THE PICKING TABLE

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Journal of the Franklin-Ogdensburg Mineralogical Society, Inc.
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ABOUT THE COVER PHOTOGRAPHS

The speakers at the Lehigh Symposium are shown in order of their appearance at the podium. Top row, left to right: Clifford Frondel (Harvard University), Avery A. Drake, Jr. (USGS, Reston, Va.) and Robert W. Metsger (N.J. Geological Survey). Center row, left to right: Peter B. Leavens (University of Delaware), Craig A. Johnson (Yale University), and Paul B. Moore (University of Chicago). Bottom row, left to right: Carl A. Francis (Harvard University) and Charles B. Sclar (Lehigh University). Manuel Robbins (to whom we all are indebted for conceiving the idea of having this symposium and who pushed it all to fruition) is shown at bottom right. Cover photographs courtesy of Betty L. Dean.

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FROM THE EDITOR'S DESK

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

Lehigh Symposium *Proceedings Volume*

The story of the Lehigh Symposium is covered on page 20 in this issue. The *Proceedings Volume*, is mentioned only casually. Only 400 copies were printed, the price is $15 by mail or $12.50 at FOMS meetings or at the Society's table at various shows. The supply will move quickly because it represents the most up-to-date book in print concerning the character and origin of the Franklin-Sterling Hill orebodies. Dr. Charles B. Sclar, Professor of Geology, Lehigh University, has contacted *Economic Geology, American Mineralogist, Canadian Mineralogist,* etc. and provided these publications with information for their subscribers about the *Proceedings Volume,* including how to order it from FOMS. Don't put off getting your copy!

Editorial Board now has an additional member

I am pleased to announce that Earl R. Verbeek, U.S. Geological Survey, Denver, has joined the *Picking Table* Editorial Board. Earl's expertise in geology, his writing skills, and his love of Franklin-Sterling Hill mineralogy make themselves readily evident in his work for this publication. Earl has agreed to do the abstracting of articles for the "Mineral Notes" section of the *Picking Table* in addition to the usual critique of articles submitted for possible publication. He has provided full input for this issue and removed considerable burden from the Editor's shoulders. Welcome aboard, Earl, and the membership thanks you!

***Picking Table* status report**

The FOMS's Xerox 630 Memorywriter is no longer used in preparing the *Picking Table.* This issue has been created on a Macintosh SE computer (enhanced with a Dove accelerator and an additional 4 meg RAM), using Aldus PageMaker and Adobe TypeMaster software, and an Apple ImageWriter II (dot-matrix printer) for printout. All photographs accompanying the text are still pasted up manually; also, the front and back covers are still manual artwork layouts. However, this issue is a transition to better things. FOMS plans to purchase a laser printer later this year, a computer of its own in 1991, and a scanner for reproducing photographs in 1992.

I have agreed to remain Editor for a while longer. However, this does not mean that the search for a new Editor should cease. FOMS needs the right person to step forward, learn the ropes, and take over when they feel comfortable with the duties and the equipment.

FOMS visits the Sterling Hill Mining Museum

The Society extends its thanks to Richard and Robert Hauck for inviting FOMS to visit the Sterling Hill Mining Museum premise on Plant Street in Ogdensburg, New Jersey on June 16, 1990, following the regular FOMS meeting. Roughly forty members took advantage of this splendid opportunity to view the operation prior to its official opening. Tour guides were available to lead small groups through the various buildings and tunnels, to offer explanations of what was being viewed, to answer numerous questions, and to insure the safety of the attendees during the tour. All of us were impressed by this tremendous undertaking by the Hauck family. The work accomplished already by the Haucks and their many dedicated volunteer workers is staggering. The Sterling Hill Mining Museum and the Franklin Mineral Museum make a wonderful one day trip and provide a true learning experience for students, bus tour patrons, mineral lovers, mining history buffs, etc.

Twelfth Annual FOMS Dinner

Saturday, October 6, 1990, is the date for the annual FOMS Dinner. Please see the inside back cover of this issue for details. Those of you who aren't familiar with the annual dinner should try it. Not only is the food good, the price reasonable, the fellowship the best, but there is a guest speaker and an auction. The auctioned items include minerals, mining memorabilia, books, photographs, fun items, etc. The proceeds go to the FOMS for its use in pursuing its educational purposes. The key to a successful evening is to bring desirable items to the auction, then just enjoy yourself!

Needed--an FOMS Display Committee Chairman

Steven Misiur has announced his intent to resign as the FOMS Displays Chairman at the end of the year. Steve has done a masterful job in soliciting and displaying minerals on behalf of FOMS at several events each year. FOMS expresses its sincere appreciation!

(Continued on Page 11, See Editor)

Notes from the Laboratory

&

Changes to the list of species from Franklin and Sterling Hill

Dr. Pete J. Dunn
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Franklin, NJ 07416

[Editor's Note: Each year a list of the mineral species occurring in the Franklin and Sterling Hill area appears as part of the official Program for the Franklin and Sterling Mineral Exhibit, which takes place the first weeked in October. The changes noted below apply to that 1989 list.]

Additions to the list

Antlerite: This species occurs as part of a thin film encrusting rhodonite which is associated with andradite and mica, from Franklin. The thin film is a mixture of brochantite, gypsum, and antlerite.

Breithauptite: This is a nickel antimonide mineral which was described in the Spring, 1990, issue of the *Picking Table*.

Marialite: This member of the scapolite group occurs as a light yellow 2-3 cm thick vein, bordered by graphite and mica, and crosscutting calcite from the Franklin Marble.

Meta-ankoleite: This is a potassium uranium phosphate hydrate mineral of the meta-autunite group. It occurs as light yellow minute crystals on Sterling Hill ore, was found by Mr. John Buczinzky, and was verified by Dr. Eugene Foord of the U.S. Geological Survey using X-ray and chemical analytical methods.

Pharmacolite: This is a calcium arsenate hydrate mineral which had been reported previously, in the 1970s, but with inadequate proof. This occurrence, as minute colorless crystals on white calcite from Sterling Hill, was found by Mr. John Buczinzky, and was verified by Dr. Eugene Foord of the U.S. Geological Survey, using X-ray and chemical analytical methods.

Wawayandaite: This is a species new to the science and it was first discovered on a specimen from the Franklin Mine. An abstract of the description appears elsewhere in this volume.

Changes to the list

Aegirine replaces acmite as a change in name only, to be consistent with the new I.M.A. nomenclatural conventions for pyroxenes.

Gageite-1Tc and Gageite-2M replace gageite on the list. Both polytypes are present at Franklin but are intermixed and cannot be distinguished without advanced methods of study.

Halloysite is deleted for lack of a known verified specimen. A significant number of clay specimens have been examined in the last 17 years, but no halloysite has been found.

Pennantite replaces grovesite in name only, in order to be consistent with contemporary nomenclature conventions for these minerals.

Richterite: Examination of material thought to be richterite indicates that preliminary identification was in error. It is deleted from the list.

Thorite is now considered validated and the qualifying asterisk is removed. A specimen in the Franklin Mineral Museum has a few traces of thorite.

Changes to the unique list

Esperite is deleted from the unique list. It was reported from the El Dragón mine, Potosi, Bolivia, by Grundmann *et al* (1990) in *Mineralogical Record*, **21**, 133-146.

Wawayandaite is added to the unique list as a new species from Franklin.

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Clinochrysotile Pseudomorphs from the Sterling Mine, Ogdensburg, New Jersey

Carl A. Francis
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Introduction

Significant mineral specimens are occasionally discovered by looking in unconventional places. It is well known that acid-insoluble residues of the Franklin Marble can yield fine crystals of graphite (Palache, 1935) and other minerals. In the present case crushing centimeter-size franklinite grains and crude crystals liberated superb pseudomorphs up to 0.5 mm in diameter of the serpentine, clinochrysotile. This is a report of that discovery.

Discovery

During investigation of specimens from the zinc mines in Sussex County, New Jersey, as part of a larger study of the forsterite-tephroite solid-solution series (Francis, 1985), caramel-colored, translucent euhedra were observed in the crushed fraction of a hand sample believed to be from the Sterling Mine (H113721). The sample consists of coarse-grained forsterite, franklinite and zincite in calcite. Hand picking of the crushed grains in search of forsterite cleavages suitable for single crystal X-ray diffraction studies turned up about half a dozen crystals of a then-unidentified mineral which display forms belonging to the isometric crystal system (Figures 1 and 2). The crystals are dominantly octahedrons, some truncated by faces of the rhombic dodecahedron, and are striated parallel to the octahedral edges. Further searching produced a crystal attached to franklinite. Subsequent inspection of the franklinite chips and franklinite surfaces on the hand specimen established that the octahedrons occur only as inclusions within franklinite and that they are abundant.

Optical Data

The opal-like translucency was the first clue that the octahedrons are actually pseudomorphs. A simple optical test firmly established the pseudomorphic character of the octahedrons. Under cross polarized light the octahedrons were observed to consist of anisotropic radiating fibers rather than the uniformly extinct (i.e. black) single crystals expected of an isometric mineral. This observation also suggested that the peculiar luster is due to the scattering of light from the surfaces of the fibers. The fibers are length-slow and have an average refractive index of 1.56. One octahedron contained a highly birefringent inclusion but the crystal was lost before the identity of the inclusion could be determined.

Chemical and X-ray Data

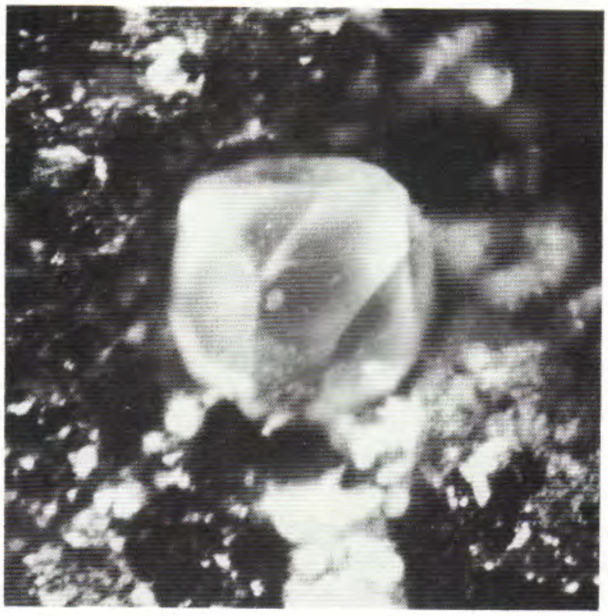
Semiquantitative chemical data were obtained using a Kevex energy-dispersive analytical system on Harvard's Cameca electron microprobe. Analysis revealed only magnesium and silicon, which severely limited the possibilities among known minerals. Identification as the serpentine group mineral clinochrysotile, which is consistent with both the chemical and optical data, was made by the traditional X-ray powder film method.

