

# THE PICKING TABLE



Buckwheat Open-Cut 1984

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# The PICKING TABLE

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Abandoned Hamburg Mine,  
at Franklin, looking south  
toward the Ding Dong and  
Trotter shafts - circa 1948.

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# Sulfur and Ferrimolybdate

## from Sterling Hill

by Fred J. Parker and Bruce E. Smith  
Flanders, NJ Allentown, PA

### SULFUR S

#### Introduction

Native sulfur has been positively identified from the Sterling Mine, Ogdensburg, New Jersey. It was found as small yellow masses and crude grains in pockets with a highly altered galena (PbS) and fine crystals of cerussite (PbCO<sub>3</sub>). The sulfur and cerussite are apparently alteration products of the galena. The matrix is a typical granular franklinite-willemite mixture in calcite.

The sulfur was discovered during the trimming of a cerussite bearing matrix. Trimming revealed new exposures which contained several 5 mm patches of the yellow mineral. The specimen is known to be from the Sterling Mine, but the exact location of its origin is not known.

#### Analysis

Identification of the sulfur was based upon X-ray diffraction data, physical characteristics and melting point determination. The three major observed diffraction peaks are compared to ASTM standard 24-733 below:

#### ASTM - 24-733 Sulfur

<u>d, Å</u>	<u>Intensity</u>
3.85	100
3.22	40
3.45	40

#### STERLING MINE Sulfur

<u>d, Å</u>	<u>Intensity</u>
3.88	100
3.24	50
3.46	55

#### Conclusion

Sulfur, (S), was previously reported from the Sterling Mine (Edwards, 1976) but was subsequently discredited. The present study, however, confirms its validity as a mineral species from the Sterling Hill deposit, and as such should be returned to the list of locally occurring species.

#### Discussion

Confirmed sulfur specimens are in the collections of the authors. Collectors should carefully examine their altered galena-cerussite specimens from the Sterling Mine inasmuch as additional specimens should exist.

References: Edwards, F.Z., *New Minerals*, PT, 17, 1, 7.

2

### FERRIMOLYBDITE Fe<sup>+3</sup>(MoO<sub>4</sub>)<sub>3</sub> · 8H<sub>2</sub>O(?)

#### Introduction

Ferrimolybdate has been identified as yellow powdery masses in a molybdenite bearing calcsilicate matrix. The yellow masses occurred both as rims around molybdenite flakes (often partially altered to powellite) and as areas to 5 mm in the enclosing quartz. The examined specimen came from the Cianciulli collection and appears the same as molybdenite-powellite specimens that came from the Sterling Mine about ten years ago.

#### Analysis

Positive identification of ferrimolybdate was made by X-ray powder diffraction analysis. The three principle peaks of the Sterling Mine sample and ASTM standard 13-191 are shown below.

#### ASTM - 13-191 Ferrimolybdate

<u>d, Å</u>	<u>Intensity</u>
8.40	60
9.87	100
6.73	20

#### STERLING MINE Ferrimolybdate

<u>d, Å</u>	<u>Intensity*</u>
8.40	100
10.10	90
6.78	25

(\* denotes peaks showed some broadening.)

#### Conclusion

Based upon the X-ray diffraction data and physical characteristics, ferrimolybdate, (Fe<sup>+3</sup>(MoO<sub>4</sub>)<sub>3</sub> · 8H<sub>2</sub>O(?), should be added to the list of mineral species known to occur within the Franklin-Sterling Hill deposits.

#### Discussion

Examination of additional Sterling Mine molybdenite specimens, especially those partially altered to powellite, may turn up additional ferrimolybdate specimens.

*The Picking Table, Spring, 1984*

# Fluorescent Calcites

## a comprehensive chemical study

by Gerald J. DeMenna  
Beckman Instruments, Inc.  
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**CALCITE ANALYSIS:** ideally  $\text{CaCO}_3$  — [56.03 wt% CaO, 43.97 wt%  $\text{CO}_2$ ].

