THE PICKING TABLE

JOURNAL OF THE FRANKLIN-OGDENSBURG MINERALOGICAL SOCIETY

Volume 42, No. 1- Spring / Fall 2001

$15.00 U.S.

# A Classic Native Copper from Franklin, N.J.

*Feature: Palache's "Contributions to the Mineralogy of Sterling Hill, New Jersey:" The 900-Foot Level Revisited*

**Schedule of Activities**

**FOMS News**

# The Franklin-Ogdensburg Mineralogical Society, Inc.



## Membership Information

Anyone interested in the minerals , mines, or mining history of the Franklin-Ogdensburg, New Jersey area is invited to join the Franklin-Ogdensburg Mineralogical Society, Inc. (**FOMS**). Membership includes scheduled meetings, lectures and field trips, as well as a subscription to ***The Picking Table***

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***The Picking Table***
Vol. 42, No. 1 - Spring / Fall 2001

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**FRANKLIN-OGDENSBURG MINERALOGICAL SOCIETY, INC.**

## *FALL 2001 ACTIVITY SCHEDULE*

***Saturday, Sept. 15, 2001***

*9:00 A.M. - Noon — Collecting at the Passaic and Noble Pits, Sterling Hill Mining Museum, for F.O.M.S. members; fee $1.00/lb.*
*(**Sterling Hill Mining Museum members continue field trip until 3:00 P.M.)*
*10:00 A.M. - Noon – F.O.M.S. Micro Group, Sterling Hill Mining Museum.*
*1:30 P.M. – 3:30 P.M. – F.O.M.S. Meeting and Lecture, Franklin Mineral Museum*
The Mining Era of Sterling Hill, *by Bernard Kozykowski*

***Saturday, and Sunday, September 29-30, 2001***

***45TH ANNUAL FRANKLIN-STERLING GEM & MINERAL SHOW*
*Sponsored by the Franklin Mineral Museum.*
*Franklin Middle School, Washington St., Franklin, N.J.*
*9:00 A.M. to 6:00 P.M. Saturday, 10:00 A.M. to 5:00 P.M. Sunday.*
*The ticket price covers the show,* The Pond *outdoor swap, and admission to the Franklin Mineral Museum: $5.00 per day for adults, $2.00 per day for children.*
The Pond *Swap-and-Sell, sponsored by the F.O.M.S., takes place outdoors on the school grounds from 6:30 A.M. to 6:00 P.M. on Saturday and from 8:00 A.M. to 5:00 P.M. on Sunday. Show admission required.*
*The F.O.M.S. Annual Banquet starts at 6:30 P.M. on Saturday at the Lyceum Hall of Immaculate Conception Church, located at the south end of Franklin's Main St. Tickets are $14.00 each and may be reserved by calling Steve Misiur at (973) 209-7212 or John Cianciulli at (973) 827-6671. The meal is an all-you-can-eat buffet; soda, tea, and coffee are included. B.Y.O.B. After the banquet there will be a talk by Dr. Lance Kearns of James Madison University. There will also be an auction for the benefit of the FOMS. Please plan on donating a good specimen, artifact, book, etc. for this auction!*
*Note that auction items may be earmarked for the benefit of the Color Fund of* The Picking Table.
***"Garage Sale" of minerals, etc., at the Sterling Hill Mining Museum on Saturday and Sunday from 1:00 P.M. to 3:00 P.M.*

***Saturday, October 13, 2001***

*** 10:00 A.M. - 4:00 P.M. – Fluorescent Mineral Society meeting at the GeoTech Center, Sterling Hill Mining Museum. R.S.V.P. to Richard Bostwick, 212-749-5817, <rbostwick@worldnet.att.net>.*
*There will be a nominal fee to defray expenses for lunch.*
*** 6:30 P.M. – 9:30 P.M. – Night collecting at the Mine Run Dump and the Passaic Pit and Noble Pit, Sterling Hill Mining Museum, for S.H.M.M. and F.M.S. members. Fee: $1.00/lb.*

***Saturday, October 20, 2001***

*9:00 A.M. - Noon — F.O.M.S. Field Trip — Collecting on the Buckwheat Dump at the Franklin Mineral Museum.*
*1:30 - 3:30 P.M. — F.O.M.S. Meeting and Lecture — Franklin Mineral Museum:*
The Mystery of the Stone Sentinels, *by Ralph Thomas.*

***Sunday, October 21, 2001***

*9:00 A.M. - 3:00 P.M. — F.O.M.S. Field Trip — Lime Crest Quarry, Limecrest Road, Sparta, N.J. This is an invitational field trip hosted by the F.O.M.S., and is open to members of mineral clubs which carry E.F.M.L.S. membership and liability insurance. Proof of E.F.M.L.S. membership/insurance required. Proper safety gear a must.*

***Saturday, October 27, 2001***

*** 12th Annual* ULTRAVIOLATION, *a Show-Swap-Sell-Session featuring fluorescent minerals only. First United Methodist Church, 840 Trenton Road, Fairless Hills PA.*
*For information call Larry Kennedy, 609-882-6819, or e-mail* uvrocks@mindspring.com
*9 A.M. to 4 P.M. "If your rocks don't glow, you're at the wrong show."*

***Saturday, November 3, 2001***

***7:00 P.M. - 10:00 P.M. — Night Dig on the Buckwheat Dump, for the benefit of the Franklin Mineral Museum. Poundage fee charged, call for details: 973-827-3481.*

***Saturday, November 17, 2001***

*9:00 A.M. - Noon — F.O.M.S. Field Trip — Franklin Quarry, Cork Hill Rd., Franklin.*
*1:30 - 3:30 P.M. — F.O.M.S. Meeting and Lecture — Franklin Mineral Museum:*
Titanium Ore Projects of the New Jersey Zinc Co., *by Peter Kern.*

*Most F.O.M.S. field trips are open only to F.O.M.S. members aged 13 or older.*
*Proper field trip gear required: hard hat, protective eyewear, gloves, sturdy shoes.*
***Activities so marked are not F.O.M.S. functions but may be of interest to its members. Fees, and memberships in other organizations, may be required.*

# Message from the President

**By Bill Kroth**

We have come a long way! The development of the facilities in the Franklin and Sterling Hill area has grown almost exponentially over the past ten years or so. Never before has the collector or visitor had such a wide selection of places, attractions, and publications. Perhaps, since most of us are part of this activity to some degree, we or do not fully recognize or appreciate the scope of this development; but let's take a moment to review and even congratulate ourselves for what has happened over the last decade or so. Some of these major accomplishments include:

- Purchase and transformation of the Sterling Hill property.
- Development of two new tunnels at Sterling Hill.
- Donation of the "upper" Sterling Hill property.
- Establishment of the world-class Thomas S. Warren Museum of Fluorescence.
- Establishment of the GeoTech Center at Sterling Hill.
- Donations of the SPEX-Gerstmann and Welsh collections.
- Expansion and renovation of the Franklin Mineral Museum.
- Donation of the Buckwheat Dump collecting area.
- Donation of the Buckwheat/Trotter property (pending).
- Establishment of the Franklin Historical Museum.
- Organization of the spring New Jersey Earth Sciencs Association Gem & Mineral Show & Outdoor Swap and Sell show including banquet and auction, now located in Franklin.
- Publication of Franklin Mineral Museum and Sterling Hill Mining Museum bulletins on a regular basis.
- Publication of Pete Dunn's monograph.
- Winning of the Carnegie Award for achievements at Sterling Hill.
- Publication of several new books on the area.

I remember, in the late 1980's, meeting in Ewald Gerstmann's smoke-filled museum on Saturday mornings with a small group of "regulars". Not too many other options existed at that time. If you wanted published information, only Palache's U.S.G.S. Professional Paper No. 180, Kushner's guide, Frondel's checklist, and a few small paperback books/pamphlets were available. Now look at the selection!

While most mineral clubs are unfortunately losing membership and remain stagnant, the FOMS is a healthy and dynamic group. Although our membership is not growing as fast as we would like, our members are certainly making up for this in their achievements. And, these achievements promote scientific education too! The "if you build it, they will come" scenario is certainly true, with over 100,000 visitors annually! And most of these visitors are greatly impressed with what they see. For example, one gentleman recently visited the Sterling Hill Mining Museum and was so moved that he donated a stock portfolio worth over $500,000 to further the development of the property! I can only imagine what improvements to the facility will occur over the next ten years!

Nature has given us a great start with the wonderful minerals of the area, but hard work, generosity, and dedication by past and present members and friends continue to metamorphose the area into a world class scientific attraction.

## *FRANKLIN MINERAL MUSEUM NEWS*

**John Cianciulli, Curator**
Franklin Mineral Museum
P.O. Box 54
Franklin, NJ 07416

Now that the 20th Century is behind us we look forward to continued growth and success in the 21st. Let us revisit some of the accomplishments The Franklin Mineral Museum has realized in the last century. It all started with the collaboration between rock collectors (FOMS) and a local community service group comprised of local businessmen (Kiwanis). Their common interest was to preserve the mining and mineral heritage of Franklin, New Jersey. The "Neighborhood House" was not only the nucleus of activity in Franklin at that time but was also the first public repository for Franklin minerals and the birthplace of our Annual Franklin-Sterling Mineral Show now going into its 45th year. In 1965 the Franklin Mineral Museum was incorporated. The seed planted during the mid-1950's was starting to grow. The pride of Franklin did not stop at its borders. In 1968 the New Jersey State Legislature proclaimed Franklin, New Jersey "the Fluorescent Mineral Capital of the World." Ten years after the incorporation of the museum (1975) Kraissl Hall was dedicated. This milestone project was made possible by a generous donation from Fred and Alice Kraissl, charter members of the FOMS. The next major expansion the "Jensen Annex" was made possible by a bequest from the David B. Jensen Estate. Mr. Jensen worked for Ward's minerals. He was actively involved with the FOMS for many years. The last major expansion was the new enlarged lobby area and rest rooms. Funds for this project came from the museum's building fund. The "world famous" miner statue is a product of donations from its sculptor Carrie Boone Nelson and an anonymous contributor. To conclude the year 2000, the Boro of Franklin has agreed to donate the Buckwheat Dump property. As of this writing the survey has been completed and the process of transferring ownership has started.

Over the years collections of minerals have been either donated or purchased to fill our exhibits. To that end 71 benefactors have collectively created collection exhibits comprising of about 6000 specimens (and counting) of Franklin-Sterling minerals and 7000 specimens of worldwide minerals including Indian artifacts and fossils. An important function of the Franklin Mineral Museum is its dedication to continued research and its offerings of many levels of education in geology and the mineral sciences. The best testament to our successes achieved in the 20th century is the parents and grandparents who bring their sons, daughters, and grandchildren to show them the magic of "rocks that glow," a childhood memory they are eager to share.

To start the new century, I would like to express my appreciation to the many, many benevolent souls who gave unselfishly to feed a dream until it turned into the reality of a world-famous institution, the Franklin Mineral Museum. I am confident great things are to come thanks to the continued support and dedication from the "friends of Franklin."