Subsequently, quantitative chemical analyses of the clinochrysotile, forsterite, and franklinite were made by wavelength-dispersive methods. The results for clinochrysotile in wt.% are: SiO_2 41.24; Al_2O_3 0.49; FeO 0.67; MnO 0.70; MgO 39.40; ZnO 1.28; Total 83.78 wt.%. Thus, clinochrysotile shows only minor substitution of Al, Fe, Mn and Zn for Mg. The total is low because the water content cannot be determined by a microprobe. This specimen contains the most Mg-rich member of the forsterite-tephroite series reported from the Sussex County zinc mines. This particular point analysis of forsterite yields the empirical formula, $(Mg_{1.41}Mn_{0.47}Zn_{0.11}Fe_{0.01})SiO_4$, which is consistent with but markedly lower in zinc than the average analysis reported by Francis (1985). The franklinite formula, $(Zn_{0.45}Mn_{0.33}Fe_{0.17}Mg_{0.06})(Fe_{1.79}Al_{0.19})O_4$, is consistent with the average composition of Sterling Hill concentrates reported by Frondel and Klein (1965).

In the course of the quantitative analyses some of the pseudomorphs were observed to be multiphase. Most of the additional minerals present were identified using the energy-dispersive system. The back-scattered electron image (Figure 3) shows that about half of the sharply defined pseudomorph is clinochrysotile (appears as dark gray and has a crackled appearance). The rest is barite (appears as white) and manganoan calcite (appears as medium gray). Careful inspection of the calcite field reveals patches of a second calcite (appears as a paler gray in image) which has a higher manganese content. On the left edge of the smaller barite field is a gray manganese-magnesium silicate (indicated as #6 in Figure 3) that may be sonolite. The elongated mineral with the ragged outline in the clinochrysotile field was not identified.

Discussion

This study clearly established that the modified octahedrons occurring as abundant inclusions in the franklinite of sample H113721 are pseudomorphs predominantly composed of clinochrysotile. No determination of the antecedent mineral is yet possible as no remanent isotropic core has been found within the pseudomorphs. The best clue to its identity is its morphology. The modified octahedral morphology of these pseudomorphs is the typical habit of spinal-group minerals. I suggest that the antecedent was a member of the spinel group, perhaps gahnite. Exsolution intergrowths of gahnite in franklinite are described by Frondel and Klein (1965) and Carvalho and Sclar (1988). The accompanying forsterite contains exsolved willemite (Francis,



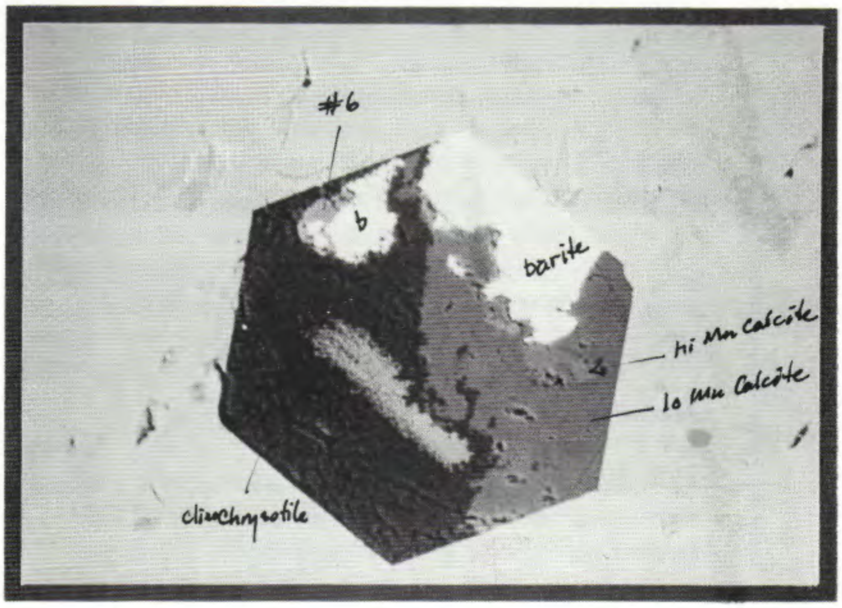


Figure 1 (Top). Clinochrysotile pseudomorph (0.40 mm diameter) embedded in franklinite showing an octahedron {111} modified by the rhombic dodecahedron {110}.

Figure 2 (Center). Clinochyrsotile pseudomorph (0.43 mm diameter) on franklinite, which is on zincite.

Figure 3 (Left). Back-scattered electron image of a multiphase pseudomorph (0.17 mm diameter). Clinochrysotile shows as the dark gray mineral on the left with a crackled appearance. Barite shows as white. Calcite shows as two shades of medium gray at right.

1985). If the franklinite originally crystallized with "excess" aluminum and magnesium, it is likely that it would have exsolved a separate aluminous spinel-group mineral, gahnite. The gahnite was later replaced by clinochrysotile etc. providing microscopic evidence for a geological event that is not at all obvious in a megascopic examination of the hand sample. It is such latter hydrothermal events that created the rich diversity of minerals for which these mines are so famous.

Acknowledgments

I am grateful to David Lange for assistance with the microprobe analyses and to Omer Dean for his photomicrography.

References

Caravalho, A.V., and C.B. Sclar (1988) Experimental determination of the $ZnFe_2O_4$ - $ZnAl_2O_4$ miscibility gap with application to franklinite-gahnite exsolution intergrowths from the Sterling Hill zinc deposit, N.J. *Economic Geology*, **83**, 1447-1452.

Francis, C.A. (1985) New data on the forsterite-tephroite series. *American Mineralogist*, **70**, 568-575.

Frondel, C. and C. Klein, Jr. (1965) Exsolution in franklinite. *American Mineralogist*, **50**, 1670-1680.

Palache, C. (1935) The minerals of Franklin and Sterling Hill, New Jersey. *U.S. Geological Survey Professional Paper 180*, 135 p.

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A Note on Hastingsite from Franklin

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Five specimens of lustrous black amphibole from assemblages away from the zinc ore at both Franklin and Sterling Hill were analyzed at the U.S. National Museum by Pete J. Dunn using microprobe techniques. Associations include feldspar, magnetite, biotite, calcite, and other minerals. The samples, which are all from localities in Franklin, include:

1. Euhedral black crystals in white marble from the dumps and prospects south of the large quarry on Cork Hill Road (commonly called the Fowler or B. Nicol Quarry). Specimen PPB-2769.

2. Black crystals, one of the chief constituents in gneiss, with magnetite, from Balls Hill. Specimen PPB-8751.

3. Black crystals in a vein of feldspar, from the Gooseberry Iron Mine, Balls Hill. Specimen PPB-8762.

4. Black crystals up to several inches across with two feldspars, from a syenite outcrop south of the Gooseberry Iron Mine, Balls Hill. Specimen PPB-8966.

5. Black amphibole with biotite and magnetite, from the iron mine dump south of the Buckwheat Dump and north of the Franklin Pond. Specimen PPB-9373.

All of the samples were identified as hastingsite. Apparently this species is common among the black amphiboles away from the zinc orebodies. Many specimens are available for collecting.

Aside from specimen PPB-2769, the others all contained 6 - 9 wt. % MgO and 19 - 24 wt. % FeO (total iron calculated as ferrous iron). All specimens contain less than 1.0 wt. % ZnO. The anomalous specimen, from the prospects south of the large quarry on Cork Hill Road, contained approximately 17 wt. % MgO, and 6 wt.% FeO (calculated as above).

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Membership News

Neal K. Resch passed away recently due to a heart attack. Neal, a trustee of the Society, was a vital and active member. He will be sorely missed by FOMS. The Society extends its deepest sympathy to his family.

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Those Rare Uraninites from Franklin and Sterling Hill, New Jersey

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Introduction

Uraninite is one of the rarities of the Franklin-Sterling Hill area. Roughly twenty-four years separate the two verified finds of this species, first at Sterling Hill in Ogdensburg and later (1989) at the Buckwheat Dump in Franklin. This article brings together the small amounts of descriptive and historical data which are available on the topic.

The Sterling Hill uraninite

Charles Locke Key, for whom both the mineral species "keyite" and "ludlockite" are named, first recognized the uraninite from Sterling Hill and has been kind enough to provide some background information, which is quoted directly as follows:

Cape Elizabeth, Maine
April 28, 1990

I remember receiving a phone call from Chet Lemanski and "Quicky" when they had their store in Franklin. They were offering me a new find of fantastic Franklinite crystals (their pitch) so I drove up to see them as soon as possible, knowing they knew good crystals when they found them. Indeed they had a lot of about three flats of matrix Franklinites, mostly fist-size and up. This was an unusual batch with highly modified Franklinite xls up to 2" in white Calcite associated with dull black crystals of Willemite, nearly colorless Sphalerite and unique reddish-color blobs of Fluorite. I noticed a dull-gray, metallic cubic xl in one large specimen that was decidedly NOT Franklinite but negotiations for the lot took attention away from specific specimens. I remember paying too much, (I'm sure they wouldn't see it that way — particularly now) but I bought the lot, took it home, proceeded to clean the specimens and when I placed the "XL" under the faucet the water amplified a "halo" emanating from the "XL", quite dramatically. A check for radioactivity confirmed Uraninite for me.

Dr. Frondel was the obvious choice to me at the time to direct the offer of the specimen to. My only regret is that I didn't take a more complete photo-record of the specimen, the xl, the lot; One picture, now lost —like the xl..............

/signed/ C. L. Key

A recent conversation with Chester Lemanski provided a few additional facts for the record: "Chet" and Donald Quick operated the Mine Hill Mineral Shoppe on Main Street in Franklin at the time; the specific flat which contained the uraninite specimen was priced at $10.00; a miner named Wynkoop (spelling uncertain) collected the flat in 1080 Stope, between the 430' and 500' level, in the Spring of 1965; and the New Jersey Zinc Company, once they heard of the uraninite find, explored the area with a scintillation counter but found no additional material. Jack Baum (personal communication) confirms that it was he who did the exploration referred to here.

The correspondence between Dr. Frondel and Charles Locke Key provides additional information about this Sterling Hill uraninite and its importance as a specimen. The first of the letters presented is dated July 1, 1966, and reads as follows:

Dear Mr. Key:

The thought of getting a really good uraninite age determination on your specimen has persuaded me to take up your offer of $750 plus a Bristol chalcocite.

Would you please supply along with the specimen a brief written note telling the where and when and other circumstances attending the discovery of the specimen so that this information can be published.

I plan to core drill the specimen from the back nearly up to the front surface in hope of finding another crystal or of breaking off the back side of the one now seen.

If you want, I can mail you the chalcocite for consideration or you can come up here during the summer at your convenience.