### Introduction

Calcite, found around the world in a myriad of forms and varieties, is described as one of the commonest of minerals. Its chemical composition is primarily calcium carbonate,  $\text{CaCO}_3$ , about 40% calcium by weight; though it is often found with high levels of other elements substituting for both the calcium and carbonate components.

These impurities are what make the well-known calcite formations of Franklin and Ogdensburg so beautifully appealing; by acting as fluorescent activators in the calcite crystal structure.

Some early research noted by Palache (1935) and Jones (1964) states that the manganese content acts as the primary activator, with activation occurring from 0.5 wt% to 17 wt%. Lead was thought to be a "co-activator," but this area was not fully investigated.

Fluorescent responses vary from a rare pale blue-violet (SW), rarer green (L/SW), cream-white (L/SW), yellow (L/SW), all uncommon, and all shades of red (L/SW), the overwhelmingly common response.

### Analysis

The following table lists complete quantitative chemical analyses of all elements detected in various calcites from the Franklin area. Samples of a pure fluorescent character were finely powdered, dissolved in a mixture of acids and analyzed on a direct-current plasma/atomic emission spectrometer, DCP. Non-metallic analyses, i.e.,  $\text{CO}_2/\text{CO}_3$ ,  $\text{H}_2\text{O}$ , S/ $\text{SO}_3$ , etc., were performed by classical wet gravimetric, acidimetric and aquametric methods, as well as by automated furnace/combustion train thermogravimetric methods.

	1	2	3	4	5	6	7	8	9	10	11
CaO	56.62	47.46	48.84	44.06	48.96	51.24	42.28	25.76	40.74	29.26	39.90
MgO	0.126	2.338	0.217	0.548	0.051	0.403	0.978	30.34	5.123	0.318	10.58
SrO	0.065	0.050	0.071	0.140	0.105	0.050	0.256	0.060	0.064	0.017	0.025
BaO	0.093	0.019	0.150	0.090	0.022	0.006	0.042	0.015	0.013	0.008	0.002
MnO	1.652	1.614	0.793	10.43	3.177	5.680	8.261	2.814	8.030	17.56	10.26
ZnO	0.005	0.065	0.011	0.198	0.035	0.024	0.039	1.185	0.812	2.054	0.477
$\text{Cr}_2\text{O}_3$	0.001	0.006	0.001	0.005	0.001	0.004	0.004	0.015	0.017	0.041	0.015
FeO	0.017	0.042	0.032	0.176	0.073	0.219	0.024	0.311	0.277	1.596	0.979
NiO	0.005	0.004	0.005	0.004	0.006	0.004	0.005	0.003	0.005	0.008	0.006
CuO	<0.001	<0.001	—	—	0.004	—	—	—	—	0.002	—
$\text{Ag}_2\text{O}$	—	<0.001	—	0.003	0.002	0.001	<0.001	—	<0.001	0.001	0.002
$\text{MoO}_3$	<0.002	0.003	—	0.003	—	0.005	0.002	0.017	0.014	0.003	0.012
$\text{Al}_2\text{O}_3$	0.004	0.002	0.004	<0.001	0.017	—	0.004	—	—	<0.001	—
$\text{PbO}$	0.183	0.015	0.033	0.073	0.265	0.012	0.123	0.094	0.087	0.016	0.023
$\text{SiO}_2$	0.024	0.030	0.004	—	0.141	—	0.411	0.006	—	4.136	—
$\text{B}_2\text{O}_3$	—	<0.001	—	<0.001	0.019	<0.001	—	—	0.003	0.011	0.003
$\text{P}_2\text{O}_5$	0.003	0.050	0.014	0.018	0.025	0.044	—	0.016	0.030	0.069	0.075
$\text{As}_2\text{O}_5$	0.071	0.141	0.095	0.083	0.206	0.061	0.038	0.098	0.085	0.019	0.069
$\text{RE}_2\text{O}_3$	0.039	0.103	0.021	0.038	0.009	0.025	0.005	<0.001	<0.001	0.051	0.093
$\text{CO}_2$	43.10	45.9	35.3	42.5	42.3	40.4	43.3	37.8	43.5	42.1	28.8
$\text{H}_2\text{O}$	0.894	1.32	0.429	0.766	1.86	0.201	1.54	2.26	0.628	1.07	1.69
$\text{SO}_3$	<0.3	0.65	9.9	1.2	1.79	1.47	1.55	<0.3	<0.3	0.72	6.8
Total	99.90	99.20	95.92	100.4	99.07	99.85	98.90	101.1	99.73	99.06	99.81

