1.625 ($\pm$ 0.004)
Fe_2O_3	0.25	β = 1.640 ($\pm$ 0.001)
Cr_2O_3	0.07	γ = 1.641 ($\pm$ 0.001)
V_2O_5	0.10	Pleochroism is indiscernible.
TiO_2	0.25	Orientation: $X \approx c$, $Z = b$
CaO	11.68	D (meas) = 3.03;
MgO	0.12	D (calc) = 3.07 g/cm³.
CuO	0.53	
Li_2O	0.21	
Na_2O	1.24	
K_2O	0.05	
H_2O^+	5.60	
H_2O^-	0.23	
Total	100.0*	

*recalculated to 100.0 weight percent after deduction of 3.00 wt. % corundum insoluble residue.

Includes traces of Ga, Mn, Ba, Sr, Y, Yb, Ni, Mo, Ag, Cd, and Sb.

between Franklin and Sterling Hill." Elsewhere in his notes he states, in abbreviated style, that "Corundum [is] found in limestone [the Franklin Marble] in hanging wall from Trotter mine [in the western leg of the orebody at Franklin] south as far as Ogdensburg." These statements appear to be legends that he gained from the local mineral collectors, and do not appear in his treatise (Palache, 1935) where it is said only that "An irregular chain of pockets containing corundum is said to have extended from Sterling Hill to Franklin." Present day field work indicates that the corundum pockets were few and far between. At the best known locality, at the former site of the iron furnace at the foot of Franklin Pond, translucent corundum crystals of a fine red color were associated with rutile and spinel but, unlike the Sterling Hill occurrence, both margarite and anorthite were lacking. This also appears to be true of most other corundum occurrences in the Franklin marble in Sussex County, New Jersey, listed by Palache (1935) and in Orange County, New York, listed by Whitlock (1903) and by Shepard (1832).

In addition to margarite, another member of the brittle mica group, clintonite, $Ca(Mg,Al)_3(Al,Si)O_{10}(OH)_2$, occurs in the Franklin Marble (without associated corundum) at Amity, Orange County, New York, northeast of Franklin, New Jersey (see Kearns, 1978). It is the type locality for clintonite (Finch, 1829); the complex synonymy of the name clintonite, which includes seybertite, is given by E. S. Dana (1896). Here clintonite occurred as reddish brown scales and aggregates of coarse lamellae and plates up to 25 cm across, associated with spinel, dolomite, clinochlore, talc, chondrodite, and vesuvianite, with corundum lacking. Clintonite was reported by Struwe (1958) from Franklin, associated with spinel, pargasite, norbergite and graphite.

The Franklin Marble, especially in its northward extension into Orange County, New York, contains (in addition to the corundum, margarite and clintonite occurrences) a wide variety of accessory minerals. In part these are more or less uniformly dispersed through the marble, in particular: graphite, chondrodite, spinel and, less abundantly, uvite. Other occurrences consist of local concentrations or pockets characterized by abundant spinel (at least one locality has octahedra up to 10 cm on edge), clinopyroxenes including fassaite, tremolite, calcic hornblende, and edenite (type locality is near Edenville), vesuvianite, scapolite, grossular, feldspars, chlorites, titanite, warwickite (type locality is at Warwick), and talc (as an alteration product). These occurrences first drew attention in the early 19th century and gave rise to a considerable body of literature, summarized by Whitlock (1903). This general assemblage, including clintonite, is viewed by Knopf (1953) and Knopf and Lee (1957) as representing limestones that have been metasomatically altered and recrystallized at elevated temperatures.

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(**Subsidence**—Continued from page 7)
was abruptly postponed with realization that what had happened once could happen again. Like now, for instance. The visitor escaped being encapsuled in a segment of hanging wall and emerged with a renewed appreciation of the irresistable forces to be encountered deep underground.

(**Editor**—Continued from page 3)
FOMS members should be obvious. Also, Marcel paints in his version of the "missing parts" on badly damaged fossils—they're shockers. His talent and wit are extraordinary!

* *

Graphite in Ore

An Unusual Occurrence at the Sterling Mine

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Graphite, one of the four polymorphous species of native form carbon, occurs commonly in the Franklin Marble. Palache (1935) commented that it is abundant at both Franklin and Sterling Hill, at all of the marble quarries nearby, and in the magnetite iron ores in the marble. The carbon comprising this mineral is generally considered to be relic carbon from primitive organisms which inhabited the ancient sea from which the original limestone, now highly metamorphosed was precipitated. The graphite occurs as small (1-5 mm) scattered grains, stain, films, and blebs in the marble.

Occurrences of graphite in the orebodies at Franklin and Sterling Hill were unknown at the time of publication of Palache's Professional Paper 180 in 1935. In that paper Palache specifically stated that "It has been found occasionally in the immediate wall rocks of the zinc-ore bodies but not in either ore body." This was still the case in 1965-66 when the author was employed as a miner at the Sterling Mine. Graphite did occur in a few assemblages proximate to the Sterling orebody, particularly the zinkenite-realgar-arsenopyrite assemblage, the exact relationship of which to the orebody has only recently been observed. Prominent concentrations of graphite in the immediate wall rocks of the Sterling Mine orebody, however, are not common.