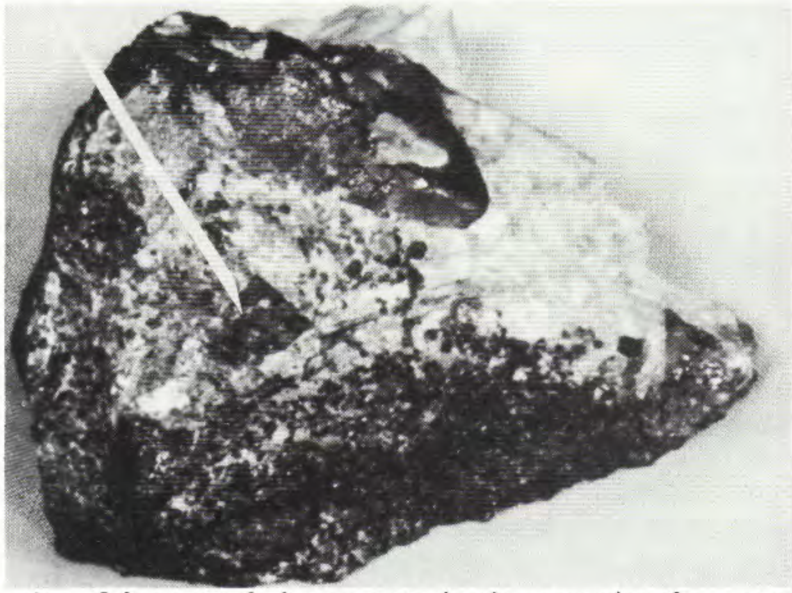
Sincerely yours,
/signed/ Clifford Frondel

The second letter, which accompanied the uraninite specimen to Harvard, includes the background information requested by Professor Frondel. The letter is quoted below essentially in its entirety:

July 20, 1966

Dear Dr. Frondel,

Enclosed herein you will find the Uraninite specimen from the Sterling Mine as per our pre-arranged agreement. I trust you will select a suitable Chalcocite from Bristol, Conn. to supplement the $750.00 purchase



price. I have attached a separate invoice convering the terms of the purchase for your purposes.

I would be most anxious to learn of the results of your efforts concerning Uranium dating and implications thereof. In spite of the economic exigencies placed upon me as a mineral dealer I have a sincere passion for minerals and a genuine concern for their scientific merit.

The details regarding the discovery of the Uraninite specimen are as follows: About this time last year (July, '65) during stoping operations on the 500' level of the Sterling Mine in Ogdensburg, N.J. a large quantity of large, well-formed though highly modified crystals of Franklinite were found. They were imbedded in a pink calcite and associated with euhedral xls of black Willemite, a garnet-red Fluorite and minor Lollingite. Nearly all of the worthy specimens turned up for sale in a local Franklin mineral dealer's stock. Fortunate timing brought me into the dealer's shop at about the same time as he received the specimens. I was very impressed with the Franklinites as they were the best I had seen from the Sterling Mine since it reopened in the '50s. I purchased as many fine specimens as I could find and about the same time I was getting down to the "dregs" I picked up the specimen that had the Uraninite xl in it. The dealer and I settled on a price of $6 or $8.00 for the specimen as a poor Franklinite specimen; later while packing same specimen I noticed what I thought to be an exceptional cubic xl of Franklinite in amongst the other xls. We both remarked about the oddity of the xl and then forgot it for the time. The next day while I was rinsing the specimens off I noticed what appeared to be a classic radiation "halo" surrounding this perfect cubic xl. While the specimen was wet the halo stood out in stark contrast to remainder of Calcite gangue. My suspicion was thoroughly aroused at this point although I couldn't convince myself of what I was optimistically hoping for. A quick check with a geiger-counter and later a more accurate check with a scintillation counter confirmed Uraninite. I was in touch with Mr. Jack Baum, N.J. Zinc Co. geologist, nearly directly to show him the specimen and see if he would search the source stope with a "counter" to determine if any more Uraninite was present................Geologist Baum did succeed in making an investigation of the stope and area but was unable to find any hint of more Uraninite. Subsequent work in the stope as well as scrutiny of many similar specimens paragenetically has failed to disclose any additional Uraninite. It would seem that this specimen is truly a one in a million...billion...what???

In case you need it; you have my permission to use any portion of the foregoing information for the paper you previously mentioned publishing re the Uraninite specimen. Should you do such a paper I hereby request a copy. Thank you.

Anticipating a shred of rapport, I remain,
Very truly yours,
/signed/ Charles L. Key

The third letter, dated July 26, 1966, touches briefly on Dr. Frondel's wonderment about this uraninite. You, the reader, may find yourself pondering the whole topic once the seed is planted in your mind.

Dear Mr. Key:

The uraninite arrived safely. Many thanks for the information about the find, which I will cite in the paper. How the few and widely scattered uranium atoms in the S.H. orebody found each other and built up one crystal of

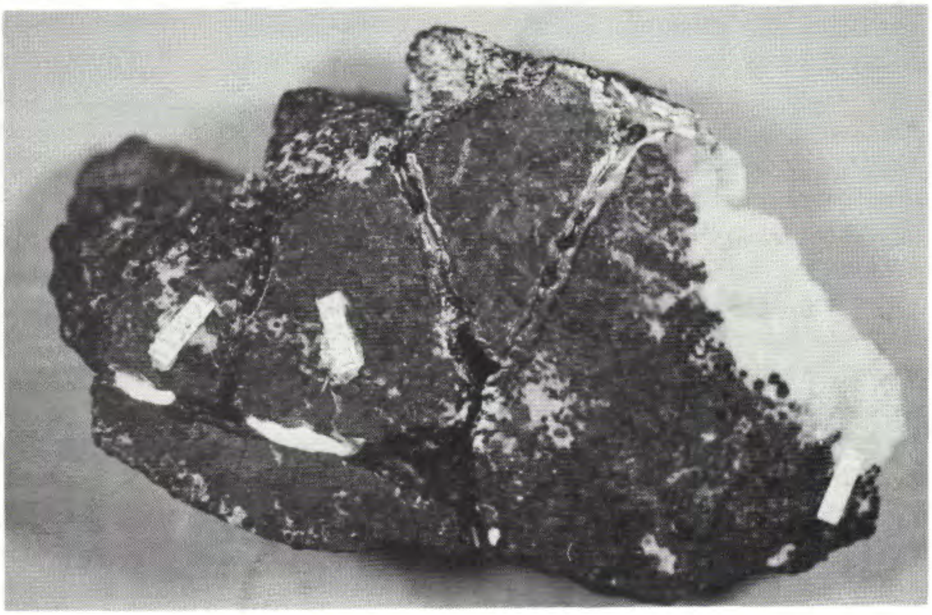


Figure 1 (far left). Uraninite fragment (at end of pointer) embedded in uranophane, Sterling Hill, N.J.: Harvard Mineralogical Museum specimen, H113292.

Figure 2 (opposite page, lower right). The reconstructed matrix for the Sterling Hill uraninite viewed from the bottom; note the four pieces, glue, and catalogue numbers.

Figure 3 (below). The reconstructed matrix for the Sterling Hill uraninite viewed from the top. Pointer shows cavity left when uraninite crystal was removed.

Figure 4 (right). The uraninite crystal fragment spared by science. Some crystal faces are visible; the fragment shares catalogue number H113292 with the matrix portion shown in Figure 1. Coin for size comparison.

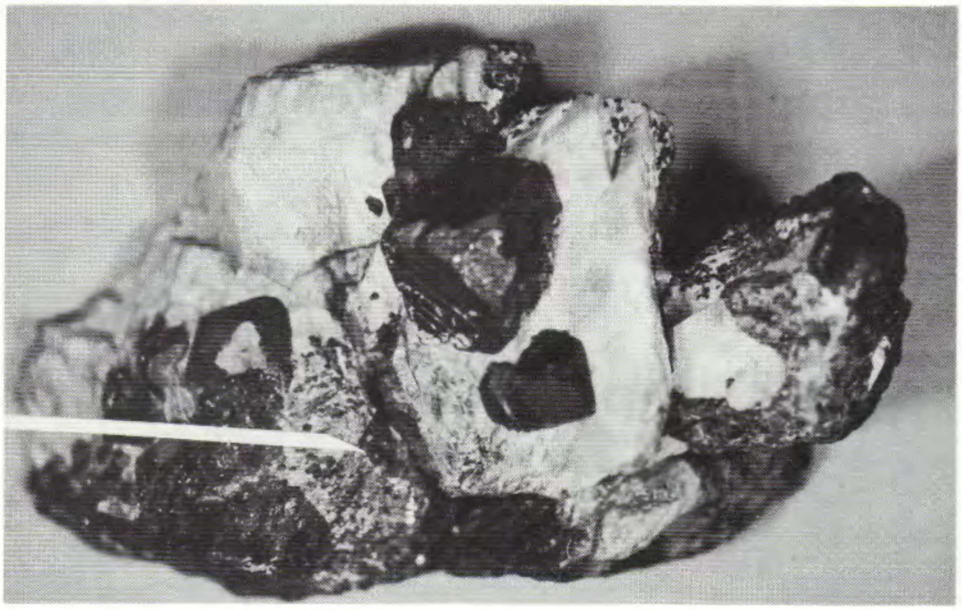
uraninite passes all understanding! A specimen of the Bristol chalcocite will be sent to you, and your invoice has been put through for payment.

Sincerely yours,
/signed/ Clifford Frondel

Almost a quarter century later, Dr. Frondel's wonderment still persists. In a recent conversation he expressed these same thoughts again, and then went on to describe his misgivings about having to destroy the single uraninite crystal for analytical purposes, all as if it had happened yesterday.

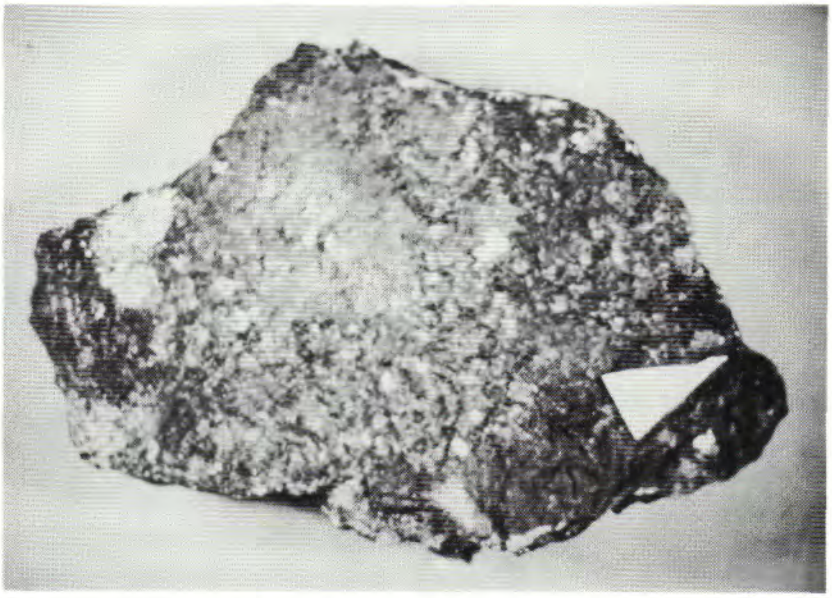
When the author first photographed the Sterling Hill uraninite specimen (Figure 1) at Harvard during the summer of 1987, he was unaware that he was photographing only a portion (9 cm x 8 cm x 5 1/2 cm) of the original matrix material. Carl Francis in a recent conversation clarified the situation: During preparation for analysis, the uraninite specimen was broken into four pieces and these were given consecutive catalogue numbers. A loose uraninite crystal fragment (Figure 4), left over from the age-determination and other analyses, shares catalogue number H113292 with the above-mentioned matrix piece. Both of these specimens are labelled uraninite. Catalogue number H113290 is labelled uranophane. It displays the part of the uranophane halo which constitutes a mold of the missing uraninite crystal. Catalogue number H113291, labelled fluorite, is the matrix portion with the garnet-red fluorite and colorless sphalerite. The fourth matrix piece, H113293, is small compared to the others and is less interesting because of its common constituent minerals (franklinite, calcite, etc.).