## *NEWS FROM STERLING HILL*

**Joseph Kaiser**
40 Castlewood Trail
Sparta, NJ 07871

The Thomas S. Warren Museum of Fluorescence opened at the end of September, in time for the Franklin show. This museum has now become a standard part of the mine tour. Children are fascinated by the fluorescent effect on their clothing and especially their teeth under long wave UV. Everyone, young and old, seems to come away excited. SHMM has gotten additional funds and plans are underway to add another room to the Warren Museum. After the serious flood in the area in August 2000, a major road project in Ogdensburg has made available about 4,000 yards of fill. This has been used to make a ramp on the west wall of the Passaic Pit, which will provide access to an adit about 40 feet up from the present pit floor. This tunnel is several hundred feet long and contains the original track and several interesting cave-like formations. The purpose of this tunnel was to service a grizzly under the Glory Hole, which provided fill material for working slopes underground. Two scientists, Bob Jenkins and Earl Verbeek, will be working with the GEMS teacher education program to provide an exciting environment in which teachers can participate while meeting their requirement for 100 hours of professional development, an effort in which Sterling Hill is a recognized provider. In December, 2000, the museum was honored to receive a donation of five hundred thousand dollars, which is to be used to obtain matching grants in order to develop and open to the public the industrial complex located on top of Sterling Hill. This includes the headframe, mill complex, hoist house and shop buildings. On Saturday, April 21, 2001, from 6:30 to 9:30 p.m., spring night collecting will take place on the Mine Run Dump for SHMM members only. Collecting in the Passaic and Noble Pits for members only will be on May 19, 2001 from 8:00 a.m. to 3:00 p.m.

**Have you renewed your *FOMS Membership ?***

Please make check or money order payable to the **FOMS**, and send to:

**John Cianciulli, Treasurer FOMS**
**60 Alpine Road**
**Sussex, New Jersey 07461**

## *FIELD TRIP REPORT*

**Steven M. Kuitems, D.M.D.**
14 Fox Hollow Trail
Bernardsville, NJ 07924

### Passaic and Noble Pits
Ogdensburg, NJ

**September 17, 2000** - A productive trip for many and a stinging surprise for at least one FOMS member. While searching several old mud zone ore piles an unexpected encounter with an underground nest of irate hornets - more than 200 strong by my estimate - sent my collecting friend flying away. Well we did manage to dig out one well crystallized andradite specimen with 5 x 5 cm crystals and a few crude augites as large as 8 cm long. The fill quarry back wall had a large mass of arsenopyrite some 2 x 3 meters in dimension with occasional flecks of molybdenite in it, but alas, no decent crystals. On the west wall of the Passaic Pit a zone of secondary copper minerals was found. Fine specimens of micro crystals of malachite, azurite, tennantite and selenite were recovered. Most activity centered around several piles of east vein willemite, franklinite, calcite ore. Some of this granular ore had some gemmy grains, and one rare giant grain was 12 cm across! Most grains were 1 cm or less and very colorful: red, pink, yellow, and pale green. Some large willemite crystals as large as 10 x 7 cm and of red to brown color were found in calcite pods. Nice exsolution willemite, tephroite plates as large as 10 cm across were found on the edges of the granular ore. Several nice sharp franklinite crystals also came out of this zone ranging from 1 cm to 5 x 5 cm. On the saddle area of the Passaic pit, many collectors worked the wollastonite outcrop which produced some granular material in pieces that were 20+ cm across. This material fluoresces a light yellow color in short wave ultraviolet (SW UV) light.

### The Buckwheat Dump
Franklin, NJ

**October 21, 2000** - A bit of searching produced several specimens of andradite garnet crystals of typical red to brown color ranging from several sharp one cm crystals to one crude giant 6 x 6 cm crystal. A small boulder of Christmas tree ore willemite, calcite was eagerly broken up and rapidly distributed to many collectors including a very delighted group of children visiting the dump area. Several bright pink solid masses of rhodonite as large as 20 x 25 cm and suitable for lapidary work, were hauled out by collectors breaking open black oxidized boulders of ore. Many collectors were concentrating on working the dolomite boulders for micro crystals. Specimens of common species including quartz, rutile, sphalerite and the rare species thorutite, synchysite-(Ce) and monazite-(Ce) were recovered. The rarest of all the species found this day were very tiny blue anatase crystals less than 1 mm long!!!

### The Limecrest Quarry
Sparta, NJ

**October 22, 2000** - A fantastic day for collecting, with beautiful weather, fine fall foliage and great attendance: 101 collectors. There was plenty of new quarry material to sort through on all bench levels. The largest amount of quarrying activity was concentrated on the very lowest level where the marble was cut through by a large pegmatite zone with abundant altered marble contacts. On the lowest bench a blocky marble area produced isolated meionite crystals up to 8 x 10 cm and scattered cubic to rectangular pyrite crystals, the largest being 1 x 3 cm. Graphite was found as discrete, long thin lenses 25 cm x 0.5 cm . Several softball size pods of a black tourmaline (schorl?) were found, some with crystals 1 cm thick. Only two partial crystals of brown uvite, the largest being 3 cm, were seen. The pegmatite zones produced several allanite specimens with one specimen having a crystal cross section as thick as my thumb (2 x 2.5 cm). Some collectors found a white feldspar, possibly albite, which fluoresces blue under SW UV in a light-colored pegmatite containing quartz. Other fluorescent feldspar in large plates was removed from the upper gneissic zones. The most interesting collecting seemed to be near the altered marble contacts. The first striking difference was color, a wide variety of striking colors beside the usual white and gray marble. There were many boulders of massive dark brown chondrodite as much as 1 x 1 meter thick! On a few of these boulders that contained calcite pods, crude crystals, some as large as 3 by 4 cm, were found. There was a bright green micaceous mineral (clinochlore?) associated with the chondrodite. Nearby were many boulders containing blue green diopside and green actinolite, both of which often occurred in concentric bands one to two cm apart separated by white calcite and rimmed by a light green unanalyzed mica. Often in the center of these masses were small pods of granular pink garnet and a platy pink feldspar with orthorhombic crystals as large as 2 x 2 cm. In shear zones within this material, bright emerald green sheets of serpentine were found. Bright yellow to pale yellow poorly fluorescing norbergite were abundant, but what was fascinating were the many small blue to green spinel crystals (up to 1.5 cm) that on the micro level are quite transparent. Spinel of an almost black color as large as 4 cm came out of an upper bench that had grains of disseminated reddish-brown subhedral chondrodite . The best spinel came out of the second bench level and had a distinctly purplish color with the finest example being a 1.5 x 2cm crystal in a pure white marble matrix. A most unusual specimen was a sharply formed black zircon crystal 1 x 0.5 cm in a pale pegmatite matrix. Two collectors found several zoned red and blue corundum crystals with a maximum size of 1 x 3 cm associated with phlogopite and green margarite in an upper bench level.

Almandine garnet of typical purple color in masses and rounded crystals came out of the upper gneissic zone. One large boulder had pyrite crystal cross sections, the largest being 5 x 8 cm, but alas, these were too shattered by quarrying operations to remove intact. This same

*(Continued on page 17)*

# *PALACHE'S*
# *"CONTRIBUTIONS TO THE MINERALOGY OF STERLING HILL, NEW JERSEY:"*
# THE 900-FOOT LEVEL REVISITED

***John A. Jaszczak***

Department of Physics and the A. E. Seaman Mineral Museum
Michigan Technological University
1400 Townsend Drive
Houghton, Michigan 49931-1295

In a 1941 paper in *The American Mineralogist*, Charles Palache described the morphology of graphite, arsenopyrite, pyrite, and arsenic crystals from the 900-foot level of the Sterling Mine, Ogdensburg, New Jersey. Original material from the U.S. National Museum of Natural History collection has been identified which verifies a proposed, remarkable, barrel-shaped habit for some of the graphite crystals. Several of Palache's goniometer mounts along with other original specimens from Lawson H. Bauer have also been identified in the Harvard Mineralogical Museum collection. Together, these collections have allowed for an interesting revisiting of this unique mineral assemblage from Sterling Hill.

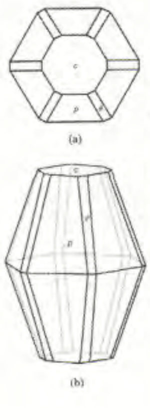
## INTRODUCTION

Mineral collectors love to revisit their favorite mineral localities. The mineral deposits at Franklin and Sterling Hill, New Jersey are prime examples of localities that many collectors look forward to revisiting. Unfortunately, many localities are regularly lost to collectors as a result of natural and human events. Despite heroic efforts to keep the Sterling Mine in Ogdensburg, New Jersey a viable source of minerals for researchers and collectors (Dunn and Kozykowski, 1992), most of the underground workings of this remarkable locality have succumbed to flood waters. By the end of 1992, all of the levels below the 180-foot level became inaccessible (Grenier, 1993). Fortunately, specimens and data rescued before then will allow research to continue well into the future. Preserved and documented specimens and data in public and private collections, and especially in mineral museums often allow for a second-hand "revisiting" of important and otherwise inaccessible mineral occurrences. This article traces such a revisiting of one particular remarkable mineral assemblage, described by Charles Palache, from the Sterling Mine's 900-foot level.

Charles Palache, Professor of Mineralogy and Crystallography at Harvard University, published a paper in 1941 entitled, "Contributions to the Mineralogy of Sterling Hill, New Jersey: Morphology of Graphite, Arsenopyrite, Pyrite, and Arsenic" in *The American Mineralogist* (Palache, 1941). This paper has been cited in at least 44 articles and books in the fields of mineralogy, physics, metallurgy and materials science, which includes those in German, Russian and English, and continues to be cited in recent literature (see Appendix). The paper contains five crystal drawings of Sterling Hill graphite, one crystal drawing of Ticonderoga, New York graphite, four crystal drawings of Sterling Hill arsenopyrite and one crystal drawing of Sterling Hill native arsenic. It also describes Sterling Mine pyrite crystals, though no drawings of such crystals were given. Two of the graphite crystal drawings have been reproduced in a number of other publications, including books, and on at least one book cover. Unfortunately for collectors, historians, and Franklin/Sterling Hill aficionados, no photographs of the studied crystals were presented.

Charles Palache received the studied material in 1937 and subsequent years from Lawson H. Bauer, chemist at the New Jersey Zinc Company. According to Palache (1941), the material was found in May 1937. The marble samples contained realgar, and the "strange red material" was brought to Bauer, who, after preparing insolubles using hydrochloric acid requested more: "Bring me all you can get" (John L. Baum, personal communication). Bauer isolated the best crystals of several minerals from the marble and supplied several selections of them to Palache in 1937 and following years.