- Sample description: Number 1 - Brightest red (SW) from clean, crystalline cleavage specimen.  
2 - Clean red (SW) w/ phosphorescent willemite.  
3 - Flat red (SW) w/ spots of barite disseminated throughout.  
4 - Red-pink (SW) w/ sphalerite, willemite, and non-fluorescent areas ("crazy").  
5 - Red-orange (SW) visibly brown w/ margarosanite.  
6 - Red-orange (SW) visibly tan-peach w/ sphalerite.  
7 - Dull pale-red (SW) visibly gray w/ brown willemite.  
8 - Non-fluorescent area ("crazy") from sample 4.  
9 - Non-fluorescent area from small grained "crazy" calcite specimen.  
10 - Yellow (LW/SW) visibly yellow w/ clean crystalline rhodonite.  
11 - Pale blue (SW) visibly gray w/ sphalerite from sample 6.

### Discussion

In Palache's report (1935), he mentions the gradation in chemical composition from pure calcite to dolomite; a mixed calcium-magnesium carbonate containing 21.7 wt% Ca and 13.2 wt% Mg, though this was not examined as a factor in fluorescent response. The data offered here suggest a significant correlation exists between the level of magnesium and fluorescence.

Lead, Pb, contrary to previous belief, does not appear to be an activator.

There were several metals analyzed in minor concentrations that seem to be acting as fluorescent "quencher" within the calcite. Molybdenum, Mo, appears in higher concentrations in samples with pale or no fluorescence, as does iron, Fe, (especially in those associations with sphalerite), and chromium, Cr. Zinc is a primary element throughout the orebody, but surprisingly there was less than 1.0 wt% Zn in the samples analyzed. However, the Zn levels were three to eight times higher in the paler and non-fluorescing samples. The manganese, Mn, content varied widely, but showed no obvious correlation to the fluorescent response; again, refuting previous belief.

Possible substitutes for the carbonate,  $\text{CO}_3^{2-}$  moiety in the form of phosphate,  $\text{PO}_4^{3-}$ , borate,  $\text{BO}_2$ ,  $\text{B}_3\text{O}_4$ , arsenate  $\text{AsO}_3$ , and silicate,  $\text{SiO}_2$ , were analyzed and found to be very low in concentration.

### References

- Bostwick, R.C. (1982) *Mineral Fluorescence at Franklin & Sterling Hill*, Rocks & Minerals, 57, 5, 196-201.  
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Palache, C. (1935) *The Minerals of Franklin and Sterling Hill, Sussex County, New Jersey*, U.S. Geol. Survey Prof. Paper 180.  
*Hill, Sussex County, New Jersey*, U.S. Geol. Survey Professional Paper 180.  
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# MINERAL NOTES

## New To Science

In the past we have taken particular pleasure in announcing the occurrence of mineral species, new to science, as having been discovered at Franklin or Sterling Hill. We are again able to do so through the courtesy of Dr. Pete J. Dunn of the Department of Mineral Sciences, Smithsonian Institution, Washington, DC, who advises:

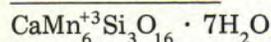
### MINEHILLITE

"We have another mineral new to the science. It is a calcium-zinc-aluminum-silicate from the Franklin mine. It is colorless, has perfect cleavage, is associated with a variety of species, frequently native lead, and is named minehillite for Mine Hill in Franklin, New Jersey."