Few specimens anywhere have the scientific significance which this prized one possesses. The Harvard Mineralogical Museum has decided to make the uraninite specimen part of its Franklin-Sterling Hill display in its main show room on the third floor. In preparation for the display, the four components of the matrix have been reassembled with glue (Figures 3 and 4) and measure 17 x 10 x 6 cm. As an added highlight the remaining crystal fragment, spared by science, mounted on a pedestal in an appropriate box, will be displayed next to the reconstructed matrix specimen and labelled as to its significance. One error, which probably occurred during transcription from notes, has been uncovered during the reconstruction of the uraninite specimen. Frondel (1972) indicates on page 81 that the uraninite crystal is a cube almost "1 inch on edge"; measurements of the uranophane mold and the uraninite crystal fragment indicate this should



read "1 centimeter on edge".

Unfortunately, all records regarding the original analyses, other than the age determination, have become the victim of time. The age determination for the orebody, was made by Dr. G. J. Wasserburg, California Institute of Technology, using lead isotope methods on uraninite. The age, 955 million years, plus or minus 30 million years, was reported by Frondel (1970).



The Buckwheat Dump Uraninites

During the autumn of 1989 a discovery of uraninite was made on the Buckwheat Dump at Franklin. This material is unlike the Sterling Hill uraninite in several ways. First of all, it was found in a calc-silicate (skarn) matrix. The associated minerals are: a gray feldspar; a greenish-black pyroxene; an altered, granular, brownish garnet; extremely sparse willemite; and a member of the allanite group. Also reported as associated minerals, but not observed by the author, are apatite, bustamite, and calcite. Second, the total bulk of specimens containing uraninite from the Buckwheat Dump is certainly greater than for the original find at Sterling Hill in the ore, but the uraninites themselves are metamict and those measured range between 5.0 mm to 7.5 mm across (see Figure 5). Known specimens of this material are in the collections of Philip P. Betancourt (specimen PPB-10037), Mike Betancourt, the Franklin Mineral Museum (specimen FMM-5036; see Figure 6), and Stephen Sanford (specimen SS-707). Additional specimens were retained by the discoverer, whose name unfortunately was not recorded.

Pete J. Dunn, in his analysis of the Buckwheat Dump uraninites, determined that "U > Th > Ce, and is thus safely called uraninite", and also that "the cerianite solid solution is negligible". Regarding the member of the

Figure 5 (lower left). A broken, metamict uraninite, 6 mm across, in a calc-silicate matrix measuring 8x14x8 cm, from Buckwheat Dump, Franklin, N.J. Stephen Sanford specimen, catalogue number SS-707.

Figure 6 (above). Metamict uraninite (at end of arrow) in calc-silicate matrix measuring 11x16x6.5 cm, Buckwheat Dump. Franklin, N.J. Franklin Mineral Museum specimen, catalogue number FMM-5036.

allanite group present in the matrix material, Dunn reports that "this dark brown glassy phase is largely metamict, but I obtained enough X-ray diffraction data to say.......it is principally a Ce-Fe-Al-silicate with many rare earths." Dunn indicates that "the principal REE's are La, Ce, Nd, and Pr"; in addition, he found that both "Sm and Gd are present, and the material is Ce-dominant."

It is interesting to note that Clifford Frondel's discussion of the scandium content of the calc-silicate (skarn) minerals at Franklin appears in the same article (Frondel, 1970) in which he announced the uranium age determination for the orebody at Sterling Hill.

Acknowledgments

I wish to thank especially Charles Locke Key and Clifford Frondel (Professor Emeritus, Department of Earth and Planetary Sciences, Harvard University) for their contributions to this article. In addition, I wish to thank the following individuals (listed alphabetically) for their input and/or critique which added considerably to the article's completeness and readability: John L. Baum (Curator, Franklin Mineral Museum); Philip Betancourt; Richard C. Bostwick; Pete J. Dunn, (Department of Mineral Sciences, Smithsonian Institution); Carl A. Francis (Curator, Harvard Mineralogical Museum);

Chester S. Lemanski, Jr.; Stephen Sanford; and Earl R. Verbeek.

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<u>**Editor**</u> **(Continued from Page 2)**

Society Equipment

The Xerox 630 Memorywriter belonging to the Society requires disposition. It was purchased in late 1985 and has been used for the print out of copy for use in *The Picking Table* and some Society correspondence. A brief description follows: it is in mint condition, comes complete with original packaging, complete set of manuals, printwheels, etc., uses 5.25" floppy disks. In addition there is a computer desk which shows minor wear.

This equipment represents a sizeable initial investment by the Society and it is the responsibility of all members to see that a fair price is received for it at the time of disposal. If any member knows of a small company or a private individual who has need of such office equipment, they should notify an officer or a trustee of the Society immediately.

There are two remote possibilities which should be researched. Whether it is practical for the Society to retain the Xerox 630 Memorywriter for the use of the Recording and/or Corresponding Secretary or possibly donating it as a gift to the Franklin Mineral Museum, should the museum have the need for the equipment. Other recommendations are welcomed.

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Notes On Some Franklin Streets

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As with many other communities, the streets of Franklin are in part a place-name archive of activities which were centered there. Noted below are some of Franklin's streets, roads, and byways, the names of which bear some relation to the town's mining and minerals industry. The author is indebted to Omer Dean and Earl Verbeek for their valued suggestions.

Beardslee Hill Drive: The Beardslee farm, along the border between the boroughs of Franklin and Ogdensburg, was once considered a possible locus of the faulted segment of the Sterling Hill orebody, and was optioned in the 1930s to cover deep test drilling. By oversight, the option was not renewed in time. By then (the 1940s) the farm had been bought by Sam Munson, father-in-law of the eventual president of the New Jersey Zinc Company, R. L. McCann.

Brick Row: A row of attached apartments built in the early 1900s to resemble English workers' dwellings for the British miners (Cousinjacks). With the rear toward Taylor Road, the prominent feature was a line of wooden privies, now gone. The builder's choice of orientation left something to be desired because the privies were on the street side of the dwelling and thus the comings and goings of the residents were exposed to full view. The buildings themselves are still there and occupied.

Buckwheat Road: Built by the Works Progress Administration (a depression relief effort) during the 1930s, and named for the open pit which borders this road on the north. The name derives from an old buckwheat field in the area later occupied by the Taylor Mine, near the northern end of the outcrop of the east vein of the Franklin orebody, and carried over to the subsequent pit and associated dump.

Catlin Road: Named after R. M. Catlin, the mining engineer who, by virtue of experience, ability, and reputation, was able to direct the fortunes of the New Jersey Zinc Company along the road to the Twentieth Century at Franklin. He lived nearby in what is now a retirement home but in the 1930s was the bachelors' and young men's boarding house, or club. Decorative swastikas in the parquet floor of the billiard room caused a fuss during WWII and were removed, when called to the attention of Company executives by mischievous young mining engineers.

Church Street: The Catholic Church moved from Cork Hill Road to the present quarters in 1902. The Kittatinny limestone of which the new structure was built was taken from cliffs along the river west of town. The accompanying Lyceum, a popular meeting hall owned by the church, was built in 1883 with the stipulation that it could be used by the townspeople in general. Church Street becomes Franklin Avenue farther south, along the pond, and to the north becomes Fowler Street, near the Junction where three railroads once met.

Cork Hill Road: This road lies near a string of old iron mines and borders two old marble quarries on the south side of Franklin, leads to a much larger quarry farther southwest, and, near Sterling Hill, goes past an open pit in glacial till where rounded pebbles, cobbles, and boulders of Franklin ore are found.

Dunn Road: Road named for a local family (descended from the American Revolution) which furnished Company salaried employees.

Edmonds Lane: Named for one of Franklin's youths, killed in WWII. His mother was a secretary in the main office of the New Jersey Zinc Company and her brother, his uncle, was real estate foreman for the company's dwellings during the 1940s and early 1950s.

Evans Street: Walter F. Evans came to the Company as a young engineer early in this century. He advanced to superintendent, commanding operations at both Franklin and Sterling Hill (circa 1940-1954). His wife, who died in childbirth, was a descendent of the Philadelphia Morris family, founded by a signer of the Declaration of Independence. Evans raised the daughter.

Fowler Street: Dr. Samuel Fowler, physician, scientist, and early (from 1816 forward) promoter of Franklin mineralogy, victim of tragedy (wherein he lost his first family to disease), twice married, unifier of the Ogden properties at Sterling with Franklin, lost the whole thing. Colonel Fowler, his son, reclaimed the titles and successfully promoted the mineral interests.