The presence of graphite in the Sterling orebody became obvious when it was noted by the author in "black ore" (ore containing black willemite and franklinite as the most prominent constituents) at the Sterling Mine during the winter of 1965-66. The author was working in 1000 Stope between the 340 and 430 levels. This was the southernmost of four large transverse stopes operating at the time (1000, 1040, 1080, and 1120 Stopes). The next southernmost stope, the 960, had already been mined out at these levels and for years had stood unfilled as a gigantic chasm.

The author worked in 1000 Stope for the removal of three horizontal slices or benches of ore, each approximately 10 feet high, 180 to 200 feet long, and, theoretically, 20 feet wide. Each slice of ore was removed starting at the hanging wall, or eastern side of the orebody. This was the "black ore" section of the orebody complex.

The "black ore" was composed chiefly of black-colored willemite, löllingite, franklinite, sphalerite and a pale pink-colored carbonate. On the macro scale, the ore exhibited the "pull-apart", or "cloud" texture which is common to, but not restricted to, the "black ore" lode. The ore was otherwise unremarkable except for the isolated presence of sphalerite and fluorite.

On one particular shift the author and his partner set off a blast at lunch time, as was allowed at that time. After the lunch period the work area was cautiously reentered to evaluate the effectiveness of the blast. One of the first procedures under such circumstances was to grab a couple of scaling bars (pry bars) and the water hose. The water was used to subdue the dust and vapors resulting from the blast and to clean the dust off of the muck pile to facilitate detection of any unexploded caps or dynamite (and mineral specimens as a coincidence). The scaling bars were used immediately to probe the ceiling for loose rock. The author was scaling loose as the ceiling and muck pile were being hosed down when several pieces of ore containing unusual, round, masses of a platy mineral with a silvery luster were noted on the broken heap of ore. One loose spherule of the mineral was found lying intact and free of matrix on the ground. Examination of the new ceiling of the work area revealed a series of pink carbonate areas in the ore containing more sections and blebs of the silvery mineral. A semi-spherical void was also noted and seemed to correspond to the spherule picked up from the muck pile; both were about one half inch in diameter. This occurrence was approximately 50 or 60 feet west of the hanging wall and about 30 to 40 feet above the 430 level. This occurrence was about equidistant between the north and south sides of the stope, about 30 to 40 feet above the 430 level, and about 50 or 60 feet west of the hanging wall as measured horizontally along the length of the stope; approximate mine coordinates are 1000 N, 1050 W. All loose specimens were collected, including the loose spherule. A field test indicated that the mineral was probably graphite based on its physical appearance and softness; however, the author had never seen graphite in spherical aggregrates. Palache (1935) mentioned that "In a unique specimen in the Canfield collection graphite forms spheroids about half an inch in diameter, with fibrous structure and mammillary surface." The inference, taken in context, is that this specimen — allegedly from Franklin rather than Sterling Hill—is not in ore.

The graphite-bearing area was only a few feet across and the area containing the richer flecks, blebs and spherules was even smaller. Attempts to collect further specimens met with only limited success since the ore broke clean here; the ceiling was solid and devoid of loose fragments which could be scaled down. Collecting efforts over a two-day period resulted in the removal of approximately two large lunchpails of specimens; among them were a few large pieces and a great number of smaller ones. The loose spherule depicted in Figure 1 was carried out carefully in a chest pocket. The other miner working in this area on the same shift, plus the two miners working on the cross-shift, discounted the value and significance of this find and collected no specimens.

Figure 1. Graphite spherule, 9 mm in diameter, 1000 stope, 30-40' above 430 level, Sterling Hill. Kraissl/Plenty Collection, Franklin Mineral Museum. Photograph by Omer Dean.

Figure 2. Graphite sprays and broken spherules in matrix, 1000 stope, 30-40' above 430 level, Sterling Hill. Specimen, part of Kraissl/Pleanty Collection, Franklin Mineral Museum, measures 8.5 x 4.5 cm; largest spherule spray in matrix measures 9 mm. Photograph by Omer Dean.

Furtherance of the mining operation resulted in the removal by the cross-shift miners of that portion of the ore pile into the ore chute. No additional graphite specimens were evident. Similarly, removal of the next-higher ore slice did not reveal a continuation of the graphite-bearing area; thus this was a highly restricted occurrence, as is true of many finds at Sterling Hill. It should be pointed out in this context that the famous Sterling mine uraninite specimen (see previous issue) was found in the 1080 stope about the same time, about 80 feet farther north and 60 feet deeper.

The largest and finest of the graphite specimens, plus the intact, loose spherule are preserved in the collection of the Franklin Mineral Museum. Initially these formed part of the Mine Hill Mineral Shoppe collection, later to become the Lemanski collection, and ultimately the Kraissl/Plenty collection. One smaller specimen was retained by the author. All other specimens were offered for sale at the Mine Hill Mineral Shoppe in Franklin and thereby dispersed.

Graphite as spherules, flecks and even as fracture-surface coatings was found rather abundantly in ore sometime after this particular find in "black ore" (Stephen Sanford, personal communication, 1990).

Today, as the Sterling Mine is slowly flooding, there is still a potential for additional graphite-in-ore specimens to be recovered. On the 430 level there is a tunnel driven through the length of the 1020 pillar, only some 25 feet in a straight line from the occurrence described here.

Reference:

Palache, Charles (1935) *The minerals of Franklin and Sterling Hill, Sussex County, New Jersey.* U.S. Geological Survey Professional Paper No. 180, pages 25-26.