## Research Reports

In the Spring 1983 issue of the *Picking Table* we announced the discovery and naming of bostwickite, a calcium manganese silicate hydrate. The describing paper entitled "Bostwickite, a new calcium manganese silicate hydrate from Franklin, New Jersey," by Pete J. Dunn of the Smithsonian Institution and Peter B. Leavens of the University of Delaware, has been published in *Min. Mag.*, 47, 387-389, from which we quote:

### BOSTWICKITE



### Introduction

"The new species described herein has been known to mineralogists for over a century. It was found in the Taylor mine, one of numerous small mines in what later became the Franklin mine, in 1874. The specimens were acquired by Frederick Canfield, a collector of New Jersey minerals, were later studied by E. S. Larsen, Jr. and were tentatively considered (Palache, 1935) to be arseniosiderite. This tentative identification was later disproved by subsequent examination by Drs. Harry Berman and Clifford Frondel who noted (Frondel, 1972) that it was a calcium manganese silicate. Examination of impure material by Dunn (1979) verified the composition, but did not name the species. Recent examination of pure material has resulted in the characterization of this species and the description is presented herein.

We take pleasure in naming the species *bostwickite* in honor of Richard C. Bostwick, a collector of Franklin minerals, in recognition of his contributions to the mineralogy of Franklin and Sterling Hill. He has been instru-

*The Picking Table*, Spring, 1984

mental in the preservation of many unique assemblages that might have been overlooked by less sophisticated observers and has contributed over a period of 20 years to our knowledge of the fluorescence of minerals from these deposits."

### Physical and optical properties

"Bostwickite is dark brownish red with a vitreous to submetallic luster on prism surfaces. It occurs as divergent sprays of bladed crystals. The surface of these sprays when the crystals are tightly packed, has a dull appearance similar to brown velvet. The streak is brownish red. The hardness is approximately 1 (Mohs'). Cleavage could not be observed inasmuch as apparent 'crystals' are actually composites of tiny microcrystals much too small for cleavage observations. The density, determined by heavy liquid techniques on a particularly dense aggregate, is 2.93 g/cm<sup>3</sup> ( $\pm 0.10$ ), but much lower values were obtained from less compact aggregates. Bostwickite is readily soluble in 1:1 HCl, coloring the solution brown.

Optically, bostwickite is biaxial negative with  $2V_{\alpha} = 25^{\circ}$ . Indices of refraction, measured in sodium light, are  $\alpha = 1.775(5)$ ,  $\beta = 1.798(3)$ , and  $\gamma = 1.800(3)$ ."



Figure 1. Bostwickite spray radiating across field of fluorite; photo by A.L. Standfast.

## Chemistry

"Bostwickite was chemically analysed utilizing an ARL-SEMQ electron microprobe. A spectrographic analysis indicated the absence of any light elements. Water was calculated by difference. The resultant analysis yields, ideally,  $\text{CaMn}^{+3}\text{Si}_3\text{O}_{16} \cdot 7\text{H}_2\text{O}$ ."

## Occurrence

"Little is known of the geologic relations of the *in situ* occurrence of bostwickite. The samples were obtained from museum collections. It was originally found in 1874 in the Taylor mine, one of many mines later consolidated (in 1897) as the Franklin mine. At least six specimens are known to have been preserved and others may repose as unknowns in systematic collections.

Bostwickite occurs on a medium-grade ore consisting of franklinite, calcite, and fluorite with minor willemite. The presence of the fluorite in the ore is uncommon and may suggest very localized and uncommon conditions of occurrence. The matrix is nearly identical on all examined specimens.

Bostwickite occurs as radial aggregates (Fig. 1, *ed.*) and hemispherules up to 3.0 mm in diameter. Some of these hemispherules are linked to form thin patches and matted aggregates up to 1.0 cm in diameter. Bostwickite occurs directly on the ore surface, as well as on secondary carbonates that coat the ore in places. There are also spherules of an unknown mineral, which are badly altered and have a silvery, fine-grained appearance. Another species, not yet characterized, is present as bright yellow, hexagonal, platy crystals, which, to the casual observer, resemble native gold in hand specimen."