Of primary interest to Palache were the remarkable graphite crystals, which he used to morphologically establish the true hexagonal symmetry for graphite. One drawing in particular (see Fig. 1a) is remarkable because it illustrates a crystal with pronounced first- and second-order dipyramidal faces. Since the crystals drawn by Palache are as viewed down the c-axis, perhaps to emphasize the hexagonal symmetry. It is easy to assume




'ig. 1. (a) Crystal drawing of graphite from iterling Hill, NJ, that appeared originally as Fig. in Palache's 1941 paper in The American lineralogist. The crystal shows the basal inacoid c{0001}, the first order dipyramid {1011} and the second order dipyramid {1122}. Drawings recreated using SHAPE, Eric Dowty R. Peter Richards, 1987, 1988). (b) Same rystal as in (a) but rotated to a different viewig orientation using SHAPE to show the barel-like morphology. (Jaszczak 1994.)

that they are tabular, which is the most common habit for graphite crystals. Based on Palache's description, however, Jaszczak (1994) showed that the crystal must have had a very rare barrel-shaped habit (Fig. 1b). Of the thousands of crystals examined by this author from hundreds of localities, no crystals have been observed with such prominent first- and second-order dipyramids and such pronounced barrel-shaped habit. With a growing curiosity, the author set out to locate, observe, and hopefully photograph the actual crystal drawn by Palache for his Fig. 3.

After the publication of the 1994 paper by Jaszczak in *The Picking Table*, Earl Verbeek supplied specimens of an arsenopyrite-realgar-zinkenite assemblage in marble from the north rib of a crosscut through the west limb of the Sterling Mine's 900-foot level for examination (Fig.2). John Kolic supplied similar material in 1996 for examination. Although both sets of samples initially appeared to contain graphite, all of the tabular shiny crystals were found to be molybdenite (see Fig. 3; compare Dunn, 1995, p 535). The identification of molybdenite was made based on luster, streak and scanning electron microscope energy dispersive spectroscopy (SEM-EDS). These marble samples, all obtained after the "reopening" of the mine by the Sterling Hill Mining Museum between 1990 and 1994, contain bladed arsenopyrite, acicular zinkenite, rounded diopside, pyrite cubes and octahedra, minor realgar, and tabular molybdenite, but no graphite. On the other hand, other samples collected in the early 1990's on the 1100-, 900- and 800-foot levels, do contain graphite in association with arsenopyrite, realgar, etc. (Dunn, 1995, p. 519, 552), although graphite was not mentioned in the detailed descriptions by Kolic and Sanford (1993) of arsenic-bearing minerals collected in 1990 on these levels. Dunn (1981; 1995, p. 668) reported a find of graphite, realgar, and arsenopyrite in calcite with post-mining guerinite; however, no date or level for the occurrence was noted (late 1970's is possible based on Dunn, 1995, p. 552, and Dunn, 1979). Dunn also wrote that no arsenic had yet been reported from the 1100-foot level occurrence (Dunn, 1995, p. 519), but that it is otherwise a "remarkably similar" paragenesis to the 900-foot level occurrence described by Palache (Dunn, 1979). It appears that the 1100-foot level realgar occurrence is located such that it could not be a downdip continuation of the 800- and 900-foot level occurrences (E. Verbeek, personal communication; see also Kolic and Sanford, 1993). Palache (1941) described the 900-foot assemblage as part of a new paragenesis at Sterling Hill, and it appears to have remained a one-time occurrence, at least until 1976 (Edwards, 1976). It is interesting that no molybdenite has been observed either in the graphitic realgar-arsenopyrite-zinkenite assemblage more recently collected, or from the original material that Bauer supplied to Palache.

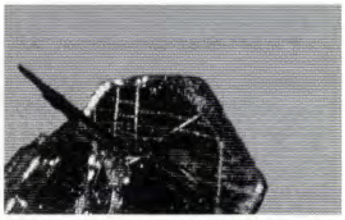


**Fig. 3.** A 0.5 mm molybdenite crystal with zinkenite needles in sample collected on the 900' level (1060N, 900W) of the Sterling mine in the early 1990's by Earl Verbeek (Fig.2. Also associated but not visible are pyrite, arsenopyrite, and diopside. Calcite was etched away in dilute HCL. (JAJ specimen # 1619 and photo 38-22).

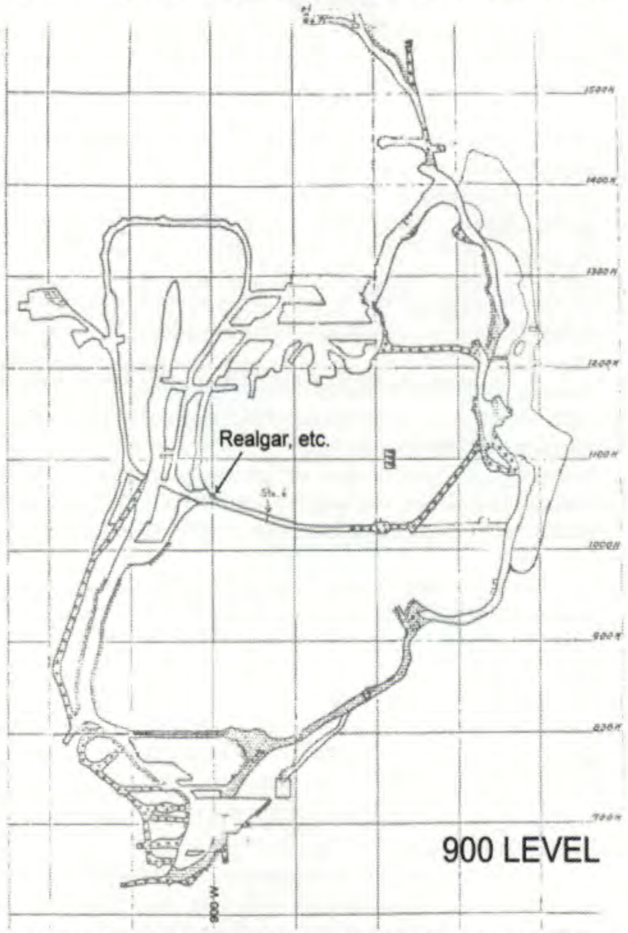
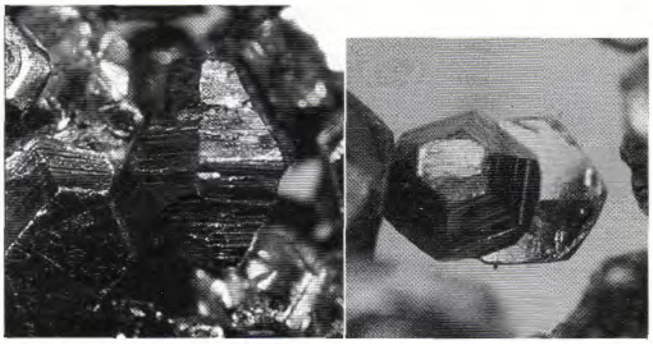



**Fig.2.** Plan view map of the 900' level, Sterling Mine showing the occurrence (at the arrow) of the realgar-arsenopyrite-zinkenite etc. found in 1990's. Approximate coordinates are 1660 N. 900W. Map modified from the original provided courtesy of Earl Verbeek.

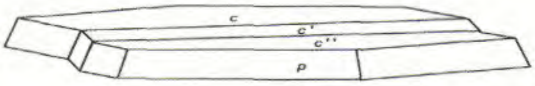
### THE GRAPHITE SEARCH CONTINUES

The author was privileged in 1996 to inspect and photograph a part of "specimen" C6355 from the L. H. Bauer collection in the National Museum of Natural History, which consisted of numerous graphite crystals (to approximately 1 mm) etched from calcite from the 900-foot level of the Sterling Mine, 100 feet east of the West Limb. Among these crystals were several that confirmed the existence of the very unusual barrel-shaped habit postulated by Jaszczak (1994) (Fig. 4). Despite the unusual, elongated development along the [00.1] direction, it is interesting to note that no obvious growth spirals are visible on the basal pinacoids of any of these crystals. A few crystals showed one or two possible, second-order dipyramid faces, but no crystals were observed which showed all of the second-order faces of a symmetrical form such as in Fig. 1. While most of the crystals have smooth or striated faces, a small fraction of the crystals have secondary, fine-grained graphite overgrowths. These overgrowths are similar to those observed from the Lime Crest quarry, Sparta, New Jersey (Jaszczak, 1997), and have been called "skeleton crystals" by Weis (1980).

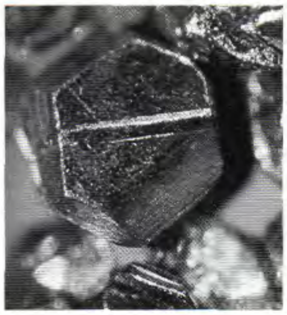


(a) (b)

**Fig. 4.** (a) Photograph of a 1 mm dipyramidal graphite crystal, and (b) 1 mm cleaved dipyramidal graphite crystal from the 900-foot level, 100 feet east of the West Limb, Sterling mine. Ex Lawson H. Bauer collection, National Museum of National History ( Smithsonian Institution) #C6355 (JAJ photos 40-34 and 40-35).

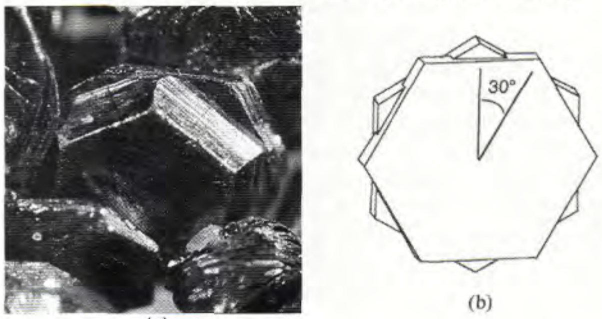



(a)



(b)

**Fig. 5.** (a) Graphite crystal from Sterling Hill [Fig. 6 in Palache (1941), recreated using SHAPE] with forms *c*{0001} and *p*{1011}, showing a single twin lamella on {1121}. The bottom of the crystal {1121} is cleaved. (b) Graphite crystal showing prominent striations due to twinning. From the 900' level, Sterling mine. Ex Lawson H. Bauer collection, National Museum of Natural History (Smithsonian Institution) #C6355 (JAJ photo 40-24).




(a) (b)

**Fig. 6.** (a) 1.5 mm graphite crystal twinned by 30⁰ rotation about [00.1] from the 900' level, Sterling mine. Ex Lawson H. Bauer collection, National Museum of Natural History (Smithsonian Institution) #C 6355. (JAJ photo 40-26). (b) Schematic showing twin relationship. This twin law was described by Vesselowski and Vasseliev (Wesselowski and Wassiliew) in 1934 based on crystals from the Zavalye deposit, Ukraine. Such twins were not noted by Palache in 1941.

Several crystals were observed that showed twinning on {1121}, as described and illustrated by Palache (see Fig. 5). Such twinning, usually induced by mechanical deformation, is responsible for the striations so commonly observed on the basal faces of graphite crystals. Another type of twinning, by a 30° or 90° rotation about [00.1] was also observed in some crystals (Fig. 6). Twinning of this type is not uncommon for graphite crystals and is sometimes known as the twin law of Vesselovsky (Wesselowski and Wassiliew, 1934). While this type of twinning was not noted by Palache in 1941, it was noted by Palache *et al.* in 1944.