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CURATOR'S MESSAGE

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Early in 1986, Wilfred R. Welsh of Saddle River, New Jersey offered his world-wide mineral collection to the Franklin Mineral Museum, Inc. Consisting of more than 4500 specimens and assembled primarily as a teaching and study collection, it will do much to improve the Museum's ability to contribute to the edification of young people and their elders. The problem of where to house the Welsh Collection was solved with receipt of a generous bequest from David Jensen. Following the design of Elizabeth DeFabritis, Architect, a suitable addition to the Museum was commenced on October 20, 1990 and was essentially completed during the fourth week of January, 1991. Opening at the far end of the Museum lobby a double door leads to a passage off which are located alcoves for the Welsh Collections of fossils and American artifacts, an exit to the picnic grounds and if need be the Buckwheat mineral collecting area, and the entrance to the great mineral hall. This is rectangular in plan with a lofty ceiling and windows high above to augment ample illumination. Capacity is 149 and heating and air circulation are calculated to benefit the exhibits. Off the mineral hall is a room 12 by 21 feet for use as an office and archives. It will house the computer, mineral identification, labelling and other curating equipment as well as the records of Franklin's mineralogy and mining, Because of the logistics of transportation, preparation and installation, an early opening of the addition is not anticipated. Thanks to the generosity of Bill Welsh and Dave Jensen, this is an exciting time for the Franklin Mineral Museum and we are all deeply grateful.

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MINERAL NOTES

Research Reports

Baumite discredited

Reference: Guggenheim, Stephen, and Bailey, S.W., 1990, Baumite discredited: *American Mineralogist*, **75**, p. 705

Authors' addresses: Guggenheim: Department of Geological Sciences, University of Illinois at Chicago, Chicago, IL 60680. Bailey: Department of Geology and Geophysics, University of Wisconsin, Madison, WI 53706.

In a previous paper [Guggenheim and Bailey, 1989; abstracted in *The Picking Table*, **31**, #1, p. 19], the material originally described in 1975 as the new mineral baumite was shown to be a mixture of several serpentines and chlorites. Based on those results, a recommendation was made to the International Mineralogical Association (IMA) Commission on New Minerals and Mineral Names to discredit baumite as a valid species. That recommendation has now been approved by the IMA.

One of the serpentine phases is a layer silicate structurally similar to greenalite and caryopilite but with larger structural domains. This phase could not be described completely and thus is not given a new species name; instead, it should be referred to as a zincian caryopilite or a zincian greenalite, depending on the dominance of Mn or Fe, respectively. [Note: Johnbaumite, an arsenate apatite from Franklin and the hydroxyl analogue of turneaureite and svabite, remains a valid species]

ERV 12/90

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Bementite

Reference: Eggleton, R.A., and Guggenheim, Stephen, A new model for the structure of bementite, a modulated 1:1 layer silicate [abs.]: *Geological Society of America Abstracts with Programs*, **20**, no. 7, p. A358

Authors' addresses: Eggleton: Geology, Australian National University, GPO Box 4, Canberra 2601, Australia. Guggenheim: Department of Geological Sciences, Box 4348, University of Illinois at Chicago, Chicago, IL 60680.

Bementite, $Mn_7Si_6O_{15}(OH)_8$, is monoclinic: a = 14.83 Å, b = 17.58 Å, c = 14.70 Å, β = 95.5°, $P2_1/c$. The mineral is a modulated 1:1 layer silicate with alternate octahedral sheets rotated by 24° in the *XY* plane. The tetrahedral sheet has pairs of 6-fold rings connected by 5-fold and 7-fold rings. Inverted tetrahedra form strips with like orientation (up or down) parallel to *X*. Linked pairs of 6-fold rings are rotated relative to pairs across strip boundaries by 24° to allow coordination to adjacent octahedral sheets.

Distance least-squares modelling shows the mean tetrahedral O-O distance to be 2.645 Å, the mean Si-O distance to be 1.623 Å, and the mean Mn-O distance to be 2.206 Å.

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Humite-group minerals

Reference: Abbott, R.N.,Jr., Burnham, C.W., and Post, J.E., 1989, Hydrogen in humite-group minerals: Structure-energy calculations: *American Mineralogist*, **74**, p. 1300-1306

Authors' addresses: Abbott: Department of Geology, Appalachian State University, Boone, NC 28608. Burnham: Department of Earth and Planetary Sciences, Harvard University, Cambridge, MA 02138. Post: Department of Mineral Sciences, Smithsonian Institution, Washington, DC 20560.

This study is outside the scope of interest of most mineral collectors. P.J. Dunn (personal communication) indicates the paper pertains to Franklin norbergite and Sterling Hill alleghanyite even though the paper does not say so explicitly. This reference is included for the sake of completeness.

OSD 1/91

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Manganese-rich ore assemblages

Reference: McSween, H.Y., Jr., 1976, Manganese-rich ore assemblages from Franklin, New Jersey: *Economic Geology*, **71**, p. 814-817
Author address: Department of Geological Sciences, Harvard University, Cambridge, MA 02138

[This paper, published nearly 15 years ago and thus somewhat dated, nevertheless is abstracted here because the assemblages discussed are represented in many systematic collections of Franklin minerals.]

Introduction

McSween studied two samples of Mn-rich ore from Franklin and remarked upon the similarity of their mineral assemblages to those of metamorphosed manganese deposits in other localities. The first sample consists of coarse plates of red zincite intergrown with emerald-green manganosite and sonolite; accessory minerals include zincian hausmannite and a fine-grained, unidentified Mn-oxide. The second sample contains finer-grained, platy red zincite intergrown with sonolite; the spinel phase is jacobsite rather than hausmannite, and no manganosite is present. Both specimens were found on the dumps at Franklin.