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In the Spring 1983 issue of the *Picking Table* we announced the renaming of ettringite to charlesite. The describing paper by Pete J. Dunn, *et al.*, has appeared in the *Am. Min.*, 68, 1033-1037, from which we quote:

## CHARLESITE



## Introduction

"An ettringite-like mineral was first described from Franklin, New Jersey by Hurlbut and Baum (1960). They noted that it contained boron and silica but, because it conformed closely to ettringite, they preferred to consider it a variety of ettringite. The recent characterization of sturmanite (Peacor *et al.*, 1983) provided insights into the complex substitutions in members of the ettringite group and our recalculation of Ito's analysis (*in* Hurlbut and Baum, 1960) indicated that the Franklin material was not ettringite, but the aluminum analogue of sturmanite. We have named this mineral *charlesite* in honor of Charles Palache (1869-1954) in recognition of his immense contributions to mineralogy and crystallography."

## Physical and optical properties

"Charlesite is transparent with a white streak. The (1010) cleavage is perfect and easily produced. The Mohs hardness is approximately 2½. The density reported by Hurlbut and Baum (1960) is 1.77 g/cm<sup>3</sup>, which compares very well with the calculated value of 1.79 g/cm<sup>3</sup>. The luster is vitreous on cleavage and fracture surfaces. Charlesite is brittle.

Charlesite is uniaxial (-) with indices of refraction  $w = 1.492(3)$  and  $e = 1.475(3)$ . Charlesite is colorless in all specimens examined. Charlesite exhibits a very weak light violet or light-green fluorescence in short-wave ultraviolet radiation and a much weaker response in long-wave ultraviolet. Surficial alteration of some crystals results in an opaque layer which exhibits moderate violet fluorescence."

## Morphology

"Charlesite occurs as hexagonal, euhedral and subhedral crystals, tabular on (0001). Crystals on the holotype sample are rounded and partially dissolved, but those from another Franklin occurrence are sharp and euhedral. A typical charlesite crystal from the roebingite-bearing assemblage is shown in Figure 1."

## Chemical composition

"The theoretical formula is  $\text{Ca}_6(\text{Al,Si})_2(\text{SO}_4)_2(\text{B}(\text{OH},\text{O}))_{12} \cdot 26\text{H}_2\text{O}$ ."

## Occurrence

"Charlesite was found in late 1945 by miners in the Franklin Mine in Franklin, Sussex County, New Jersey, and was brought to the attention of one of the authors (JLB). This initial discovery was reported by Hurlbut and Baum (1960) and they provided a sketch-map which included the vein in which charlesite occurred. It was located immediately above the 800 level, about 15 feet into the ore from the hanging wall, and close to the north side of the Palmer shaft pillar. The ore consists of franklinite and willemite with minor andradite and moderately abundant mica, likely of phlogopite/hendricksite composition. This primary assemblage is unevenly coated with a dark brown layer of grossular which is coated, in turn, with a fine-grained impure mixture consisting, for the most part, of a ganophyllite-like mineral of unknown composition. Subsequent crystallization produced a thick druse of ganophyllite (Dunn *et al.*, 1983) in crystals up to 2.0 mm intergrown with second-generation willemite and minor rhodonite, both of which are euhedral. These three minerals are unevenly coated with a Mn-chlorite and pectolite. Continued crystallization resulted in the growth of euhedral, colorless, transparent charlesite crystals up to 6.0 mm, which appear to have formed contemporaneously with large (12 mm) superb crystals of clinohedrite. These minerals were followed in the crystallization sequence by very small fascicles of pectolite and colorless acicular crystals of xonotlite, the latter of which appear to grow preferentially on charlesite. This description is of the cotype, NMNH C6247."

"The other cotype specimen, NMNH C6401, is probably of a very closely related paragenesis, but exhibits different mineralogy. This assemblage consists of willemite/franklinite ore coated with a second generation of bright green

prismatic willemite crystals up to 20 mm. Some willemite has been partially dissolved, leaving light orange vugs and molds formed of granular grossular which is coated with euhedral hancockite. Charlesite crystals (Fig. 1) occur as colorless, water-clear, euhedra in vugs among the willemite crystals and also filling cracks in fractured willemite. The willemite crystals are coated with a Mn-chlorite and, in turn, by pearly-white prehnite. Some interstices among these coated crystals are filled with granular clinohedrite. The entire assemblage is covered by a druse of granular datolite, followed by massive roeblingite."