During several visits to the Harvard Mineralogical Museum, with the assistance of Dr. Carl Francis and Bill Metropolis, searches for the original graphite specimens that Palache obtained from Bauer defied all efforts to find them. However, during subsequent visits to the Franklin Mineral Museum and the Sterling Hill Mining Museum, it was learned that collectors had historically seemed more interested in the realgar and arsenopyrite in Sterling Hill specimens than in the graphite crystals. This fact is hinted at in Edwards' note (1976).

"It is quite evident that Palache's interest was primarily with the graphite crystals imbedded in the calcite. It is also probable that the specimens submitted by Dr. Bauer were all consumed by acid. At any rate, very few pieces of this occurrence may be found in collections today." (p. 7.) "It should also be mentioned that equally scarce and much unappreciated are the graphite crystals which so intrigued Dr. Palache." (p. 8.)

It is perhaps ironic that a Sterling Hill specimen of realgar with arsenopyrite, native arsenic, and graphite in calcite, formerly in the Edwards collection (provenance: ex Billy Ball, ex Schortmann's Minerals, ex Frank Edwards, ex Lee Areson #LA815, ex Richard Hauck, now in the Steven Phillips collection), has no mention of the graphite on the Edwards' or Schortmann's Minerals labels. Several specimens were purchased from the Franklin Mineral Museum gift shop labeled "Realgar" from the Sterling Mine and were tentatively attributed to the 1100-foot level by John Cianciulli. These were probably collected in either the late 1970's or early 1990's, and contain crystals of realgar, arsenopyrite, pyrite, zinkenite, and graphite, but, consistent with Dunn (1995, p. 519), do not appear to contain native arsenic crystals (Fig. 7).

During a subsequent visit to Harvard in December 1996, attention was therefore focused on looking at the arsenopyrite and realgar specimens in the Franklin/ Sterling Hill collection, rather than directly for graphite. Although Edwards (1976) had supposed that all of the material submitted by Bauer to Palache was consumed by acid, several samples were found that the catalog indicated were donated by Bauer in 1937:

#97548 "Graphite" in calcite (7x4.5x2 cm). Contains little or no arsenopyrite and no realgar.

#97549 "Realgar" in calcite (11x7x5 cm). Contains visible arsenic, arsenopyrite, silicates, and graphite, and appears to fit very well the description by Palache of the 900-foot level assemblage (see Fig. 8).

#97550 "Arsenopyrite" in calcite (10.5x5.5x4.5 cm). Contains no graphite or realgar.

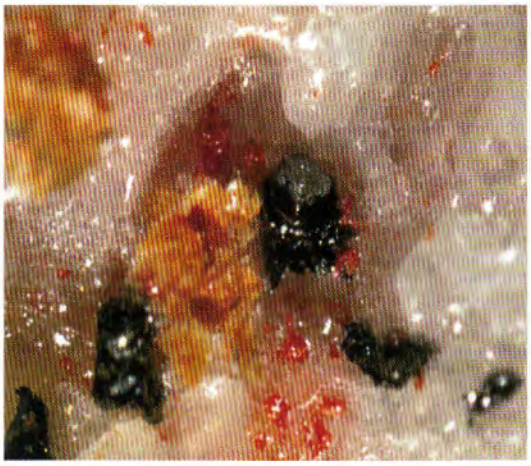


Fig. 7. Sterling mine graphite, realgar and silicates exposed from partially enclosing calcite matrix with dilute HCl. The graphite crystals are approximately 0.5 mm. Purchased from the Franklin Mineral Museum. (JAJ specimen 1941 and photo).

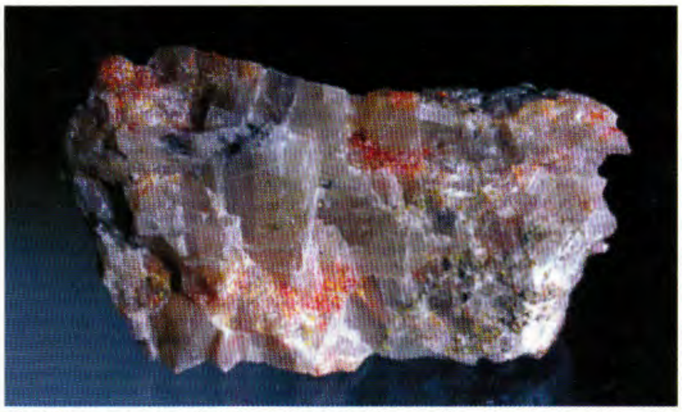
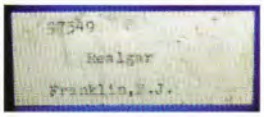


**Fig. 9.** 4.5 cm sample of realgar, arsenopyrite, pyrite, arsenic, graphite, diopside etc. in calcite from the Sterling mine. (ex Alan Pinger collection; A. E. Seaman Mineral Museum # AWP 1360) with Pinger's label (R). (JAJ photo 80-19). The numbers and letters on the label in ink correspond to to notations correlated to species in Pinger's notebooks; however, their significance is unknown. The Allen W. Pinger (May 8, 1897 - September 19, 1975) collection was donated to the A. E. Seaman Mineral Museum at Michigan Technological University in 1976 by his widow, Adaline Van Evera Pinger. This specimen has a sawed base and may have originated from New Jersey Zinc Company holdings.



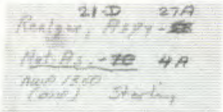



**Fig. 8.** Harvard Mineralogical Museum #97549, specimen of realgar, arsenopyrite, pyrite, graphite, diopside, etc. in calcite (11x7x5 cm). Harvard's catalog indicates that this specimen was from L. H. Bauer in 1937. Despite its label (L), it is almost certainly from the 900' level of the Sterling mine. It bears strong resemblance to A.W. Pinger specimen APW1360 (Fig.9). (JAJ photos 85-5 and 86-12.)

**Fig. 10.** 9 cm tall bottle of residues from L.H. Bauer from the 900-foot level, Sterling mine, Ogdensburg, New Jersey in 1937. (JAJ photos 90-16) Harvard Mineralogical Museum #97552

While all three of these specimens have labels indicating they are from "Franklin, NJ", there is little doubt that they are from Sterling Hill, and that #97549 is from the 900-foot level occurrence. It seems that whoever made the catalog entries didn't make the distinction between Franklin and Sterling Hill. It is also possible that "Franklin" may simply refer to the "Franklin region," which was an expression Palache did use in the 1941 paper (p. 715). It has long been a common practice not to distinguish between Franklin and Sterling Hill, and old specimens can be found in many collections that are clearly from Sterling Hill but labeled "Franklin" (E. Verbeek, personal communication). Harvard specimen #97549 is also quite similar in appearance to AWP1360 (see Fig. 9) from the Allen W. Pinger (geologist at the New Jersey Zinc Company from 1923 to 1950) collection in the A. E. Seaman Mineral Museum. Pinger's label clearly notes that the specimen is from "Sterling", and also notes the presence of realgar, native arsenic, and arsenopyrite, though not the graphite, which is present in the sample as well. Later-collected (post 1970's), 900-foot level samples of the arsenic-bearing mineral assemblage are visually distinct from the material found in 1937, based on the author's inspection of an admittedly limited number of the later-collected specimens, in comparison with Harvard #97549 and AWP1360. Distinctive features include the overall texture, coloration, calcite grain size, and arsenic abundance and grain size.

In the same drawer with the above specimens at Harvard was found a box containing the following:

•#97552: a 9 cm tall by 2 cm diameter glass bottle (Fig. 10) containing acid-insoluble residues as individual grains and clusters of grains (see Table 1). Included are damaged and euhedral graphite crystals, euhedral arsenopyrite crystals, rounded diopside crystals, euhedral pyrite crystals, zinkenite whiskers, and arsenic masses and crystals, all of which were described by Palache.

Table 1. Mineral Species found in the bottle of acid residues (etched from calcite) from L. H. Bauer in 1937 (Harvard Mineralogical Museum #97552).

| ***Group***<br>**Species** | **Relative Abundance**<br>1=very common<br>2=common<br>3=uncommon<br>4=rare | **Analysis** |
|---|---|---|
| *Native Elements:* | | |
| Arsenic ✓ | 2 | EDS |
| Graphite ✓ | 2 | |
| *Oxides* | | |
| Arsenolite (crust on arsenic; see Dunn 1995, p. 519) | not confirmed | EDS |
| *Sulfides* | | |
| Arsenopyrite ✓ | 2 | EDS, X-ray |
| Pyrite ✓ | 3 | EDS |
| Pyrrhotite (magnetic) | 2 | EDS |
| Realgar ✓ | 2 | EDS |
| Sphalerite | 4 | EDS |
| Zinkenite ✓ | 4 | EDS, X-ray |
| Stibnite ✓ (possible surface coating on zinkenite) | not confirmed | EDS, X-ray |
| *Silicates* | | |
| Diopside ✓ | 1 | EDS |
| Titanite | 3 | EDS |
| Albite | 2? | EDS |
| Microcline † | 2? | EDS |
| Quartz † | ? | EDS |
| Tremolite (white, fibrous) | 3? not confirmed | EDS |

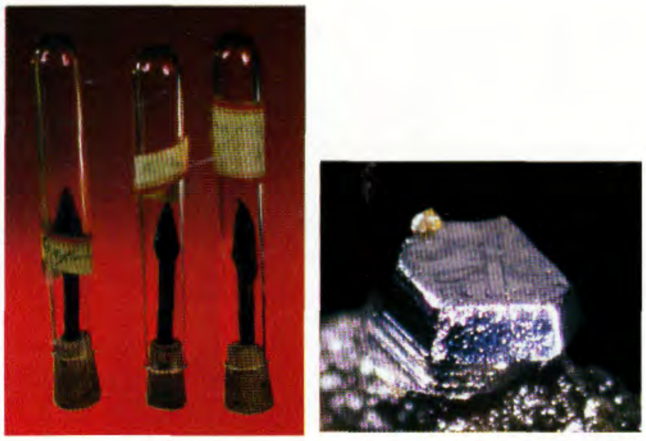
✓ Denotes species described or noted by Palache (1941).
† Noted also by Dunn 1979; 1995, p. 552.
EDS = Scanning Electron Microscope Energy Dispersive Spectroscopy

In addition, the bottle contains translucent, brown, lensoidal titanite crystals, tabular pyrrhotite crystals and grains, crystals of a white fibrous unidentified mineral (possibly tremolite), quartz grains, microcline grains, and reddish sphalerite aggregates. All of the above occur as loose grains and in association with other minerals, especially with clusters of rounded silicate grains. The bottle also contains several crystal grains that appear to be foreign based on their occurring only as a few loose grains. Several loose rutile crystals were found in the bottle and appear to be foreign since they do not occur in association with any other species. Harvard's catalog indicates that this bottle of residues was also from Bauer in 1937.