Mineral descriptions

Zincite occurs as large plates flattened on {0001}. Two chemically distinct zincites were distinguished in thin section. Red zincite of composition $Zn_{0.93}Mn_{0.06}O$ comprises most of the ore, but also present is yellow zincite of greater purity and composition $Zn_{0.97}Mn_{0.02}O$; the paler color of the latter is attributed to its lesser manganese content. The yellow zincite contains tiny exsolution blebs of yellow-green manganosite and deep-red hausmannite oriented in subparallel fashion.

Sonolite occurs as large, pinkish-brown grains intergrown with zincite. The grains have smooth, rounded outlines and in thin section resemble plagioclase due to their low-order interference colors and ubiquitous polysynthetic twinning.

Jacobsite occurs as large, anhedral to subhedral crystals dispersed in red zincite. It is of composition $(Mn_{0.65}Zn_{0.35})(Fe_{1.5}Mn_{0.5})O_4$ and is an intermediate phase within the solid-solution series **jacobsite** $(MnFe_2O_4)$—**franklinite** $(ZnFe_2O_4)$—**hausmannite** $(MnMn_2O_4)$—**hetaerolite** $(ZnMn_2O_4)$ all of which have been reported from Franklin. Optical study revealed no exsolution phases similar to those observed in franklinite (see Frondel and Klein, 1965), but X-ray patterns showed faint lines thought to be diffuse satellite reflections of hausmannite or hetaerolite.

Manganosite occurs as anhedral grains intergrown with zincite. Thin exsolution lamellae of yellow zincite form an orthogonal network within the manganosite grains.

Hausmannite, together with an unidentified brown colloform manganese oxide or hydrated oxide, forms thin reaction rims between grains of manganosite and zincite. The hausmannite has composition $(Mn_{0.39}Zn_{0.39}Fe_{0.18})Mn_2O_4$, intermediate between ideal hausmannite and hetaerolite, and is in immediate contact with zincite. The brown colloform material forms a rim between the hausmannite and manganosite; this phase contains 74% Mn (expressed as MnO), 1.3% ZnO, and other oxides (SiO_2, FeO, MgO, and Al_2O_3) summed to less than 1%. It could not be positively identified.

Paragenesis

The paragenetic sequence for these assemblages was derived from the following observations:

(1) Sonolite appears to have been replaced by red zincite. Anhedral sonolite grains with smooth, curving boundaries have higher zinc contents near contacts with zincite.

(2) Yellow zincite contains exsolution lamellae of both hausmannite and manganosite, but red zincite contains no exsolution phases. Though textural relations between the two forms of zincite is not clear, the red zincite is interpreted to be the original phase and the yellow zincite, of lower Mn content, to have been derived from it by exsolution of the Mn-rich phases.

(3) Rims of zincian hausmannite separate grains of manganosite and zincite. The unidentified Mn-oxide crosscuts both the zincite and hausmannite, but not the manganosite [thus manganosite is interpreted to be the latest among these phases]. The

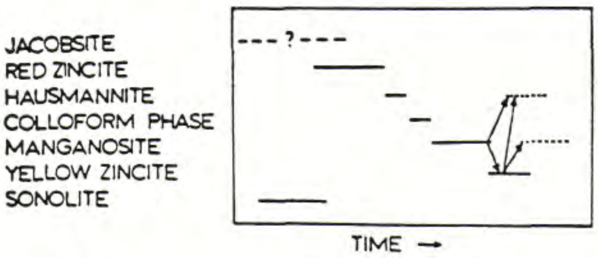

Figure 1. Paragenetic sequence inferred for Mn-rich Franklin assemblages. Arrows indicate exsolution or oxidation from host phase.

colloform texture of the Mn oxide is suggestive of open-space filling [and from this McSween seems to infer that manganosite, as a still-later phase, also formed in residual open space; wording is murky here].

(4) Exsolution of zincite lamellae from grains of manganosite occurred in response to decreasing temperature. The exsolution of manganosite lamellae from grains of yellow zincite probably occurred simultaneously. Blebs of hausmannite formed by oxidation of both phases.

(5) The time of jacobsite crystallization is unknown, but the relative paucity of hausmannite exsolution lamellae (to form the intergrowth known as vredenburgite) suggests that the jacobsite may have formed after peak metamorphic temperatures were reached. [The amount of $MnMn_2O_4$ capable of being held in solid solution in jacobsite, later to exsolve as hausmannite, decreases with decreasing temperature].

Comparison to metamorphosed sedimentary manganese deposits

Several metamorphosed sedimentary manganese deposits contain mineral assemblages similar to those of the Franklin area. These deposits include:
Manganese deposits of India - The unmetamorphosed assemblage pyrolusite-cryptomelane-coronadite gives way to braunite-bixbyite-hollandite ores at low to intermediate grades of metamorphism; jacobsite or vredenburgite appears at higher grades, and at still higher grades hausmannite appears.
Noda-Tamagawa deposit, Japan - Manganosite, pyrochroite, hausmannite, jacobsite, vredenburgite, and braunite occur at this deposit as a result of thermal metamorphism.
Kaso mine, Tochigi Prefecture, Japan - alleghanyite occurs in association with manganosite at this locality; alleghanyite has also been reported in association with platy zincite from the northern end of the Franklin mine.
Långban, Sweden - braunite, hausmannite, jacobsite, and manganosite occur at this locality and may offer the closest analogy to the Franklin ores.