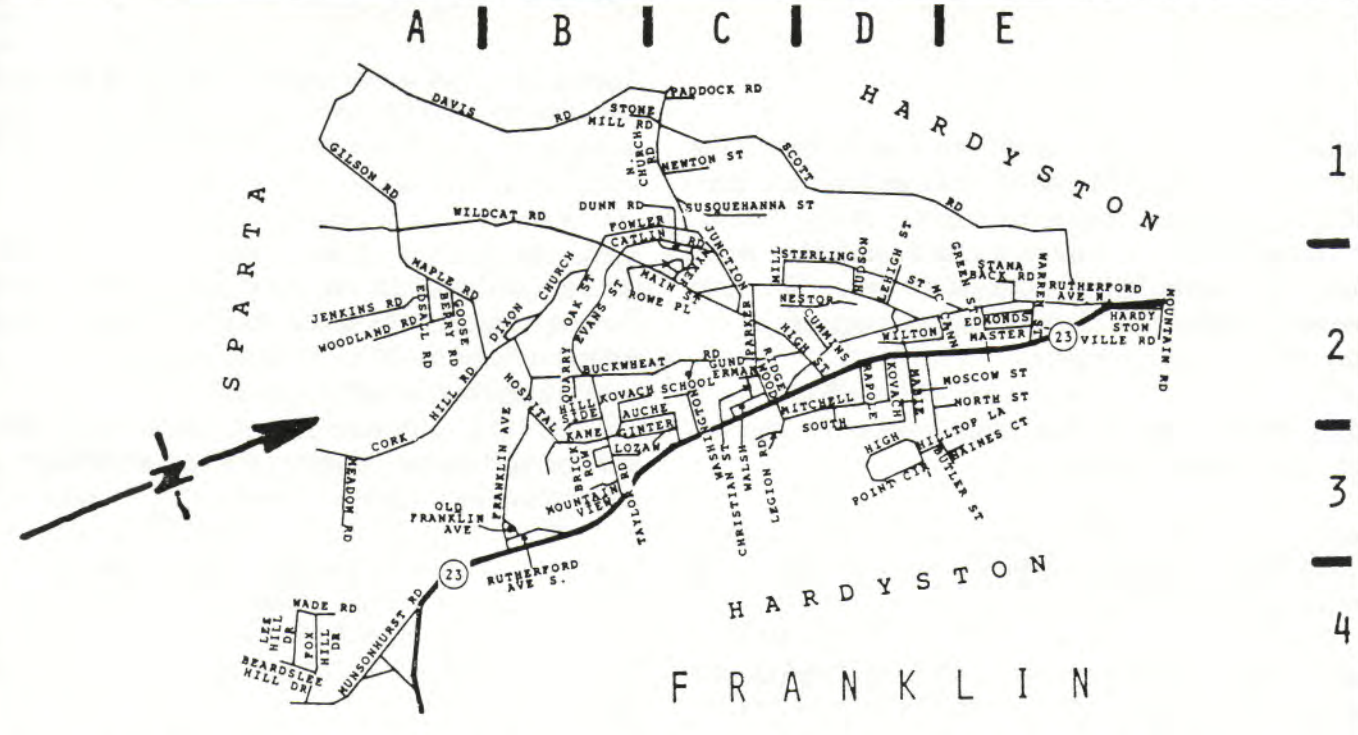
Franklin Avenue: Provided access to the early town, and runs alongside Franklin Pond, joining Church Street with Route 23.

High Street: The high point on Mine Hill. Divides Hamburg Mine property from the others. Spectacular subsidence took place here from the 1930s to the 1950s and rendered unusable the Borough Hall formerly located at Parker and High Streets. The Company-owned Mine Hill railroad had to be raised frequently to maintain its grade as the surface sank.

Highpoint Circle: Franklin's highest point, excellent view; no place to be in Winter. Kids used to burn the pasture here every year; different kids but same tradition.

Hospital Road: Dead-end (!) road. First hospital in the County, founded 1908, Company operated, babies cost $50 for obstetrics in 1940. The surgeons were the best and needed to be to serve crushed miners underground before moving them. Two of the surgeons were from Harvard Medical School - pretty good for a mining town.

Hudson Street: Named from the Lehigh and Hudson Railroad, carrier of plant concentrates to the smelter at Palmerton, Pa.



Auche Dr C-2
Beardslee Hill Dr A-4
Brick Row B-3
Buckwheat Rd B-2 C-2
Butler St D-2
Catlin Rd D-1
Christian St B-2 C-2
Church St B-2
Cork Hill Rd A-3 B-3
Cummins St C-2
Davis Rd A-1 B-1
Dixon Rd B-2
Dunn Row C-1
Edmonds La E-2
Edsall Rd A-2
Evans Rd B-2
Fowler St B-1 C-1
Fox Hill Dr A-4
Franklin Ave B-3
Gilson Rd A-1
Ginter St B-2 C-3

Gooseberry Rd A-2
Green St E-2
Gunderman Rd C-2
Haines Ct E-2
Hardystonville Rd E-2
High Point Cir C-2 D-3
High St C-2 D-2
Hillside AveB-2
Hilltop La D-2
Hospital Rd B-2
Hudson St D-2
Jenkins Rd A-2
Junction St E-2
Kane St B-3
Kovach St C-2
Kovach Ter B-2 C-2
Lee Hill Dr A-4
Legion Rd C-2 D-2
Lehigh St D-2
Lozaw Rd B-3 C-3

Mabie St D-2
Main St C-2 D-3
Maple Ave A-2
Master St E-2
Mc Cain St D-2
Meadow Rd A-3
Mill St C-2
Mitchell Ave D-2
Moscow St D-2 E-2
Mountain Rd E-2
Mountainview Rd D-3
Munsonhurst Rd. C-4
Nestor St C-2 D-2
Newton St C-1
N. Church Rd C-1
North St E-2
Oak St B-2
Old Franklin Ave B-3
Paddock Rd C-1
Parker St C-2
Quarry Rd B-2

Rapole St D-2
Ridgewood Rd D-2
Rowe Pl C-2
Rutherford Ave N. C-2D-2
Rutherford Ave S. B-3
School Plaza C-2
Scott Rd C-1 D-1 E-1
South St D-2
Stanaback Rd E-2
Sterling St D-2
Stone Mill Rd C-1
Susquehanna St C-1
Taylor Rd B-2 B-3
Wade Rd A-4
Walsh Rd C-2
Warren St E-2
Washington Ave C-2
Wildcat Rd A-1 B-1
Wilton St D-2
Woodland Rd A-2
Wyker Rd C-2

Jenkins Road; Recalls David Jenkins, educated at Rutgers and Cornell, and Chief Chemist of the New Jersey Zinc Company Franklin-Sterling operations, a big hearty man, Mayor of Franklin almost forever (1925-1950) and protector of Company interests therein. Jenkins ran a tight ship.

Junction Street: Three railroads (the Lehigh and Hudson Railroad; the New York, Susquehanna and Western Railroad; and the Delaware, Lackawanna and Western Railroad) all met here. In the early days, local kids went to high school in Newton by train, taking the DL&W, if they went to high school at all. The ore went to Palmerton, Pennsylvania, on the Lehigh. The Susquehanna connected Franklin with civilization, *i.e.* New York City whence came the important visitors and consultants. A short-line Company railroad, the Mine Hill Railroad, ran from the Junction up Mine Hill to service the Trotter Yard with three Company-owned cars and a rented camelback locomotive.

Legion Road: Shortcut to American Legion Hall. The Franklin Ogdensburg Mineral Club used to meet there during the 1950s but the fee became too steep. Besides, the downstairs part was noisy due to Legionnaires doing what Legionnaires did best, at their bar. The Zinc Company, which used to hold annual meetings in obscure places, held one there.

Lehigh Street: Like Hudson Street, named for the Lehigh and Hudson Railroad.

Lozaw Road: Local family; one Raymond Lozaw was a popular cage-man at Franklin in the early 1940s: a gentleman in a rough business.

Mabie Street: Mabie Farm occupied north Franklin; the Mabies were Huguenot descendants. The farm was the site of extensive drilling in the search for additional ore in 1951-1952.

Main Street: At one time this was the principal shopping area of Franklin and locus of the Palmer plant. This was one of the few streets in old Franklin with sidewalks. Both the street and the sidewalks were concrete.

Maple Street: Upper-class section of Franklin, with golf club; planted with maples. High-ranking Company men lived here.

McCann Street: Named after Raymond L. McCann, ambitious young mining engineer who in 1951 became President of the New Jersey Zinc Company, married the daughter of the area's largest landowner, became the quintessential Company-man, and presided over the merger of the Company into Gulf and Western. Conservative, although not as much as his predecessors, and a friend of the Museum, he lived in Franklin in a Company house. His Company files were donated in 1988 to the Franklin Mineral Museum by his children.

Mill Street: Named after the Franklin mill.

Moscow Street: Named for the Russian inhabitants, the menfolk of whom were miners.

Nestor Street: William C. Nestor was hired by the New Jersey Zinc Company at Franklin during the early 1900s. He was a leader of the community: Board of Education, Chamber of Commerce, Company store supervisor, Franklin Athletic Association, and employment manager of the Zinc Company.

Newton Street: Just west of the Wallkill at the Junction (that area of Franklin where the railroads connected and/or crossed); named for the County seat; miners lived here.

North Church Road: From Franklin west to Route 94, this road is named for the North Presbyterian Church of Hardyston, built from stone quarried locally, officially dedicated May 6, 1831, attended by most local Company wheels in the 1800s, operated until 1905, and torn down in 1958. Reverend Haines, Union Army Chaplain and son of Governor Haines, was pastor in later years and wrote about County churches.

Oak Street: Named for the giant oak that lives here. The cemetery here is resting place of Franklin's early settlers, including Michael Rorick who bought a tract along the Wallkill in 1765 and helped to promote the iron industry.

Parker Street: Named for the mining complex initiated by "Judge" Parker's convincing insistence that ore underlay his mining lease. He was right. The street goes by Parker shaft (see *The Picking Table*, **23**, #2, 6-8).

Quarry Road: Goes to the Fowler - B. Nicol - Cellate Quarry.

Rowe Place: The circle behind the New Jersey Zinc Company's main office, dominated by Captain Rowe's house. Rowe was the Mine Captain at Franklin (thus the title) during the early 1900s; he assembled a fine collection of the local minerals, later acquired by Rutgers University; and the mineral roweite was named after him in 1937. Rowe's house was later a school principal's house, and later still was owned by W. H. Callahan, Chief of Exploration, New Jersey Zinc Company (1950-1970), who was first to suggest that the local ores were sea floor deposits of the Red Sea type. Callahan's staff discovered the Elmwood, Tennessee, zinc ore deposit.

Sterling Street: Named for the Sterling Mine; street serves the Mexico section of town; Company miners' houses inhabited at one time by Mexican miners.

Stone Mill Road: Site of a colonial grist mill on a branch of the Wallkill River which drains from Lake Grinnell. The land was purchased by Dr. Samuel Fowler in 1813 from Cornelius Losey and Samuel Tuttle, by which time the mill had been converted to a fulling mill (for woolen cloth) and then to a storehouse. Fowler lived here with his second family and here conducted his mineral experiments and entertained the prominent mineralogists of his time.

Susquehanna Street: One-sided street next to the tracks at the Junction. This is in the flood plain, where the typhoid epidemic started in 1922. This was started when a Company worker in error opened a valve permitting river water to flow from the fire lines into the town drinking water lines. The resulting disaster received national attention and eventually led to added Federal laws concerning water-supply systems.

Taylor Road: From Buckwheat Road to Route 23, past Brick Row, named for the Taylor mine after Moses Taylor. The Taylor mine refers to the former workings along the eastern leg of the Franklin orebody and Moses Taylor was the most colorful individual to be associated with Franklin. Building a career on hard work, a clever mind and the ability to foresee the probable results of financial manipulations far beyond the understanding of the majority of his contemporaries, he was able to win control of banks, railroads, and the New Jersey Zinc Company, leaving his peers speechless and wondering what had happened. His is the story of the American industrial revolution which he helped to advance.

Washington Avenue: Patriotic name. A concrete road at the south side of Shuster Park, above some of the older underground workings at Franklin, it suffered from subsidence in a spectacular fashion as it sank, tilted, and sheared off, in the 1930s and 1940s, forcing its abandonment.

Wildcat Road: Colonial name. Dense growth and narrow defile made a natural shelter for wildlife. There is an Indian cave here. The road follows the Wildcat marble formation to Sterling Hill.