•Three 6 cm tall glass vials with tiny, lustrous graphite crystals, labeled #11, #12, #14, each mounted with wax on a brass goniometer shaft, which in turn is secured in a cork (Fig. 11). Similar graphite crystals were observed and isolated from the bottle of residues #97552.

•One glass vial (Fig. 12) containing a pyrite crystal mounted on a brass goniometer shaft and dozens of loose pyrite crystals showing combinations of cube, octahedron, pyritohedron and possibly other forms (Fig. 13). This vial, labeled "Pyrite - Bauer", also contained a few loose, well-formed graphite crystals (Fig. 14) and graphite crystals on pyrite crystals (Fig. 15).

•One glass vial with loose arsenopyrite crystals labeled "Arsenopyrite needles" (Fig. 12) containing arsenopyrite whisker crystals with aspect ratios approaching 40:1



(a) (b)

**Fig. 11.** (a) Three of Palache's glass vials with tiny Sterling Hill graphite crystals mounted with wax on brass sticks for optical goniometry. Vials are approximately 6 cm tall, not including the corks. (JAJ photo 45-1). (b) Closeup of 0.3 mm graphite crystal #14 (JAJ photo 76-24). Harvard Mineralogical Museum.

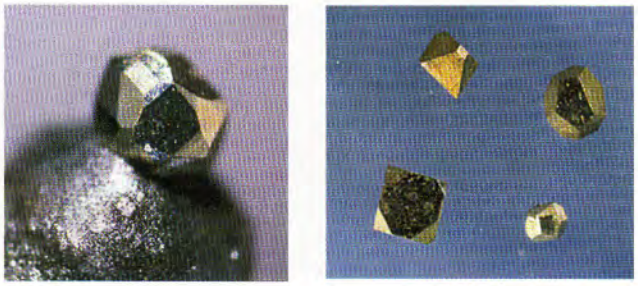
**Fig. 12.** Glass vial (bottom) with one goniometer mount of pyrite and loose crystals (see Fig. 13), from the Sterling mine. The bottle of "stibnite" contains needles of zinkenite and possibly stibnite. The inclined vial without a goniometer mount (upper left) contains "arsenopyrite needles." (JAJ photo 45-6). Harvard Mineralogical Museum #97552.

• Four glass vials, each containing an arsenopyrite crystal mounted on a brass goniometer shaft (Fig. 16). The corks are numbered 1 through 4.

• One glass vial labeled "Arsenopyrite Twins" containing loose arsenopyrite twins and an attractive trilling (Fig. 17). Clusters of small arsenopyrite twins also occurred in the bottle of residues #97552 (Fig. 18).

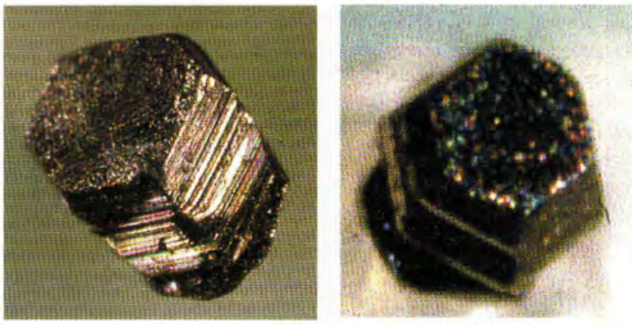
• One small glass bottle (Fig. 12) labeled "Stibnite - S. Hill, N.J." containing several clusters of zinkenite crystals, both loose and associated with native arsenic and orange, realgar-included silicates (Fig. 19).

Although all of the above vials, with the exception of the bottle of residues #97552, were *not* individually labeled with a catalog number, it seems reasonable to assume they all were from Bauer in 1937 or subsequent years, from the 900-foot level of the Sterling Mine, and that Palache had studied this material. They are all attributed in the Harvard catalog as being part of #97552.



(a) (b)

**Fig. 13.** (a) Complex pyrite crystal (0.5 mm) mounted with wax on a goniometer post in glass vial labeled "Pyrite-Bauer" (see Fig.11) (JAJ photo 77-27). (b) Assortment of loose pyrite crystals (to 0.5 mm), from the same vial as (a), showing cube-modified octahedron, pyritohedron, complex crystal, and an octahedron-modified cube (clockwise from upper left) (JAJ photo 88-19). Harvard Mineralogical Museum #97552.



(a) (b)

**Fig. 14.** Graphite crystals isolated from glass vial labeled "Pyrite-Bauer". (a) 1.1 mm naturally sheared crystal. (JAJ photo 76-36.) Similar sheared crystals are also common among the crystals from the National Museum of Natural History, ex Lawson H. Bauer, #C6355. (b) 0.3 mm crystal with prominent dipyramidal faces (JAJ photo 76-38). Harvard Mineralogical Museum #97552.

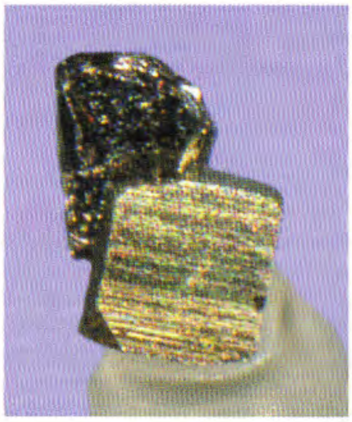
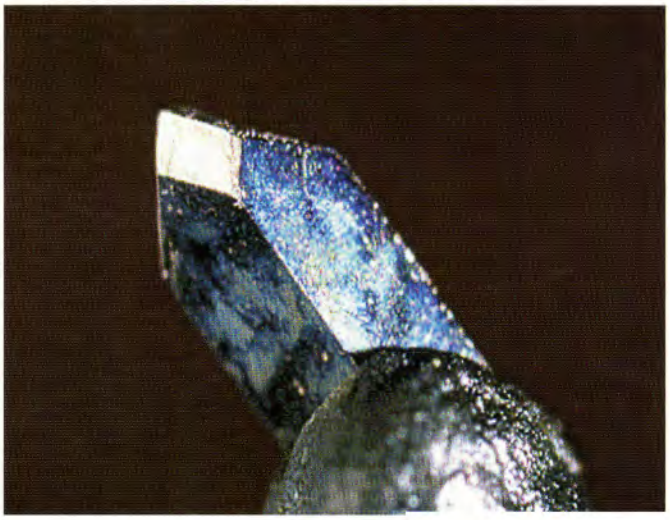


**Fig. 15.** 0.3 mm cuboctahedral pyrite crystal intergrown with a bent graphite crystal from the glass vial labeled "Pyrite Bauer". Harvard Mineralogical Museum #97552. (JAJ photo 89-14.)



Palache wrote in his paper that out of hundreds of graphite crystals examined, he measured ten crystals with the optical goniometer. Whether crystals 11, 12, and 14 were among those he studied is not certain but it seems likely. The whereabouts of the remaining graphite crystals, including those of which he actually published drawings, remain unknown. Although the original crystal drawn by Palache in his Fig. 3 (see Fig. 1) has not been found, the occurrence of very unusual barrel-shaped graphite crystals is now well established through the finding of other of Palache's goniometer mounts of graphite crystals and through finding other original Bauer material in the Harvard and Smithsonian collections.

## OTHER MINERALS

### PYRITE:

The small vial labeled "Pyrite - Bauer", contained a complex pyrite crystal mounted on a goniometer shaft (Fig. 13a), and numerous loose crystals of different habits (Fig. 13b) that fit well the description of the pyrite crystals given by Palache (1941). A few pyrite crystals in this vial had graphite crystals on them or partially intergrown with them (Fig. 15). Euhedral pyrite crystals are a relatively scarce fraction in the bottle of residues (Harvard #97552).

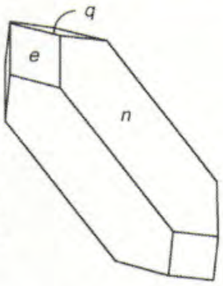
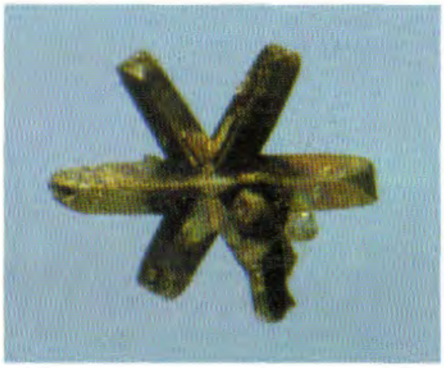



**Fig. 16-a** (above) 2 mm arsenopyrite crystal mounted on wax on a goniometer post in glass vial (mount #2). Idealized crystal of arsenopyrite (right) with forms *q* {210}, *e*{012} and *n*{101} made with SHAPE [based on data from Palache et al. (1944) but using orthorhombic mmm point-group symmetry]. Harvard Mineralogical Museum #97552. (JAJ ph 77-24.)

### ARSENOPYRITE:

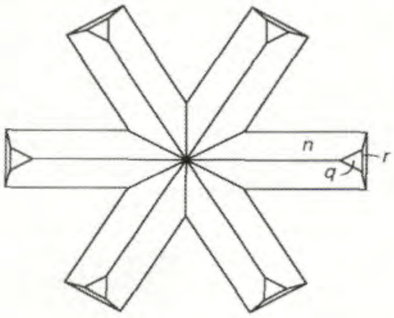
Palache (1941) noted that arsenopyrite occurred in the residues in abundance and beauty, ranging from needles (Fig. 12) to stout, euhedral prisms (Fig. 16) or flattened plates. Careful inspection of the loose residues in Harvard #97552 revealed virtually all the morphologies described by Palache. Some crystals in the residues and one on goniometer mount #3 are deeply striated, similar to those illustrated by Dunn (1979) from the 1100-foot level. One crystal isolated from the residues, and the crystal on goniometer mount #4 resemble Palache's Fig. 10, with forms *q*{210}, *e*{012}, and *n*{101} nearly equally developed. The crystal on goniometer mount #1 is similar to Palache's Fig. 9, which shows a slightly tabular crystal with a "rare" *b*{010} truncation of the typically acute termination.