McSween comments that the lack of chemical analyses of the ore minerals at these deposits precludes accurate comparisons between the assemblages, but he offers the following general observations: (1) Braunite and tephroite are common phases in the metamorphosed sedimentary manganese deposits and are represented by sonolite in the Franklin ores (a confusing statement—tephroite was a common mineral at Franklin, and in his description of the other deposits McSween made no mention of this mineral]. (2) Manganosite is a rare mineral and apparently forms only at very high temperatures. (3) Jacobsite and hausmannite are common among metamorphosed manganese deposits, but the high zinc contents of the Franklin spinels make these phases distinctive. (4) Manganoan zincite and the complex exsolution relationships between zincite and manganosite are features unique to the Franklin area.

ERV 12/90

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Protore and metamorphism

Reference: Leavens, P.B., 1988, Protore and metamorphism of the Franklin and Sterling Hill (New Jersey) Zn-Fe-Mn ore deposits [abs.]: V.M. Goldschmidt Conference (May 11-13, 1988), Baltimore, MD: *V.M. Goldschmidt Programs and Abstracts*, University of Pennsylvania, Philadelphia, PA, p. 56

Author Address: Department of Geology, University of Delaware, Newark, DE 19716.

The Zn-Fe-Mn oxide and silicate deposits at Franklin and Sterling Hill in recent years have been interpreted as metamorphosed ocean-floor exhalative deposits. The deposits are here further interpreted as having formed in a narrow rift lake or linear sea with restricted circulation. The protore was a variable mixture of sphalerite, hemimorphite, smithsonite, sauconite, and iron and manganese oxides formed in a terrestrial or shallow marine setting through a combination of hot-spring deposition (sphalerite) and syndepositional weathering and reworking. Argillaceous clastic sediments, local evaporites, and manganoan limestones were also deposited and were intercalated with the protore minerals. Dolomitic limestones and marls were the major sediments deposited beyond the ore-bearing horizons.

Metamorphism of these deposits to sillimanite grade during the late Precambrian Grenville orogeny produced the remarkable assemblage seen today. Sphalerite remained unaltered and is locally abundant in the Sterling Hill ores. Hemimorphite dehydrated to willemite, and smithsonite formed zincite or reacted with iron and manganese oxides to form the abundant franklinite ores. The dehydration of hemimorphite to willemite released large amounts of water and thus locally lowered the proportion of CO_2

in the metamorphic pore fluids, encouraging decarbonation reactions. The high-grade minerals glaucochroite and wollastonite formed locally, but the lower-grade pair rhodonite-calcite is typical of the deposits in the absence of abundant willemite. In marble outside the deposits, calcite + quartz is a common assemblage but wollastonite has not been found.

ERV 12/90

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Shear zone development in marble

Reference: Stephens, G.C., Metsger, R.W., and Yang, Qingming, 1988, Shear zone development in marble: observations on the Zero fault at the Sterling Hill mine, Sussex County, New Jersey [abs.]: *Geological Society of America Abstracts and Programs,* **20**, no. 7, p. A180

Authors' addresses: Stephens, Yang: Department of Geology, George Washington University, Washington, D.C. 20052. Metsger: New Jersey Zinc Company, Ogdensburg, NJ 07439.

The Zero fault, a major shear zone of N35E trend and near-vertical dip, has been mapped from the surface to depths of 2450 feet within the Sterling Hill mine, where it cuts through the Precambrian Franklin Marble. The fault truncates the east-plunging orebody and offsets its down-plunge extension. Times of major fault movement are poorly constrained but are believed to have occurred during the mid- to late Paleozoic.

Franklin Marble outside the shear zone consists of large, single-twinned calcite crystals with an average grain size of 8-30 mm; disseminated flakes of graphite are a minor (1-2%) constituent. Calcite grains at the margins of the shear zone are multiply rather than singly twinned, and the earlier twins are deformed. Recrystallization of these grains within the shear zone led progressively to the production of a mosaic of much smaller, strain-free grains. Regions of high strain within the shear zone are marked by extreme grain-size reduction, strong grain-shape preferred orientation due to flattening parallel to the shear zone, and a marked increase in graphite content due to pressure solution during faulting.

ERV 12/90

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SCENES UNDERGROUND

Figure 1. Loading an ore car in the Sterling Mine, Ogdensburg, New Jersey (undated). Photograph courtesy of the Franklin Mineral Museum archives.

Figure 2. Drilling a round in the Franklin Mine, Franklin, New Jersey, circa 1930-40. Photograph courtesy of Bob Svecz and the Franklin Mineral Museum archives.

THE FRANKLIN-STERLING HILL AREA MINERAL SPECIES LIST (12/31/90)

Key: Species followed by dates were first described from this area during the year indicated. Dates followed by a single asterisk and a second date mean the original species was later found to be polytypic. Species shown in italics remain unique to the area. A double asterisk indicates further confirmation is required.