Woodland Road: Scenic description. An abandoned Catholic cemetery, buried in the woods for many years, presents a mournful sight. Many of the foreign-born miners killed at work have been moved but some remain, with no one to care.

Wyker Road: The Wykers were an old County family. Road goes by the former chemical laboratory of the New Jersey Zinc Co. It was here that Lawson H. Bauer made his studies of local mineralogy and entertained a generation of scientists with his displays of fluorescence, electrical conductivity, magnetism, insoluble residues of micro crystals, and handed out specimens from chests, drawers, closets, window sills, lockers and anywhere else that had a flat surface. His performance was a delight and his association with Charles Palache a fruitful one. He died in 1954, the same year as Palache and the Franklin Mine.

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MINERAL NOTES

NEW TO SCIENCE

Wawayandaite

$Ca_{12}Mn_4B_2Be_{18}Si_{12}O_{46}(OH,Cl)_{30}$

An article entitled "Wawayandaite, a new calcium manganese beryllium boron silicate from Franklin, New Jersey", written by Pete J. Dunn, Department of Mineral Sciences, Smithsonian Institution, Washington, DC 20560, Donald R. Peacor, Department of Geological Sciences, University of Michigan, Ann Arbor, MI 48109, Joel D. Grice, Mineral Sciences Division, National Museum of Natural Sciences, Ottawa, Ontario K1P 6P4, Canada, Frederick J. Wicks, Department of Mineralogy, Royal Ontario Museum, Toronto, Ontario M5S 2C6, Canada, and Peter H. Chi, Gas and Particulate Science Division, National Institute of Standards and Technology, Gaithersburg, MD 20899, appeared in American Mineralogist, 75, 405-408 (1990). The following information is abstracted from that article.

Occurrence and Paragenesis

Wawayandaite, ideally $Ca_{12}Mn_4B_2Be_{18}Si_{12}O_{46}(OH,Cl)_{30}$, was found on museum specimens from the Franklin Mine, Franklin, Sussex County, New Jersey. The name alludes to the grossly curved and winding habit of the preponderance of its crystals and derives from "wawayanda", which in the language of the Lenni Lenape Indians (early inhabitants of the Franklin area) means "many or several windings". Wawayandaite is a late-stage vein mineral, occurring with superb, 6 x 1 mm, prismatic willemite crystals and with 5 mm, equant, rhombic calcite crystals, both of which occur on a vein surface of andradite in calcite-poor, willemite-franklinite ore. Pink hodgkinsonite and colorless, twinned cahnite crystals are also on the specimen. These minerals are partially coated with a druse of dull reddish brown friedelite. Wawayandaite occurs last in this sequence, forming platy crystals, warped crystals, and clay-like aggregrates coating the earlier minerals.

The specimens containing wawayandaite were found prior to 1923 and undoubtedly were retained for their superb willemite crystals, the best ever found at Franklin. Although crystal habits and textures of the wawayandaite vary, the host assemblage and matrix are invariant, and there is no doubt that the specimens derive from one isolated occurrence.

Description

Wawayandaite occurs rarely as sharp, platy, 0.1-mm-diameter crystals, tabular on {100} and twinned on (100); other forms are indiscernible. The majority of wawayandaite crystals, however, are grossly curved in all dimensions and are exceedingly thin, resembling diaphanous, warped, and freely formed barysilite; some Franklin prehnite is slightly similar. Wawayandaite also occurs as exceedingly fine-grained aggregrates resembling clay.

Wawayandaite is colorless and transparent, although the few known platy, flat crystals are decidedly turbid and the fine-grained aggregrates are white and opaque. An intense pearly luster is obvious on the grossly curved, thin crystals but is not evident on the flat crystals; the luster of the fine-grained aggregrates ranges from pearly to dull. The streak is white. The platy crystals are brittle but the thin, curved crystals are quite flexible. An apparent cleavage is perfect on {100}.

Hardness (Mohs') is near 1 for the aggregrate, but the best crystals are too small for testing. The density of the aggregrates is <1.0 g/cm^3; that of crystal clusters using heavy-liquid techniques varies substantially (probably due to entrapped air) from 2.4-3.0 g/cm^3. The highest value is close to the calculated density of 2.98 g/cm^3.

Wawayandaite is biaxial negative, $2V_{obs}$ = 85.2(2.6)°. Indices of refraction in Na light are $\alpha = 1.619$ (calc.), $\beta = 1.631(1)$, and $\gamma = 1.641(1)$; dispersion is strong, $r < v$. The orientation is $X \wedge a = 11.5°$ within the obtuse β angle, $Y \parallel b$, $Z \parallel c$. Wawayandaite shows no observable pleochroism or discernible fluorescence in ultraviolet radiation.

Chemical Composition

The paucity of material necessitated that a number of analytical techniques be used instead of classical wet-chemical methods. Microprobe analysis was used for determination of Si, Mg, Ca, Zn, Mn, and Cl; water and other volatiles were determined by thermogravimetric (TGA) and evolved gas (EGA) methods, and B and Be were determined by ion-microprobe mass spectrometry. The combined analyses yield: SiO_2 28.2, MgO 1.9, CaO 24.8, ZnO 1.1, MnO 9.8, B_2O_3 3.8, BeO 17.6, H_2O 9.6, Cl 3.0, less O ≡ Cl 0.7, total = 99.1wt%. The empirical formula, calculated on the basis of 76 O + Cl atoms, is $(Ca_{11.12}Mn_{3.48}Mg_{1.19}Zn_{0.34})_{\Sigma 16.13}B_{2.75}Be_{17.71}Si_{11.81}(OH)_{26.80}Cl_{2.12}O_{47.08}$, idealized as $Ca_{12}Mn_4B_2Be_{18}Si_{12}O_{46}(OH,Cl)_{30}$, with Z = 1.

X-ray Crystallography

Wawayandaite was studied using Weissenberg, precession, and X-ray powder diffraction methods. The mineral is monoclinic, space group *P2/c* or *Pc*, with refined lattice parameters a = 15.59(2), b = 4.87(1), c = 18.69(4) Å, β = 101.84(15)°, corresponding to a unit cell with Z = 1. The strongest diffraction lines d,I/I_0, (*hkl*) are: 3.157,100,(11$\bar{4}$); 15.1,90,(100); 3.001,70,(4$\bar{1}$0); and 2.626,70,(11$\bar{6}$). Care should be taken in interpreting X-ray diffraction patterns of wawayandaite, however, as willemite can be so abundant and intimately mixed that it can add strong reflections to the patterns. ERV 6/90

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[Editor's Note: Two new facts of interest in connection with the above from Dr. Pete J. Dunn (personal communication): There is now a third known wawayandaite assemblage in which it occurs as minute pearly crystals in altered willemite-franklinite-andradite ore, associated with secondary fluorite and hodgkinsonite. Wawayandaite was in Roebling's hands as early as 1923.]

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RESEARCH REPORTS

Forsterite-Tephroite Series

An article entitled "New data on the forsterite-tephroite series", written by Carl A. Francis, Harvard Mineralogical Museum, Cambridge, MA 02138, appeared in American Mineralogist, 70, 568-575 (1985). The following information is abstracted from those parts of the paper dealing with zincian tephroites from Franklin and Sterling Hill, New Jersey. Comments added by the abstractor are enclosed in brackets.

Introduction

Compositions of various members of the olivine group commonly are depicted on ternary [triangular] diagrams in terms of end-member components forsterite (Mg_2SiO_4), fayalite (Fe_2SiO_4), and tephroite (Mn_2SiO_4). Most natural olivines, however, are essentially binary solid solutions rarely containing more than ten percent of the third component. The preponderance of lunar, meteoritic, and terrestrial olivines are members of the forsterite-fayalite series, whereas manganese-rich olivines are rather restricted in occurrence and consequently have not been studied as closely. Among the latter are the Mn-Mg-Zn olivines (principally tephroites) from the ore deposits at Franklin and Ogdensburg, New Jersey; these olivines are unique in containing zinc as an additional major component. [Fe and Ca appear as minor substituents] A suite of eight samples from these two localities was studied to investigate the crystal chemical role of zinc in olivines with a view to elucidating their petrogenesis.

Chemistry

Zincian olivines from Franklin and Ogdensburg are predominantly tephroites and exhibit a considerable range in composition, from ($Mg_{1.33}Mn_{0.41}Zn_{0.25}Fe_{0.01}$) to ($Mg_{0.05}Mn_{1.89}Zn_{0.05}Fe_{0.01}$). [The eight microprobe analyses show the following ranges in composition: MgO, 0.97-33.63%; MnO, 18.00-65.93%; ZnO, 1.81-12.78%; FeO, 0.10-3.75%; CaO, 0.08-1.30%.] Tephroite occurs in the primary ores as large (≤10 cm) gray, pink or reddish-brown crystals which crystallized with franklinite and zincite but not willemite in a gangue of white calcite. Hurlbut (1961) demonstrated that such tephroites typically contain exsolution lamellae of willemite. The new analyses show that these tephroites carry approximately 10 mole% Zn_2SiO_4 component, and conversely the exsolved willemite lamellae carry approximately 10 mole% "olivine" components. [Exsolved willemite lamellae from the same samples show the following ranges in composition: MgO, 0.00-2.72%; MnO, 2.14-5.13%; ZnO, 64.62-69.44%; FeO, 0.03-0.52%; CaO, 0.00-0.03%.]

Because natural Fe-Mn olivines with intermediate compositions are known from several localities, the uniformly low and relatively constant Fe contents (about 0.10 atoms per formula unit) in Franklin/Ogdensburg tephroites presumably reflect low Fe contents of the bulk rock compositions or partitioning of Fe^{2+} into associated franklinite. Calcium, too, is present in only minor amounts in these tephroites and is strongly partitioned into the manganoan calcite gangue. There is no evidence of a natural solid solution between tephroite (Mn_2SiO_4) and glaucochroite ($CaMnSiO_4$) at the conditions of metamorphism that prevailed in northwestern New Jersey. [See also the paper by Leavens *et al*, 1987, or its abstract which appears on the next page of this issue, for a similar conclusion]

X-ray crystallography

The unit cell parameters *a*, *b*, and *c* of chemically diverse nonzincian olivines [principally from Langban, Sweden, but including also some synthetic samples] are all observed to be nonlinear functions of composition [expressed as Mg/Mg+Mn+Fe+Zn+Ca]. This nonlinearity clearly is a function of cation order in the olivine structure. The unit cell parameters of the zincian samples from Franklin and Ogdensburg show the same nonlinearity, strongly implying that they too are ordered. In a previous study, Brown (1970) demonstrated such order for a sample of Franklin tephroite; crystal structure refinement showed that zinc is preferentially concentrated on the M(1) site and manganese on the M(2) site.