(a)



(b)

**Fig 17**. (a) Vial of loose "arsenopyrite twins" containing not only twins, but one 0.6 mm trilling (b). (c) Idealized crystal drawing of an arsenopyrite trilling made with SHAPE, using forms *n* {101}, *q*{210} and *r* {140} and based on mmm point group symmetry. Twinning is by reflection on (012) and (0-12). Harvard Mineralogical Museum #97552. (JAJ photos 85-4 and 82-25). Compare to the illustration by Palache (1944 p. 317)




(c)

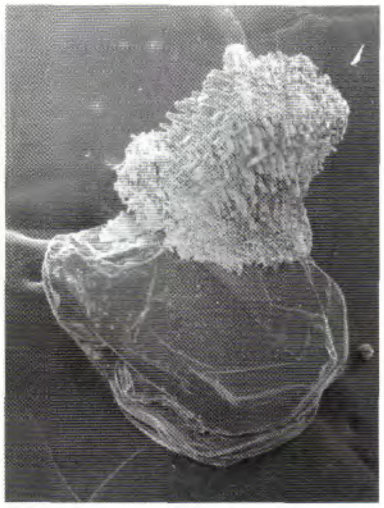


**Fig. 18.** Cluster of twinned arsenopyrite associated with a tabular crystal of graphite. From the bottle of acid insoluble residues. Harvard Mineralogical Museum #97552. SEM photo by George W. Robinson (74-4)

Among arsenopyrite twins in the vial labeled "Arsenopyrite Twins" (Fig. 17a) was discovered a striking arsenopyrite trilling (Fig. 17b). It is curious that Palache did not mention such twins or triads in the 1941 paper. However, Palache *et al.* (1944) did include a drawing (see Fig. 17c) of an almost identical trilling in the 7th edition of *Dana's System of Mineralogy* (page 318 vol. 1) from Weiler, Germany. A similar drawing of a trilling from Weiler also appeared in *Goldschmidt's Atlas der Krystallformen*. On page 317 of *Dana's System*, however, Palache *et al.* noted that "star-shaped trillings" also occur at Franklin, New Jersey. It is tempting to speculate that this statement was founded upon Palache's discovery of the trilling illustrated here (Fig. 17b). Perhaps it was discovered in the Bauer residues sometime between submitting the 1941 and 1944 publications.

Many arsenopyrite crystals and aggregates occur in the bottle of residues (#97552). Some occur as clusters of twinned crystals that appear to be epitaxic on a host crystal such as sphalerite (Fig. 18). Gandolfi X-ray diffraction of one such cluster, however, did not indicate the presence of any sphalerite. The identity of separate grains of sphalerite from the bottle of residues has been confirmed by SEM-EDS.

**STIBNITE-ZINKENITE-BERTHIERITE**

Needles of either stibnite or a lead sulphantimonide were reported by Palache (1941) among the associated species in the residues. The fact that insufficient material was available for a satisfactory determination of the species at that time, as stated by Palache, suggests that it was only a minor association, in contrast to some of the more recent occurrences on the 800-, 900- and 1100-foot levels. Subsequent descriptions of this material are interesting. In 1973, Cook reported "1/8 to 1/4 inch berthierite crystals were found among fragments of stibnite and realgar in a small vial labeled 'Pb,Sb sulfosalt: Sterling' by C. Palache (Harvard #109648)". This suggests, though it does not confirm, that stibnite was found in the material. Cook noted that berthierite is soluble in HCl and may have been destroyed in many samples in the process of extracting the insoluble residues. It appears that this material, which has been relocated in the Harvard collection, was obtained originally by Palache from Bauer, was cataloged by Cook after his study, and was subsequently studied by Dunn (C. Francis, personal communication). Edwards (1976) stated that stibnite had been verified by X-ray diffraction and that the only known specimens were in the A. Kraissl and D. Cook collections. On the other hand, Dunn and Baum (1987) removed stibnite from the official list of Franklin and Sterling Hill species, commenting that purported stibnite specimens had been found to be similar species. These similar species are presumed to be berthierite and zinkenite, which remained on the list (Baum *et al.*, 1987). Kolic and Sanford (1993) reported stibnite as a rare member of the arsenic-mineral assemblage, along with more prevalent zinkenite and minor realgar in quartz-rich boudins, on the 800-foot level (1040 crosscut, 980W). They also noted zinkenite as being found on the 900-foot level (1050N, 880W). Dunn (1995, p. 544) noted that stibnite was found in 1990 as microscopic gray crystals on the 800- and 900-foot levels

**Fig. 19.** Acicular zinkenite crystals with arsenic and orange realgar-included silicates, from the vial labeled "Stibnite-S.Hill, N.J." Harvard Mineralogical Museum #97552.( JAJ photo 77-29). Zinkenite was verified by SEM-EDS on crystals from a grain of similar associations from the glass bottle of residues.

**Fig. 20-a.** *(left)* Realgar crystals (0.6 mm across) (JAJ photo 85-16)

**Fig. 20-b.** *(right)* Subhedral realgar grains on 2 mm arsenic crystal (JAJ photo 85-9). Isolated from bottle of residues. Harvard Mineralogical Museum #97553.

in association with zinkenite, arsenopyrite, realgar, calcite, quartz, pyrite, and silicates. Its identity was verified by X-ray powder methods. Dunn also noted (1995, pp. 553, 556) that re-examination by Cook (1973) and by himself, of some of Palache's "needles of an antimony compound" by X-ray diffraction and EDS showed some of the crystals to be zinkenite and berthierite.

As part of this study, two loose, small needles were removed from the vial labeled "Stibnite - S. Hill, NJ" (Fig. 12) for analysis. Qualitative SEM-EDS indicated that one of the needles contained only antimony and sulfur, suggesting it could have been stibnite. Gandolfi X-ray diffraction and subsequent SEM-EDS analysis on broken fragments of the original crystal, however, showed only zinkenite. SEM-EDS and Gandolfi X-ray diffraction of the second crystal confirmed its identity as zinkenite as well. Similar appearing crystals associated with realgar-included silicates in a sample similar to that in Fig. 19, as well as a crystal associated with molybdenite from the sample in Fig. 3, were all found by SEM-EDS to be zinkenite. Similar appearing crystals associated with

realgar-included silicates in a sample similar to that in Fig. 19, as well as a crystal associated with molybdenite from the sample in Fig. 3, were all found by SEM-EDS to be zinkenite.

## REALGAR

Realgar was noted by Palache as occurring in rude prismatic crystals with ragged terminations, and thus being ill suited for goniometric measurement. Dunn also noted that the realgar from the similar occurrence on the 1100-foot level occurred only as formless blebs (see also Fig. 7). Indeed, most of the realgar among the residues in Harvard #97552 occurred as anhedral grains and aggregates; however, one nicely terminated prism was isolated from these residues (Fig. 20a). Some realgar grains are associated with native arsenic (Fig. 20b). Fine-grained inclusions of arsenic sulfide were found by SEM-EDS to be the source of the orange color in many grains of diopside, microcline and albite. These inclusions are assumed to be realgar since Dunn (1979) reported orange-colored blebs from the 1100-foot level to be microcline with realgar inclusions.

## ARSENIC

Palache (1941) noted that arsenic was present in "but" a few grains and crystals, one of which was found to be measurable on the goniometer. This crystal was drawn in his paper as Fig. 12, showing forms *c*{0001} *e*{1014}, *f*{2021}, and *p*{0112} (see Figs. 21 a,b). No arsenic crystals were found among the other goniometer mounts at Harvard; however, numerous arsenic grains were found in the bottle of residues #97552. Most commonly, the

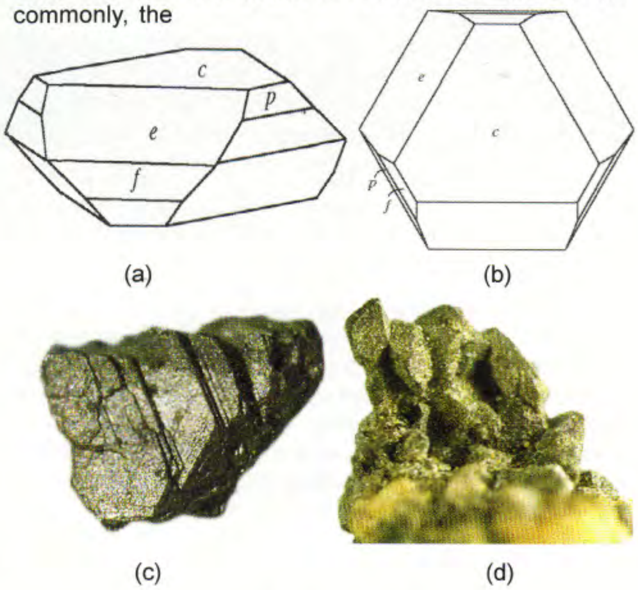



Fig. 21 (a) SHAPE crystal drawing of an arsenic crystal after figure 11 of Palache (1941) showing forms *c* {0001}, *e* {10-14}, *f* {2021}, and *p* {0112}. (b) Same crystal as (a) rotated view down the *c*-axis. (c) Arsenic crystals (2mm across) showing prominent basal pinacoids *c* {0001} (JAJ photo 85-13). (d) 1.5 mm group of euhedral arsenic crystal with oxidized surfaces. (JAJ photo 85-32). (c) and (d) are from a bottle of residues. Harvard Mineralogical Museum #97552.

grains are anhedral or subhedral. Some grains show prominent basal pinacoids (Fig. 21c) and a few are euhedral (Fig. 21d). Most of these native arsenic grains show a sugary coating. EDS analysis of the surface of these crystals shows only arsenic, so it is presumed that the coating is arsenolite. It is not known if this formed naturally or after the acid etching (Dunn, 1995, p. 519). Hopefully, this question may be answered by future analysis of matrix samples such as Harvard #97549 or AWP1360. Several subhedral native arsenic grains, to as much as 4 mm across, are also prevalent on the matrix sample Harvard #97549 (Fig. 8). Native arsenic has been observed intergrown or in contact with graphite, zinkenite, realgar, and realgar-included silicates (Fig. 19). Kolic and Sanford (1993) noted an occurrence of native arsenic as minute gray spheres in vugs from a July 21, 1990 find on the 900-foot level.

### DIOPSIDE

As noted by Palache, some of the most common insoluble grains are diopside. These occur as single grains or clusters with frosty, rounded surfaces with occasional crystal faces (Fig. 22). They are typically either orange in color from arsenic sulfide inclusions or nearly colorless and transparent

### MISCELLANEOUS

Several species have been noted in the residues of Harvard #97552 that were not mentioned by Palache (1941). Pyrrhotite occurs as numerous grains that magnetically stick to tweezers, and also as crystals associated with silicate clusters (Fig. 23). Among the insoluble silicates also were lensoidal titanite crystals and a fibrous white mineral (Fig. 24), containing Ca, Mg and Si, that could be an amphibole or pyroxene. SEM-EDS analyses show that the insoluble silicates include diopside, albite, quartz and microcline. The silicate grains commonly are colored orange by realgar inclusions, as was also found by Dunn (1979) in microcline grains from 1100-foot level.

### CONCLUSION

Charles Palache's 1941 paper was a unique and important contribution to the descriptive mineralogy of graphite. Preservation of original study material in the Smithsonian and Harvard Museum mineral collections has allowed for a rewarding "revisiting" of the 900-foot level of the Sterling Mine, and a continuing appreciation of an interesting and unusual arsenic-bearing mineral assemblage.

### ACKNOWLEDGMENTS

I am very grateful to Carl Francis and Bill Metropolis for assistance at the Harvard Mineralogical Museum, for arranging for samples to be studied and photographed, and for supplying invaluable information. I thank Jack Baum and John Cianciulli for hospitality at the Franklin Mineral Museum, and to Dick and Elna Hauck for their hospitality and assistance. I am indebted to Pete Dunn for supplying helpful information and the L. H. Bauer graphite crystals from the National Museum of Natural History (Smithsonian Institution) collection for study. Earl Verbeek and John Kolic are gratefully acknowledged for generously supplying information and "modern" samples from the arsenopyrite-realgar-zinkenite-molybdenite occurrence on the 900-foot level of the Sterling Mine. Many thanks to George Robinson for performing SEM-EDS analyses. Thanks to Steve Misiur and Earl Verbeek for supplying useful comments that improved this manuscript. Gandolfi X-ray diffraction analyses were performed at the Hawley Labs, Department of Geological Sciences and Geological Engineering, Queen's University.