Acanthite
Actinolite
Adamite
Adelite
Aegirine
Akrochordite
Albite
Allactite
Allanite-(Ce)
Alleghanyite
Almandine
Analcime
Anandite
Anatase
Andradite
Anglesite
Anhydrite
Annabergite
Anorthite
Anorthoclase
Antlerite
Aragonite
Arsenic
Arseniosiderite
Arsenopyrite
Atacamite
Augite
Aurichalcite
Auroraite
Austinite
Azurite
Bakerite
Bannisterite - 1968
Barite
Barium-pharmacosiderite
Barylite
Barysilite
Bassanite
Bastnäsite-group mineral
Baumhauerite
Bementite - 1887
Berthierite
Biotite
Birnessite
Bornite
Bostwickite - 1983
Brandtite
Breithauptite
Brochantite
Brookite
Brucite
Bultfonteinite
Bustamite
Cahnite - 1927
Calcite
Canavesite
Carrollite
Caryopilite
Celestine
Celsian
Cerussite
Chabazite
Chalcocite
Chalcophanite - 1875
Chalcopyrite
Chamosite
Charlesite - 1983
Chlorophoenicite - 1924
Chondrodite
Chrysocolla
Clinochlore
Clinochrysotile
Clinoclase
Clinohedrite - 1898
Clinohumite
Clinozoisite
Clintonite
Conichalcite
Connellite
Copper
Corundum
Covellite
Cryptomelane
Cuprite
Cuprostibite
Cuspidine
Datolite
Descloizite
Devilline
Digenite
Diopside
Djurleite
Dolomite
Domeykite
Dravite
Dypingite
Edenite
Epidote
Epsomite
Erythrite
Esperite - 1965
Euchroite
Eveite
Fayalite
Feitknechtite - 1965
Ferrimolybdite
Ferristilpnomelane
Ferro-axinite
Flinkite
Fluckite
Fluoborite
Fluorapatite
Fluorapophyllite
Fluorite
Forsterite
Franklinfurnaceite - 1987
Franklinite - 1819
Friedelite
Gageite-1Tc - 1910*, 1987
Gageite-2M - 1910*, 1987
Gahnite
Galena
Ganomalite
Ganophyllite
Genthelvite
Gersdorffite
Gerstmannite - 1977
Glaucochroite - 1899
Goethite
Gold
Goldmanite
Graphite
Greenockite
Grossular
Groutite
Guerinite
Gypsum
Haidingerite
Halotrichite
Hancockite - 1899
Hardystonite - 1899
Hastingsite
Hauckite - 1980
Hausmannite
Hawleyite
Hedenbergite
Hedyphane
Hematite
Hematolite-like mineral
Hemimorphite
Hendricksite - 1966
Hercynite
Hetaerolite - 1877
Heulandite
Hexahydrite
Hodgkinsonite - 1913
Holdenite - 1927
Hübnerite
Humite
Hyalophane
Hydrohetaerolite - 1935
Hydrotalcite
Hydroxyapophyllite
Hydrozincite
Illite

Ilmenite
Jacobsite
Jarosewichite - 1982
Jerrygibbsite - 1984
Johannsenite - 1938
Johnbaumite - 1980
Junitoite
Kaolinite
Kentrolite
Kittatinnyite - 1983
Kolicite - 1979
Köttigite
Kraisslite - 1978
Kutnohorite
Larsenite - 1928
Laumontite
Lawsonbauerite - 1979
Lead
Legrandite
Lennilenapeite - 1984
Leucophoenicite - 1899
Linarite
Liroconite
Lizardite
Löllingite
Loseyite - 1929
Magnesiohornblende
Magnesioriebeckite
Magnesium-chlorophoenicite - 1924
Magnetite
Magnussonite
Malachite
Manganaxinite
Manganberzeliite
Manganese-hörnesite
Manganhumite
Manganite
Manganosite
Manganpyrosmalite - 1953
Marcasite
Margarite
Margarosanite - 1916
Marialite
Marsturite - 1978
Mcallisterite
Mcgovernite - 1927
Meionite
Melanterite**
Meta-ankoleite
Metalodevite
Metazeunerite
Microcline
Mimetite
Minehillite - 1984
Molybdenite
Monohydrocalcite
Mooreite - 1929
Muscovite
Nasonite - 1899
Natrolite
Nelenite - 1984
Neotocite
Newberyite
Niahite
Nickeline
Nontronite
Norbergite
Ogdensburgite - 1981
Ojuelaite
Orthochrysotile
Orthoclase
Orthoserpierite
Otavite
Oyelite-like mineral
Parabrandtite - 1987
Pararammelsbergite
Parasymplesite
Pargasite
Pectolite
Pennantite
Petedunnite - 1987
Pharmacolite
Pharmacosiderite
Phlogopite
Picropharmacolite
Pimelite
Powellite
Prehnite
Pumpellyite-(Mg)
Pyrite
Pyroaurite
Pyrobelonite
Pyrochroite
Pyrophanite
Pyroxmangite
Pyrrhotite
Quartz
Rammelsbergite
Realgar
Retzian-(La) - 1984
Retzian-(Nd) - 1982
Rhodochrosite
Rhodonite
Riebeckite
Roeblingite - 1897
Romeite
Rosasite**
Roweite - 1937
Rutile
Safflorite
Sarkinite
Sauconite
Schallerite - 1925
Scheelite
Schorl
Sclarite - 1989
Scorodite
Seligmannite
Sepiolite
Serpierite
Siderite
Sillimanite
Silver
Sjögrenite
Skutterudite
Smithsonite
Sonolite
Spessartine
Sphalerite
Spinel
Starkeyite
Sterlinghillite - 1981
Stilbite
Stilpnomelane
Stilpnomelane (Mn-dominant)
Strontianite
Sulfur
Sussexite - 1868
Svabite
Synadelphite
Talc
Tennantite
Tephroite - 1823
Thomsonite
Thorite
Thortveitite
Tilasite
Tirodite
Titanite
Todorokite
Torreyite - 1929
Tremolite
Turneaureite - 1985
Uraninite
Uranophane
Uranospinite
Uvite
Vesuvianite
Villyaellenite
Wallkilldellite - 1983
Wawayandaite - 1990
Wendwilsonite - 1987
Willemite - 1824
Wollastonite
Woodruffite - 1953
Wulfenite
Wurtzite
Xonotlite
Yeatmanite - 1938
Yukonite
Zinalsite - 1958
Zincite - 1810
Zinkenite
Zircon