Infrared spectroscopy

Infrared spectroscopy is sensitive to the bending, stretching, and twisting modes of molecules and atomic clusters in crystals. Absorption spectra of olivines exhibit a characteristic configuration of bands [peaks] whose positions are compositionally dependent. A linear dependence of band position on composition was reported previously for synthetic samples in the forsterite-tephroite series, but data from a subsequent study, which included two Franklin tephroites, suggested nonlinearity for some bands. The observed nonlinearity was interpreted to be a result of Mg-Mn cation ordering, but the possibility that it could be due instead to the previously unrecognized third significant component—zinc—must also be considered. Data from the present study confirm that the nonlinearity can confidently be attributed to cation ordering as originally proposed.

Petrogenesis of zincian tephroites

The compositions of samples of tephroite and of the willemite lamellae exsolved from them contain petrogenetic information about metamorphic conditions at Franklin and Sterling Hill. The bulk composition of one sample was calculated from the known compositions of the willemite lamellae and tephroite host and from estimates of their relative proportions gained by point counting of an oriented thin section. The bulk composition of a second sample was provided by the most zinc-rich tephroite reported by Palache (1935); this is interpreted in the present paper to represent an unseparated or poorly separated tephroite-willemite sample. The values—16 and 22 mole% Zn_2SiO_4, respectively—are consistent with the [limited] experimental data on the solubility of Zn_2SiO_4 in olivines. Saver and Hummell (1962), for example, reported that saturation limits for Zn_2SiO_4 in forsterite range from 16 mol% at 850° C to 24% at 1460° C. These experiments, however, were performed only at atmospheric pressure and with Mn-free olivines; Syono *et al.* (1971) observed that the solubility increases with increasing pressure. Further work, including homogenization studies or calibration of the olivine-willemite solvus, would allow increased understanding of the thermal history [e.g. temperature of crystallization and the temperature at which exsolution ceased] of these deposits. ERV 6/90

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Glaucochroite

*An article entitled "Glaucochroite (olivine, $CaMnSiO_4$) from Franklin, New Jersey: Its composition, occurrence, and formation", written by Peter B. Leavens, Department of Geology, University of Delaware, Newark, DE 19716, Pete J. Dunn, Department of Mineral Sciences, Smithsonian Institution, Washington, DC 20560, and Donald M. Burt, Department of Geology, Arizona State University, Tempe, AZ 85287, appeared in American Mineralogist, **72**, 423-428 (1987). The article includes much information of interest to the collector community and thus is abstracted below to somewhat greater length than normal.*

Glaucochroite, $CaMnSiO_4$, a member of the olivine group, is known primarily from the Zn-Mn-Fe deposit at Franklin, New Jersey. It occurred in a number of places in the northern part of the deposit and, though much less abundant than rhodonite, was not as restricted as Palache's (1935) report suggests. It has not been found at Sterling Hill. Glaucochroite at Franklin has been found in a variety of assemblages in three principal forms: as euhedral crystals, as coarse-granular blue material, and as fine-granular brown material. Characteristics of the various assemblages are as follows.

Euhedral crystals of glaucochroite

Glaucochroite in euhedral crystals is rare, but the 15 available specimens permitted the recognition of several distinct assemblages. In most of these the glaucochroite forms bladed crystals up to 1 cm in length, frequently in columnar bundles.

1. Crystals embedded in nasonite, with minor amounts of primary franklinite and andradite, and additional light-yellow andradite which surrounds the primary material. Barite, clinohedrite, willemite, and a late-stage Mn-chlorite are present in very minor amounts.

2. Crystals embedded in massive green willemite that encrusts common, granular willemite-franklinite ore. Andradite and hodgkinsonite along the interface between the willemite and ore suggest a vein assemblage. Clinohedrite is intergrown with the willemite, cuspidine occurs in vugs in the same mineral, and barite is present in minor amounts.

3. Crystals embedded in both massive, white clinohedrite and in hardystonite, with andradite (of several generations) that encloses sparse franklinite. Some specimens appear brecciated, wherein the andradite is cemented with the glaucochroite-bearing assemblage. Two specimens contain cuspidine in 2-3 mm crystals.

4. Crystals lining vugs in an assemblage of massive willemite, white diopside, and slightly pinkish-blue massive glauchroite. Clinohedrite, nonfluorescent calcite, and stilpnomelane are minor phases.

Massive, coarse-grained blue glaucochroite

1. Blue glaucochroite with bright green willemite and franklinite, the latter in octahedra up to 2 cm across.

Hardystonite and calcite are common but not always present; leucophoenicite and zincite are sparse.

2. Blue glaucochroite with willemite, franklinite, and leucophoenicite. Hardystonite and calcite are absent or present only in traces.

3. Blue glaucochroite in a coarse-grained intergrowth of andradite, willemite, and calcite.

4. Blue glaucochroite with andradite, bustamite (both in grains up to 2 cm across), and willemite.

Massive, fine-grained brown glaucochroite

1. Brown glaucochroite with esperite (as irregular segregrations), hodgkinsonite (frequently along esperite-glaucochroite interfaces), calcite, willemite, zincite, and franklinite. The entire assemblage frequently is sheared. Irregular masses 3-5 mm across of possibly remnant blue glaucochroite embedded in fine-grained brown glaucochroite are present in a few specimens.

2. Fine-grained, impure, sheared and/or altered glaucochroite, reportedly white when first taken from the mine but soon turning to dark brown, in specimens that in general appear crushed or sheared. This is the material known locally as "calctephroite" [this paper] or "calcotephroite" [Palache, 1935].

Chemical analysis

Microprobe analyses of fifteen samples of glaucochroite show little deviation from the ideal formula, even though the samples included five crystal occurrences and nine massive samples of varying colors and textures. Only minor solid solution toward tephroite (maximum of only 6 mol%) and monticellite (maximum of 12 mol%, with most samples much lower) was noted. Optical study of a large number of other samples from Franklin likewise showed none whose properties would indicate compositions intermediate between glaucochroite and tephroite.

Formation of glaucochroite

[The following section is a liberal rewording of information contained in the original paper]

Experimental data and observations of mineral assemblages at Franklin and elsewhere suggest that glaucochroite at Franklin formed instead of the more common assemblage rhodonite + calcite in local areas where the metamorphic pore fluid was enriched in H_2O relative to CO_2, but under the same temperature and pressure conditions as the deposit as a whole. In general, the following assemblages are stable under conditions of progressively lower CO_2 pressure: (a) rhodonite + calcite, (b) bustamite + tephroite + calcite, (c) bustamite + glaucochroite + calcite, and (d) glaucochroite + wollastonite. The relevant reactions are:

rhodonite + calcite = bustamite + tephroite + CO_2
bustamite + tephroite + calcite = glaucochroite + CO_2
bustamite + calcite = glaucochroite + wollastonite + CO_2

Observations of mineral assemblages at Franklin that bear on this hypothesis include the following:

(1) Glaucochroite has not been found with rhodonite, although the assemblage rhodonite + calcite is a typical one at Franklin. The abundance of rhodonite relative to glaucochroite suggests that metamorphic conditions in most parts of the Franklin deposit were such that rhodonite + calcite was stable and glaucochroite was not.

(2) Glaucochroite and tephroite have not yet been found together, nor exsolved from each other. The report by Palache (1935) of coexisting tephroite and glaucochroite may have been a mistake for samples in which fine-grained brown glaucochroite and coarse-grained blue glaucochroite occur together. These observations are consistent with the notion that glaucochroite formed under local conditions of lower CO_2 pressure than those required for tephroite stability.

(3) The assemblage bustamite + glaucochroite was seen three times. This assemblage, too, is consistent with lower CO_2 pressures than those required for stability of the assemblages rhodonite + calcite and tephroite + bustamite + calcite.

(4) The common occurrence of glaucochroite with the hydrous species leucophoenicite is consistent with locally elevated pressures of H_2O relative to CO_2 in the pore fluid during metamorphism. This assemblage is equivalent to another common one at Franklin: glaucochroite + leucophoenicite + CO_2 = tephroite + calcite + zincite + H_2O.

(5) The assemblage glaucochroite + wollastonite, whose appearance would be favored by even lower pressures of CO_2 than those present during formation of the above-mentioned assemblages, has not been found at Franklin.

The occurrence in the same deposit of different but equivalent mineral assemblages as discussed above suggests that metamorphic conditions at Franklin varied locally. Assuming broadly similar temperature and pressure conditions during metamorphism of the deposit as a whole, the observed differences in mineral assemblages could have been caused by local variations in the relative mole fractions of CO_2 and H_2O in the metamorphic pore fluid.

Occurrence of cuspidine

Cuspidine forms colorless, clear, distorted crystals in several of the assemblages described above. It is readily recognized by its moderately strong yellow to pale violet fluorescence under longwave ultraviolet light; the response under shortwave radiation is similar but weaker. The occurrence of cuspidine at Franklin was reported by Palache(1910, 1935) as a result of an earlier analysis

(Continued on Page 22, See Notes)

The Lehigh Symposium Story

Omer S. Dean, President
Franklin-Ogdensburg Mineralogical Society

A symposium, co-sponsored by the Franklin-Ogdensburg Mineralogical Society and Lehigh University, was held on Saturday, May 19, 1990, in Harvey A. Neville Hall, Lehigh University, Bethlehem, Pennsylvania. The symposium was entitled "Character and Origin of the Franklin-Sterling Hill Orebodies". This was the second symposium sponsored by the FOMS since its beginnings back in 1959. The first symposium was held in the Franklin Armory, Franklin, New Jersey on June 3 and 4, 1961. Readers may find more details about the first symposium in *The Picking Table*, 2, #2, 5-6 (1961).

It is Manuel Robbins to whom we are indebted for the conception, labour, and birth of the Lehigh Symposium. Manny, author and columnist, has been interested in the origin of the orebodies for a long time and felt unsatisfied by what was to be found in the literature. He felt that a symposium might focus wide-spread attention on the topic. His first contact with the FOMS was with William J. Trost, FOMS president at the time, who gave him strong initial support. Manny made his first presentation to the FOMS Board of Directors in April, 1988, and met with them on several occasions during the two years that followed. Each session was structured around project status and what was yet to be done.

Manuel Robbins' efforts were all-encompassing. He provided the schedule of activities leading up to the symposium date; coordinated the advertising campaign, including providing information and dates to various periodicals; coordinated speaker and campus issues with Dr. Sclar; reviewed and edited the first drafts of papers; edited final manuscripts for the proceedings volume; wrote the Forward for the Proceedings Volume; obtained bids from printers; provided guidance to the chosen printer; etc. Some of his tasks unavoidably bordered on the mundane; to mention only a couple: it was Manny who drove around Bethlehem sketching out the small map for getting to the symposium which was used in the advertising flyers; it was Manny who brought the big coffee urn for use at the symposium and it was he who purchased the coffee, the cups, etc.