**Fig. 22.** 0.5 mm transparent diopside crystal isolated from bottle of residues, Harvard Mineralogical Museum #97552 (JAJ photo 85-35)

**Fig. 23.** Pyrrhotite with diopside. Isolated from bottle of residues, Harvard Mineralogical Museum #97552 (JAJ photo 85-22)

**Fig. 24.** Association of various insoluble silicates, including fibrous crystals of amphibole or pyroxene, and brown lensoidal titanite crystals. Also associated are arsenopyrite (upper right) and graphite (lower right). Isolated from bottle of residues, Harvard Mineralogical Museum #97552 (JAJ photo 85-22)

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## APPENDIX

In 1994, Jaszczak listed 29 publications that cite Palache's 1941 paper (*American Mineralogist* **26**, 709-717). Below are given 16 additional publications citing Palache (1941) [not including this paper]. The author invites notification of additional publications that should be included.

1. Jaszczak, J. A. and Rakovan, J. Growth spirals on graphite crystals from the Trotter mine dump, Franklin, New Jersey. *The Picking Table* (to be published).
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3. Hanna, G. A. and Jaszczak, J. A. (1999) A new find of spherical graphite from Sterling Hill, New Jersey. *The Picking Table* **40**, 27-30.
4. Kvasnitsa, V. N., Yatsenko, V. N., and Jaszczak, J. A. (1999) Disclinations in graphite crystals from anorthosites of Ukraine. *Canadian Mineralogist* **37**, 951-960.
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13. Kwiecinska, B. (1980) Mineralogy of Natural Graphites. *Prace Mineralogiczne* **67** (Polska Akademia Nauk, Zaklad Narodowy imienia Ossolinskich, Wroclaw) 87 pp.
14. Dunn, P. J. (1979) Contributions to the mineralogy of Franklin and Sterling Hill, New Jersey. *Mineralogical Record* **10**, 160-165.
15. Ubbelohde, A. R. and Lewis, F. A. (1960) *Graphite and Its Crystal Compounds*. (Clarendon Press, Oxford) 217 pp.

# Yellow-Fluorescing Fluorite And Cuspidine

## *From the Franklin Mine, Franklin, New Jersey*

**John Cianciulli, Curator**
Franklin Mineral Museum
P.O. Box 54
Franklin, NJ 07461

Just when you think you have seen almost everything from the great zinc ore deposits of Franklin and Sterling Hill, Sussex County, New Jersey, interesting finds are made in old collections and on the dumps. The Franklin Mineral Museum recently acquired a small collection of minerals from Mr. Steven Phillips. While looking through the material Steve handed me what he thought was a strange rock slightly larger than a golf ball (6 x 5 x 4.5 cm). I shoved it in my pocket as Steve and his sons Neil and Scott proceeded to offload the other crates of minerals from his truck.

zincite, and franklinite.

Soon after a local rock collector was on the scene looking for a rock that fit the description of the one Steve had handed me. I showed him the strange rock and the collector confirmed that this was the material he was looking for. Because of the yellow-cream fluorescence, the collector thought it was barite associated with hardystonite and minor clinohedrite. Subsequently I found two more examples of this unusual material in this collection one larger (7x 6.5 x 6.5 cm) and one smaller (4 x 3 x 2.5 cm).

Upon closer examination the mineral first thought to be barite was determined to be fluorite. Optics helped confirm its identity as fluorite. Under short wave ultraviolet light (Fig. 2) the larger fluorite samples have a zoned cream and yellow fluorescence. The smaller sample fluoresces a strong uniform yellow. Under mid-range ultraviolet light the fluorite fluorescence is a slightly dimmer yellow, and there is little or no response under long wave ultraviolet light.

The fluorite color in daylight (Fig. 1) ranges from an almost indiscernible purple to medium purple, typical of fluorite from localities such as Rosiclaire, Illinois but is anomalous from the Franklin mine ores. Note, however, purple fluorite is hardly rare from the Franklin Marble in the local area. The medium purple areas fluoresce a rich yellow while the lighter color fluorite fluoresces weaker yellow to cream with good intensity. While yellow fluorescing fluorite is known from numerous other localities, this is the first time it has been reported from Franklin.

I Showed the material to Jack Baum, Jack suggested that hydrocarbons have been found in fluorite at the "Blue John" mine at Treak Cliff Hill, England and other well known fluorite localities, so "why not here?" Subsequently I sent a sample of the fluorite to Tony Nikischer of Excalibur Minerals. It is known that hydrocarbons and rare earth elements have been responsible for fluorescent responses of fluorite under ultraviolet light. Tony performed semiquantitative X-ray energy dispersive spectral analysis (EDS) and confirmed the presence of carbon. There was no detectable level of rare earth elements. Based on his interpretation of the EDS analysis, Tony believed that the carbon detected in the fluorite sample suggested that hydrocarbons may be admixed in the fluorite. This may explain the yellow fluorescence of this find.

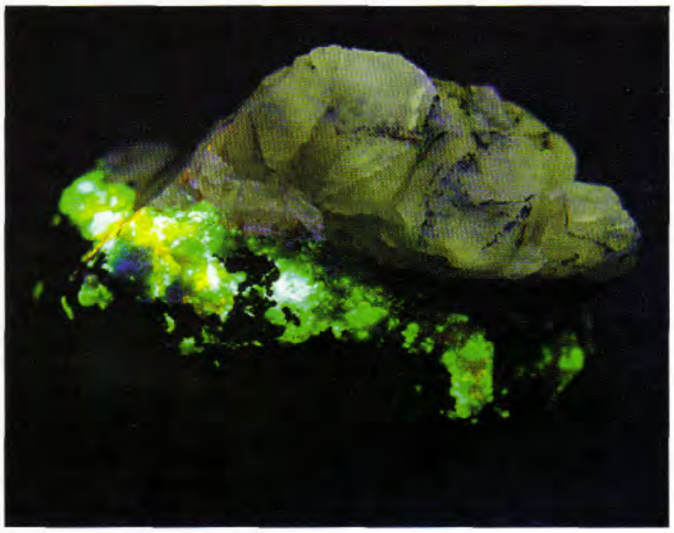

**Fig. 2** Short wave fluorescent response of Fig. 1.

*Specimen is 4 X 3 X 2.5 cm, Franklin Mineral Museum collection*
*Photos by Gary Grenier*

(continued from page 16)

The assemblage consists of massive granular franklinite with some iridescent grains (up to 1 $mm^2$), willemite, and patches (up to 3 $cm^2$) of blue-violet fluorescing (SW) hardystonite, and grains of orange fluorescing (SW) cuspidine (up to 0.5 x 1 cm). Willemite is finely disseminated through the franklinite. Most of the cuspidine is in contact with or very close to the fluorite. The fluorite occurs as a translucent vein up to 2.5 cm thick in this assemblage. On one of the samples pink fluorescing (SW) prehnite occurs in an open seam and along the contact area of fluorite and franklinite as pearly-white spherules (0.5 $mm^2$) and flat radiating crystals that form rosettes (1 $mm^2$). Orange zincite is also present in this contact area and on the fluorite. The cuspidine and prehnite were identified by observation of fluorescence and by optics.

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**Dunn, Pete J.** (1995) - "Cuspidine" - Franklin and Sterling Hill, New Jersey " the world's most magnificent mineral deposits" Part III Chapter 16, p. 409.

**Wilbur, Dru** (1999) - Cuspidine: Surprising Rediscovery of an Old Classic, and a Neophytes Education - *The Picking Table* Vol. 40, pp. 34-35 (40th Anniversary Issue).

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**Acknowledgments:**

The author would like to thank John L. Baum Curator Emeritus of the Franklin Mineral Museum Inc. and Mr. Lee Lowell for their research assistance; Mr. Anthony Nikischer of Excalibur Minerals for EDS analysis; and Mr. Steven Phillips for bringing the first specimen to my attention.

### *( Field Trip report continued from page 5)*

marble boulder produced a number of small yellow-green uvite crystals as large as 2 cm. The crystals were often very distorted due to a nearby shear zone. A similar boulder produced a subhedral 4 x 4 cm mass of pale yellow fluorescing (SW UV) uvite. A number of stout prismatic tremolite crystals as large as 1 x 7 cm long were seen and several were in nice fanlike clusters. Most of the crystals were dark gray but a few were light green. Diopside occurred in bright green short prisms up to 1 x 1 cm that fluoresced bright blue under SW UV. A number of fluorescent specimens of diopside dominant bulls eye pattern with a faint purple fluorite on the periphery were recovered this day. Some of these specimens contain norbergite and phlogopite with the diopside and give a blue and yellow response under SW UV. Margarite was found in small plates and masses up to 2 x 2 cm from an area of the once prolific find on the western side of the quarry some eight years ago. A productive time was had by all and nobody went home with an empty bucket.

*(Hopefully some additional identification work will be done to update our species list for Limecrest Quarry. Please let me know if you have any confirmations of species.)*

## FOMS Color Fund Contributors

Greg and Theresa Anderson
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A.E. Seaman Mineral Museum
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Elaine Sole
Richard Stagl

# John Albanese -

## A Mineral Dealer from New Jersey

**Richard Hauck**
**43 Woodland Road**
**Franklin, NJ 07416**

Many states have produced classic personalities involved with minerals. During the 1950s Massachusetts produced the Schortmann Brothers, New York had Hugh Ford, and New Jersey had its premier dealer in John S. Albanese.

Perhaps it's the dust from the traprock quarries of the Watchung Mountains or the zinc dust of the Sussex area that gets into the bloodstream to produce the giants of minerals that Jersey claims. New Jersey produced Roebling and Canfield, whose collections are the cornerstones of our national collection, and George Kunz (of Hoboken!) whose contributions to gemology and mineralogy may never be surpassed. John S. Albanese comes from this mineralogical environment.

John was born in the last years of the nineteenth century. He made it to 70+ years of age but as of 2000 has been gone from the mineral game for over 30 years.

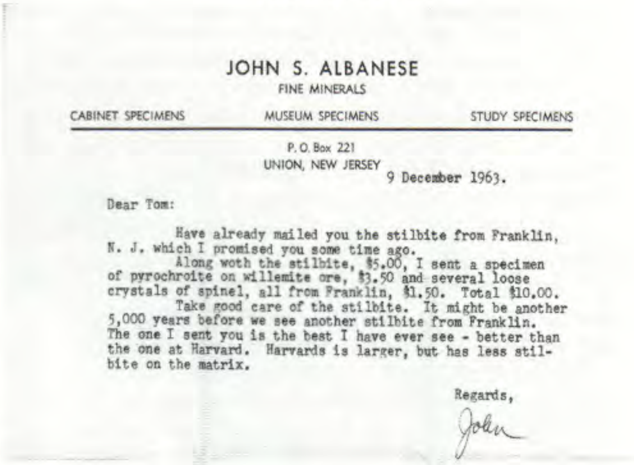
He was a family man, with a daughter who helped at mineral shows and a son who followed geology in the western states. He was also a proud man whose limited formal education was not an insurmountable handicap in the mineral business. An indication of the man's depth is that at 40 years of age he enlisted in the military service of his country long after age and family were safe deferments.