SPECIES TOTALS
337 Confirmed
2 Need further confirmation
66 First described from area
33 Unique to area

PRESIDENT'S MESSAGE

Philip P. Betancourt
410 Chester Avenue,
Moorestown, NJ 08057

The Society is looking forward to a new year of activities. Great changes are taking place at the Franklin Mineral Museum, and the new architectural addition being built this winter will soon house the Wilfred Welsh mineral collection, bringing a new dimension to the exhibits available to the Franklin area.

The first new activity of the year has already taken place. As announced at the last meeting of 1990, the Society was invited to visit the Smithsonian Institution in January. Twenty-seven members of the FOMS enjoyed the trip to Washington on January 12. The visit, at the invitation of Dr. Pete J. Dunn of the Department of Mineral Sciences, included a tour of the public mineral gallery as well as an opportunity to see the Smithsonian's research facilities and its reference collection of minerals. Housed in 203 tiers of drawers, the reference collection is one of the world's most important mineral collections. It incorporates many specimens which have been scientifically studied, including many type specimens for mineral species. The collection in the museum preserves these specimens for future reference or additional study, so that it is a major scientific resource for the field. The museum is not normally able to open this facility for individuals or groups because of the heavy demands on staff and their research, and such a visit as the FOMS enjoyed can only take place every few years. The Society is thankful for the rare opportunity afforded its members at this visit, and all those who attended the tour were very appreciative of the trouble Pete went through to arrange it. Many rare and unique Franklin and Sterling Hill specimens, which members would otherwise never have had an opportunity to see, were available. The trip was enjoyed by all.

One of the highlights of the spring will be the First Annual FOMS Spring Sell/Swap, sponsored jointly with the Sterling Hill Mining Company. The event will replace the April meeting and will run for two days, Saturday and Sunday, April 20-21. It will be held at the Sterling Mine, in Ogdensburg.

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Sterling Hill Update

[Charles B. Ward, Committee for Historic Preservation of the Sterling Hill Mine, has provided the following news item.]

"As the curtain lifts on a new chapter in the lengthy history of the Sterling Hill mine in Ogdensburg, New Jersey, the Hauck brothers Richard and Robert, who last year privately acquired the mine, see the water rising. The Haucks and many dedicated volunteers have made herculean efforts to save equipment and minerals from the depths of the mine. On the surface they have uncovered artifacts and old workings, and have created paths to and through the Passaic open pit to connect to a newly blasted and opened tunnel. They have created an attractive entrance and gift shop to welcome all. A unique experience awaits visitors, including an informative tour underground to the 'Rainbow Room' where minerals under ultraviolet light fluoresce in situ. The tour ends at the Mine Museum where ore cars, crushers, mine lamps, and mineral displays educate all on Sterling Hill mining.

The Haucks and their volunteers continue to work very long hours to recover equipment and minerals from one of the oldest mines in the United States. Even as the water rose to flood the 1000-foot level, fluoborite was discovered and preserved. On the 900-foot level, realgar and mcgovernite have been rediscovered. Specimens of realgar, mcgovernite, hedenbergite, chabazite, barite, wollastonite and some of the best stilbite ever found have been preserved in the Mine Museum. Unfortunately, in October of 1990 the 900-foot level was lost to rising water. Even as you read this update, sand tailings used for backfill in the stopes are settling and moving to lower regions in the mine, ending forever our opportunity to study and preserve those portions of the unique mineral and mining history of Sterling Hill.

We feel it is essential to support the Hauck's endeavor to secure the right to pump out the water and historically register the mine site for future generations. We have therefore established a trust fund for the purpose of raising the $50,000 required to start up the pumps to prevent water from claiming the mine. It is also hoped that once the pumps are working the water level will fall and more of the history of Sterling Hill will be revealed.

The Committee for Historic Preservation of the Sterling Hill Mine has been authorized to make the following offer: For the sum of $25 you can receive a small cabinet-size specimen of recently recovered fluorescent minerals to make a special addition to your collection and, at the same time, you will know that you are contributing to preserve a piece of the Natural History. Those who are able to contribute larger sums will receive appropriate specimens for their collection.

Please support this worthwhile effort to save this geologically significant and unique mine by way of contributions. To order your piece of history please select from one of the following minerals and forward your remittance of $25.00 plus $3.95 shipping and handling (N.J. residents please add $1.50 sales tax) to: SAVE THE MINE, c/o Charles B. Ward, C.P.A.—Trustee, C.H.P.S.H.M., 56 Chambers Road, Danbury, CT 06811. You may specify (1) fluorescent willemite-calcite, (2) zincite, or (3) fluorescent wollastonite. You will also receive: a certificate stating mineral species, location within the mine, and date; and a free pass for a tour of the mine ($6.50 value).