Manuel Robbins needed a lot of help and he got it from Dr. Charles B. Sclar, from Lehigh University, and from FOMS members. Let me quote from the letter which I requested Manny write to me: "Dr. Sclar's role was indispensible. He brought the prestige of the University and his own personal prestige into the picture. As a result, everyone we invited to speak (with the exception of [*name omitted*]) immediately accepted our invitation. In addition, two other scientists —from Australia and Denmark—asked to be allowed to submit papers, and were accepted. He [*Dr. Sclar*] also was able to get campus facilities for us at no charge to us, and was in frequent contact with the speakers at all times, and kept them on schedule with regard to producing papers......, and, of course, he conducted the symposium himself." Manny and the Society are also indebted to Paul Benoit, a graduate student at Lehigh, who oversaw certain final retypes performed at Lehigh, provided the table of contents for the Proceedings Volume, and maintained local contact with the printer during the printing itself.

The following FOMS members, not mentioned previously, deserve the Society's thanks for their contributions of effort, talent, and time to the Symposium: Philip P. Betancourt—the printing of tickets for the Symposium; the preparation and printing of the pre-

Figure 1. Neville Hall, Lehigh University main campus, Bethlehem, Pennsylvania, site of the Symposium on the morning of May 19, 1990.

FOMS - Lehigh University

Symposium

on

Character and Origin of the Franklin-Sterling Hill Orebodies

May 19, 1990

Coffee: 9:30 - 9:55 A.M.

10:00 A.M. Historical overview of the development of mineralogical science at Franklin and Sterling Hill, Sussex County, N.J. *by* Clifford Frondel, Harvard University.

10:40 A.M. The regional geological setting of the Franklin-Sterling Hill District *by* Avery A. Drake, Jr., U.S. Geological Survey.

11:20 A.M. Geology of the Sterling Hill Zn, Fe, Mn deposit *by* R.W. Metsger, N.J. Geological Survey.

Lunch: Noon - 1:30 P.M.

1:30 P.M. Franklinites from Franklin and Sterling Hill, New Jersey and oxygen fugacities of the deposits *by* P.B. Leavens, University of Delaware, and J.A. Nelen, Smithsonian Institution.

2:10 P.M. Unusual oxygen isotopic compositions in and around the Sterling Hill and Franklin Furnace ore deposits *by* C.A. Johnson, D.M. Rye, and B. J. Skinner, Yale University.

Break: 2:50 - 3:10 P.M.

3:10 P.M. Origin, boron isotope geochemistry, and mineralogy of the Franklin Marble *by* Paul B. Moore, University of Chicago and G. H. Swihart, Memphis State University.

3:40 P.M. Synthesis of Franklin and Sterling Hill minerals using a microwave oven *by* H. K. Worner, B. E. Chenhall, and J. Jones, University of Wollongong, Australia. Presented by Carl Francis, Harvard University.

4:10 P.M. Luminescence and composition studies on primary, altered, and secondary willemites from the Sterling Hill mineral deposit, New Jersey *by* E. Makovicky, University of Copenhagen, and B.J. Skinner, Yale University. Presented by Craig Johnson, American Museum of Natural History.

4:40 P.M. Geothermometry at the Sterling Hill zinc deposit, Sussex County, N.J. (Just how hot did it get at Sterling Hill?) *by* C. B. Sclar, Lehigh University.

5:10 - 5:20 P.M. *Closing Remarks*

Figure 2 (above). The agendum for the Lehigh Symposium.

publication order forms for the Proceedings Volume. Richard C. Bostwick—obtaining price quotes for various printing methods for the Proceedings Volume. John Cianciulli—obtaining price quotes for the printing of the advertising flyers; having the flyers printed; paying all the bills; manning the admission ticket/publication sales table at the Symposium (John even missed hearing the speakers). Joan Cianciulli—shared duties with John at the admission ticket/publication sales table. Warren Cummings—provided geological specimens for the displays in the lobby outside the room in which the Symposium was held. Omer S. Dean—created flyer layout; created the cover artwork for the Proceedings

Figure 3 (left). Lehigh Symposium attendees begin arriving outside Neville Hall before 9 a.m. on Saturday, May 19, 1990.

Volume; obtained a bid for flyer printing; provided general support. Ron DeBlois—helped Steve Misiur with setting up the specimen displays for the Symposium. Steven C. Misiur—took responsibility for all advertising and publicity, sent Symposium flyers to over 290 mineral clubs; notified a number of journals, beyond those contacted by Manny, regarding the Symposium; gathered specified specimens from individuals for the displays; made labels for the specimens; set up the displays and later took them down, etc. Neal K. Resch—obtained and provided Society members with detailed directions regarding the Bethlehem area and the Lehigh Campus; helped guide attendees to Neville Hall from Mountain Top on the morning of the Symposium. Hugh Ronemus —made eye-catching signs and posted them in strategic places in Bethlehem and the approaches to Bethlehem; provided verbal guidance to attendees who arrived at the Mountain Top location on how to get to Neville Hall; provided attendees with suggestions regarding eating places and other necessities during the noon hour and break periods at the Symposium. Stephen Sanford—provided specimens from his Franklin-Sterling Hill geological collection for use in the displays at the Symposium. Edward H. Wilk--provided the postcard photograph of the Palmer Shaft, Franklin Furnace, New Jersey, circa 1907, used as part of the artwork on the cover of the Proceedings Volume.

The Symposium agendum, including the titles of the various presentations, is shown in Figure 2, and the various speakers are pictured on the front cover of this issue of *The Picking Table*. The Franklin-Ogdensburg Mineralogical Society extends its congratulations to Dr. Sclar for a job well done and expresses its sincere appreciation to him for his many and diverse efforts on the Society's behalf. The Society expresses its gratitude to Lehigh University for hosting the Symposium in its Neville Hall; the facilities were very appropriate for the needs of such a function. The Society expresses also its thanks to the speakers who constituted this Symposium; their presentations were thought-provoking and their delivery exceptional. Finally, those authors who contributed papers but who could not be present at the Symposium, and thus had others speak for them, are thanked for their considerable contribution to the stature and merit of the proceedings.

It is hoped that no one has been overlooked in the list of acknowledgments. If it has happened, please accept my apologies and please see that I am notified so the situation can be rectified in the next issue in the "From the Editor's Desk" column. Speaking of acknowledgments, the author thanks Jack Baum and Earl Verbeek for their valued suggestions, and Betty L. Dean for her photographs (Figures 1 and 3) which will help us remember this occasion.

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Notes (Continued from Page 19)

(1899) of colorless crystals by C. H. Warren, but samples since that time have been unknown. Cuspidine has not been found at Sterling Hill.

The composition of Franklin cuspidine conforms closely to the ideal composition and shows minimal substitution of (OH) for F. The mineral in some specimens is in apparent chemical equilibrium with glaucochroite (which is younger) and hardystonite, and in other specimens occurs as a late-stage mineral, forming druses with clinohedrite in solution vugs in massive willemite, in assemblages where glaucochroite crystals are embedded in the willemite. ERV 6/90

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Membership News

Joe Cilen, a trustee of the Society and our Banquet Chairman, is recuperating at home from recent heart surgery. Will Shulman, a member of long standing, is also recuperating from heart surgery which he underwent in the late spring. The Society wishes you both a speedy recovery.

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The Franklin-Ogdensburg Mineralogical Society, Inc.

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.

September 15, 1990 (Saturday)		
Field Trip:	**10 a.m. - noon**	**Buckwheat Dump, Evans Street, Franklin, N.J.**
Business Meeting:	**1 - 1:30 pm.**	Many important items to be discussed! **Kraissl Hall, Franklin Mineral Museum, Evans Street, Franklin, N.J.** Be there!!
Lecture:	**1:30 pm. sharp**	"The Life of R. B. Gage, Franklin Mineral Collector" by Neal Resch.
October 6, 1990 (Saturday)		
Dinner:	**7:00 p.m.**	**12th Annual FOMS Dinner.** See opposite page for details.
October 6 & 7 (Saturday & Sunday)		
Show:	**Usual hours will prevail**	**The 34th Annual Franklin-Sterling Mineral Exhibit, Franklin Armory, Franklin, N.J.** The guest speaker is Earl R. Verbeek, U.S. Geological Survey, Denver, Colorado. His program is entitled "Structural environment of late-stage hydrothermal minerals at Sterling Hill--new work on old faults".
October 20, 1990 (Saturday)		
Field Trip:	**10 a.m. - noon**	**Buckwheat Dump, Evans Street, Franklin, N.J.**
Lecture:	**1:30 p.m.**	"Cahnite and other minerals from Franklin and Sterling Hill" by Vandall King, Rochester, N.Y. The lecture and the business meeting which follows will take place in **Kraissl Hall, Franklin Mineral Museum, Evans Street, Franklin, N.J.**
November 17, 1990 (Saturday)		
Field Trip:	**9 a.m. - noon**	**Old Andover Iron Mine, Limecrest Road, Andover, N.J.**
Seminar:	**12 noon-3:30 p.m.**	**Hardyston Township School, Route 23, Franklin, N.J. An interactive specimen-based seminar conducted by Dr. P. J. Dunn.** The seminar will be similar to that held in the Immaculate Conception Church on 11/02/84, with the exception that the specimens will be handled by only a few persons, but studied by all. For this type of activity, it is necessary for all attendees to bring specimens of specific assemblages, which will be announced in a special bulletin.
Business Meeting:	**3:30 p.m.**	Brief meeting which will include passing of the gavel to the new FOMS president for 1991.

THE TWELFTH ANNUAL F.O.M.S. DINNER, OCTOBER 6, 1990. DON'T MISS IT!!

The place and the time:
The Lyceum Hall, Immaculate Conception Church, 75 Church St. (Main St. runs dead into Church), Franklin, N.J. It's less than 5 minutes by auto from the Armory, site of the 34th Franklin-Sterling Mineral Exhibit. Social Hour begins at 6:30 p.m. and dinner at 7 p.m.

The food:
Dinner is a buffet, catered by Meyer's Bakery-Cafe who catered this event last year. The meal includes: assorted salads, bread and rolls, roast beef, roast chicken, kielbassy and sauerkraut, broiled fish, pasta, mashed potatoes, vegetable of the day, assorted desserts, coffee, tea, and soda.

The price:
$12.50 per person. Dinner is limited to 100 persons. Tickets will be on sale at the September meeting ot by mail. Make checks payable to FOMS. If by mail, enclose a self-addressed, stamped, return envelope to: Joe Cilen, 92 Westervelt Avenue, Hawthorne, NJ 07506. Joe can be reached by phone at (201) 427-1810. If Joe can't be contacted, please call Maureen E. Woods at (201) 948-3130. Get your tickets early—don't be disappointed!

Special features:
The guest speaker is Earl R. Verbeek, U.S. Geological Survey, Denver. Richard C. Bostwick will be the Master of Ceremonies. There will be an auction of mineral specimens, Franklin memorabilia, books, mining artifacts, photographs, etc. for the benefit of the Society. Your donation of choice items will help support the Society's educational causes. The auctioneer will be the illustrious Dick Hauck or an "unidentified but noteworthy" accomplice.

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MINERALOGICAL SOCIETY, INC.

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