John tried his hand at publishing. He produced a series on his first interest, Franklin-area mineralogy. After 8 issues, financial practicality took precedence over his enthusiasm and as he stated in a letter to a customer in September of 1961, he "could not get enough subscriptions. In fact they fell off to 180. Most collectors want to read junk with nice pictures. Instead I will now write a real book - about 400 pages - on Franklin minerals with plenty of 'pitchers' for the gratification of those who like to see pictures but too lazy to read." The book was never to appear, poor health saw to that. Albanese's *Notes on the Minerals of Franklin and Sterling Hill, New Jersey* ran for 8 issues from October 1959 to July 1961. Like so many before, such as Bates, Chamberlain, Dake, and Zodac, John suffered the disappointments of being a publisher.

John had his own way of doing and saying things. He always went out of his way to encourage young collectors but apparently didn't have too much respect for the younger generation. He commented to a customer in a letter in 1962, " I am sending you a real 'old timer'... I could have sold it to the Franklin, N.J. High School, but kids don't know minerals from soda-pop". However, John was impressed by professional mineralogists and thought it important to associate with them. He brought an important specimen of barysilite to the Franklin Symposium in 1961 for Dr. Clifford Frondel to see, a specimen overlooked when Dr. Frondel had examined the Nick Trofimuk Franklin collection. John states, "Had Frondel known this specimen had crystals buried beneath, he would have given his right arm and a few thousand of Harvard University dollars for it." As it turned out, Frondel forgot to visit with John after the lecture, as John then states, "If Professor Frondel wants to see the worlds only barysilite xls. From Franklin he will have to see my old friend Thomas Calcina!" Albanese sold it to Tom for $150.


Many of today's collectors would not remember the opening day of the early Franklin Kiwanis mineral shows at the Franklin Armory. Those who were active in those years would be in a line out front waiting for the show to open. This group of collectors knew where they were headed first: John Albanese's booth. Although today's collectors will never know the pleasures of anticipation of the treasures John always had for the show, these collectors still benefit from the many outstanding specimens that John Albanese made available at more-than-fair prices. He truly was a great dealer as well as an outstanding contributor to the pleasures and preservation of the mineral world.

Letter from John Albanese to Thomas Calcina
December 9, 1963



JOHN S. ALBANESE
FINE MINERALS

CABINET SPECIMENS — MUSEUM SPECIMENS — STUDY SPECIMENS

P. O. Box 221
UNION, NEW JERSEY

9 December 1963.

Dear Tom:

Have already mailed you the stilbite from Franklin, N. J. which I promised you some time ago.

Along woth the stilbite, $5.00, I sent a specimen of pyrochroite on willemite ore, $3.50 and several loose crystals of spinel, all from Franklin, $1.50. Total $10.00.

Take good care of the stilbite. It might be another 5,000 years before we see another stilbite from Franklin. The one I sent you is the best I have ever see - better than the one at Harvard. Harvards is larger, but has less stilbite on the matrix.

Regards,

John

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Tarzana, CA 91357-2694
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# Glaucodot

## *Added to the Franklin Species List*

**Tony Nikischer**
Excalibur Mineral Company
1000 North Division Street
Peekskill, NY 10566

In July of 1999, Forrest Cureton of Grass Valley, California, submitted a sample to Excalibur Mineral Company for identification. The specimen consisted of a mass of greyish metallic material approximately 5.5 cm x 4.5 cm x 3.0 cm, with numerous small knobby appendages. Several 1-cm pods of yellowish sphalerite were evident on the sample, as were minute interstitial fillings of purple fluorite and some residual white calcite. The specimen had obviously been etched with acid, and a small old label was attached to the back of the sample identifying it as "Chloanthite - Franklin, NJ". The original owner of the sample is not known, but the specimen also passed through the collections of P.A. Foster, M.D. (Los Angeles, CA) and Jean and Harry Hamel (also of Los Angeles), prior to being placed in the Cureton collection. Little specimen material of legitimate Franklin "chloanthite" is known today. The nickel, cobalt, and iron arsenide assemblage had been studied as early as 1889 by Koenig, later detailed by Holmes in several papers in 1935-1947, and described by Oen et al in 1984. This material has been found to consist largely of nickeline, pararammelsbergite, rammelsbergite, skutterudite, safflorite, loellingite, gersdorffite, arsenopyrite and several other species. The current study adds glaucodot to this interesting assemblage.

A small knob approximately 1 mm across was removed from the sample. In the scanning electron microscope at about 3300x, the small ball showed to be a conglomeration of numerous intergrown metallic aggregates of various arsenides, with minute orthorhombic crystals sparsely perched on the surface of the knob. The crystals were approximately 20 microns in length, and they showed a prismatic habit elongated parallel to (010).

Utilizing an EDAX "Super Ultrathin Window" energy dispersive spectroscopy detector in a Philips 525M scanning electron microscope operated at 20 KV, one of these minute crystals was analyzed. The average analysis yielded Co 16.64%, Fe 9.69%, Ni 8.26%, As 44.00%, S 21.40% = 99.99%. The empirical formula from the resulting analysis suggested:

$$(Co_{0.36}Fe_{0.28}Ni_{0.23})_{0.87}As_{0.95}S_{1.08}$$

This is in reasonable agreement with published analyses of glaucodot, considering the operating conditions, but with significant nickel in apparent substitution for cobalt and iron.

The hand specimen was then examined by John Cianciulli of the Franklin Museum in order to confirm its Franklin origins. The physical appearance of the sample, coupled with its association with sphalerite, calcite and fluorite, further supported the "Chloanthite - Franklin, NJ" label and suggested the specimen was a legitimate Franklin piece.

The tiny sample fragment that was chemically studied was subsequently X-rayed by Andy Roberts of the Geological Survey of Canada (GSC) using a Debye-Scherrer Camera, and the presence of glaucodot was confirmed. The X-ray film is filed at the GSC under index # X-79125. The chemistry, physical appearance and mineral associations, and the X-ray pattern of the sample all support the addition of glaucodot to the Franklin species list. The specimen currently resides in the private collection of Forrest and Barbara Cureton.

**Acknowledgement**

*The author wishes to thank the Curetons for their* interest, curiosity, and willingness to lend the specimen for this project; John Cianciulli for his careful study of the sample; Andy Roberts for his consistent and tireless support of the collector community; Pete Dunn for his superb monograph that is now the standard reference we all consult and the cornerstone we hope to build upon whenever a Franklin mystery presents itself.

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**The temperature in the mine is 55 degrees F.**

**Learn about the importance of the mining industry in northwestern New Jersey**
**See historic mine workings!**

# A Classic Native Copper

## From
## Franklin, New Jersey

by
**John L. Baum**

*The specimen of native copper appearing in this issue of* The Picking Table *is one of the finest mineral specimens ever recovered from the Franklin mines. The specimen now reposes in the Steven Phillips collection. I remember when Ewald Gerstmann owned the specimen and then sold it. He acquired the piece for a song (of reasonable weight) from a miner. Some time later, Ewald accidentally broke the piece and repaired it. I guess he was distraught and disappointed by the fact that it was a "broken" specimen and it became expendable. But who would buy it? John Hendricks obliged and relieved Ewald of the specimen. Well, a few years later, Hendricks was selling his collection, Ewald reconsidered his former position, that is, his thinking about the piece. He made an offer that Hendricks could easily refuse. As Ewald explained to John MacDonald and me, "Aw da piece wuz broken, I dropped the darn piece an' glued it back. He's nuts for paying dat kinda money! I'm payn' for a broken piece!" The "He" was Dick Hauck. John MacDonald and I had stopped over at Ewald's home shortly after his unsuccessful bid to reacquire the native copper specimen from Hendricks. I was an innocent bystander, sort of like a witness to an accident. I didn't know that Hendricks was selling his collection. Heck, I didn't even know who John Hendricks was! All I knew at the time was that a great native copper specimen was sold to a "mature" looking guy named Dick Hauck. I was just a young punk collector with very limited resources at the time. If only I had the shekels then. To fill in the rest of the story of the odyssey of this most exceptional native copper specimen, John L. Baum's account from* The Picking Table, *(1975), v. 16, no 1. p. 9, is reprinted below. -Peter Chin*

During the latter part of 1945 an area of unusual minerals was encountered in the Franklin Mine of the New Jersey Zinc Company in Sussex County, N.J. Immediately above the 800 ft. level, about 15 feet into the ore from the hanging wall (east edge) and close to the North side of the Palmer Shaft piller (central portion of the ore body), occurred a vein system arranged in a H pattern as viewed in vertical section. The veins connected with potash feldspar above. The veins, a foot or so wide, consisted largely of andradite garnet and hedricksite but there were local concentrations of hancockite near the floor of the 10 foot high working place and of other silicates and native copper closer to the feldspar above. The silicates such as roeblingite, hancockite, clinohedrite, xonotlite, rhodonite, datolite and others postdate emplacement of the feldspar and represent reworking of the adjacent vein by solutions which have corroded cavities and formed spongy zones in the garnet/hancockite vein system. The locality is described with emphasis on the ettringite by Hurlbut and Baum in the American Mineralogist, Volume 45, 1960, pages 1137-43.

The working place was being mined by Nick Trofimuk and others, and this writer visited the spot right after a blast. Sticking out of the wall on a corner, fully exposed, was the rounded shape of a chunk of native copper. I pointed it out to a miner visiting from a neighoboring working place, and loosened the specimen so that it fell the short distance to the muck pile. Before I could pick up the piece, the visitor, Andrew Opatic, snatched it up and ran away with it, saying that he always wanted a piece of native copper. The mine management offered to recover the specimen for me, but I turned the offer down ( a mine is no place to have enemies) and instead offered another material for trade but the specimen was not for sale or trade. Years later Ewald Gerstmann bought it from the Opatic mantelpiece for the highest price paid for a Franklin specimen up to that time. He broke it while transporting it to or from display elsewhere and later sold it to John Hendricks. Ewald, a short time later, tried to repurchase this specimen from John Hendricks but was unsuccessful. Two or three years ago, Dick Hauck finally purchased the Hendricks collection and obtained the specimen. While I cannot guarantee any of this story from the point where it was sold by Opatic, I do believe the sequence of events is accurate.

**PHOTO ON BACK COVER:** native copper, ganophyllite, charlesite, xonotlite, clinohedrite, willemite, and franklinite. Steven Phillips collection. Specimen measures 10.5x4.5x4.5 inches
*(Photos on front and back covers of this issue taken by Gary Grenier)*