Plan to visit the mine, located at 30 Plant Street, Ogdensburg, New Jersey 07439; telephone: (201) 209-7212."

[**Editor's Note**: Richard Hauck informs me (personal communication while at the Tucson Show) that the pumps are running at Sterling but that does not mean the financial needs are over. The donations to date (as of mid-February) were around $30,000; a good start, of course, but still far short of the goal amount. Don't put it off, make your contribution now!]

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ON APR 20-21, 1991

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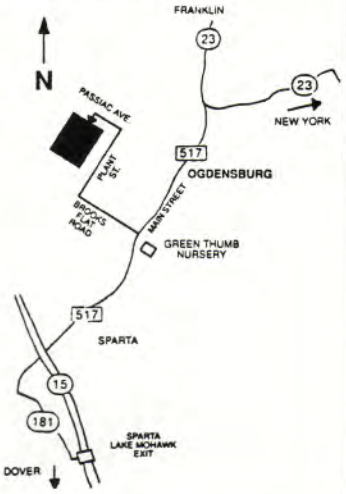

FURTHER INFORMATION:

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The regular activities of the Society consist of lecture programs and field trips. The regular meetings of the Society are held on the third Saturday of March, April, May, June, September, October, and November. Unless otherwise specified, lecture programs will be followed by business meetings. The seasonal schedule below shows **time** and **place** in **bold face** for all activities. Except for March and November meetings, held at the Hardyston Township School, all others take place at Kraissl Hall, Franklin Mineral Museum, Evans Street, Franklin, New Jersey.

* *

SPRING ACTIVITY SCHEDULE

March 16, 1991 (Saturday)

Field Trip:	**None**	
Program #1	**10 a.m. -1 p.m.**	**SWAP and SELL.** All activities today will be held at the **Hardyston Township School, Route 23, Franklin, New Jersey**
Business Meeting	**1 p.m. -1:30 p.m.**	
Program #2	**1:30-3 p.m.**	**"New View of Sterling Hill Underground"** by Bernard Kozykowski

April 20-21, 1991 (Saturday and Sunday)

Field Trip:	**None**	
Lecture:	**None**	
Special Event:	**9 a.m. - 4 p.m.**	**The 1st Annual FOMS Spring Sell/Swap will be held outdoors in the Sterling Mine parking lot, 30 Plant Street, Ogdensburg, N.J.** Please see the full page ad on page 22 for additional details.

May 18, 1991 (Saturday)

Field Trip:	**9 a.m. - noon**	**Old Andover Iron Mine, Limecrest Road, Andover, New Jersey.**
Lecture:	**1:30 - 3 p.m.**	**Speaker to be announced later by flyer.** Both the lecture and the business meeting which follows it will be held in **Kraissl Hall, Franklin Mineral Museum, Evans Street, Franklin, N.J.**

June 15, 1991 (Saturday)

Field Trip:	**10 a.m. - noon**	**Buckwheat Dump, Evans Street, Franklin, N.J.**
Lecture:	**1:30 - 3 p.m.**	**Speaker to be announced later by flyer.** Both the lecture and the business meeting which follows it will be held in **Kraissl Hall, Franklin Mineral Museum, Evans Street, Franklin, N.J.**

* *

COLOR SLIDES AND COLOR PRINTS AVAILABLE FROM THE FRANKLIN-OGDENSBURG MINERALOGICAL SOCIETY

Photomicrographs of Franklin-Sterling Hill minerals by Dr. Alfred L. Standfast

Each set of color slides or color prints features four different minerals from the Franklin-Sterling Hill area. There are ten different sets available. The minerals featured in the various sets are listed below; the abbreviations in parentheses indicate where the mineral was found:

Set #1--Aragonite, (SH); gold, (SH); rhodonite with garnet, (Fr); and sarkinite, (SH)
Set #2--Chalcopyrite with aurichalcite, (Fr); siderite, (SH); silver, (SH); and tephroite with willemite, (Fr)
Set #3--Copper, (SH); franklinite with chlorophoenicite, (Fr); quartz with rutile, (Fr); and smithsonite, (SH)
Set #4--Graphite with realgar, (SH); greenockite with galena, (SH); hauckite, (SH); and willemite, (Fr)
Set #5--Bostwickite, (Fr); erythrite, (SH); lead vein in ore, (Fr); and zincite with pyrochroite, (SH)
Set #6--Hodgkinsonite, (Fr), retzian-(Nd), (SH); scheelite, (SH); and thomsonite, (Fr)
Set #7--Cahnite, (Fr); clinohedrite, (Fr); goethite, (Fr); and vesuvianite, (Fr)
Set #8--Azurite with wurtzite, (Fr); gageite, (Fr); kolicite, (SH); and roeblingite on leucophoenicite, (Fr)
Set #9--Anatase, (Fr); barite, (Fr); gypsum, (SH); and leucophoenicite, (Fr)
Set #10--Aurichalcite with hemimorphite, (SH); fluorite, (SH); hancockite, (Fr); and heulandite, (SH)

Each set is priced at $5.00. If ordered by mail, indicate whether you want slides or prints and add $0.50 per set for postage and handling. Make check or money order payable to FOMS and address your order to: Stephen C. Misiur, 309 Fernwood Terrace, Linden, NJ 07036

* *

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