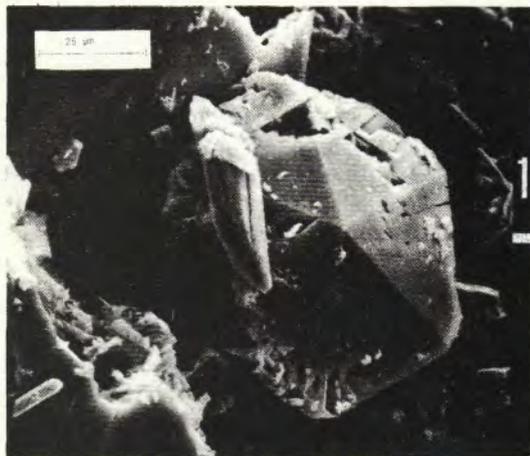


Figure 1 - SEM photomicrograph of typical charlesite hexagonal dipyramidal crystals.

"Yet another distinct assemblage was noted by two miners, Harold and Kenneth Stanaback, and presented to one of the authors (JLB). This assemblage provided the holotype specimen. It consists of franklinite ore with very minor willemite, which is encrusted with a 1-5 cm layer of vuggy, recrystallized datolite, manganaxinite, prehnite and hancockite. This irregular layer is, in turn, coated with ganophyllite, followed by a layer of extremely fine grained Mn-chlorite. Subsequent crystallization gave rise to white, pearly prehnite, followed by sparse barite and, in turn, abundant clinohedrite and charlesite. In this assemblage, the charlesite crystals have a dull luster, are slightly white and, in some cases, cavernous and partially dissolved."

"Although these parageneses have some minerals in common, the diversity of textures and ore-relationships suggests some degree of spatial separation of the occurrences. Hence, charlesite might have been more common than the present paucity of preserved specimens indicates."

In our last issue we announced the discovery and naming of several new minerals from Franklin and Sterling Hill. Formal descriptions of two of these species appeared in the *Am. Min.*, 68, 1029-1032, in a paper entitled "Kittatinnyite and walkilldellite, silicate/arsenate analogues containing calcium and manganese, from Franklin and Sterling Hill, New Jersey," by Pete J. Dunn of the Smithsonian Institution and Donald R. Peacor of the University of Michigan, from which we quote:

*The Picking Table, Spring, 1984*

## KITTATINNYITE and WALLKILDELLITE

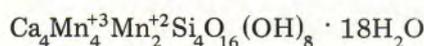
### Introduction

"We report here on the unusual occurrence of two new minerals which are isostructural, one of which is a silicate and one an arsenate. The unusual nature of the simultaneous recognition of them as new species is even more surprising in that they are from the related Franklin and Sterling Hill deposits, but were found 100 years apart."

Kittatinnyite was found in 1874 in the Taylor Mine, one of many small mines consolidated in 1897 as the Franklin Mine. It is associated with bostwickite (Dunn and Leavens, 1983), but was found in a quality suitable for investigation on only two of the five known bostwickite specimens. Kittatinnyite is named for the word *kittatinny* which, in the language of the Algonquin Indians who inhabited the Franklin area, meant "endless-hills" in allusion to the topography of the area around Franklin, New Jersey.

Walkilldellite was found in the related deposit at Sterling Hill approximately in 1974, 100 years after the finding of kittatinnyite. Like kittatinnyite, walkilldellite is quite rare; it is known from only one specimen and occurs as only a few milligrams on the holotype specimen. It is named for the *dell* of the *Walkill* River, where the Franklin and Sterling Hill deposits outcropped in full view."

### KITTATINNYITE



#### Crystallography

"Crystals of kittatinnyite are very small, exceptionally thin, and invariably distorted. Only one single-crystal was found which could serve as a source for single-crystal data, and the diffraction patterns have reflections which are exceptionally weak and diffuse. Nevertheless, standard Weissenberg methods showed that the Laue symmetry is  $6/m\ 2/m\ 2/m$  and that reflections are extinct which obey the relations:  $00l, l = 2n + 1$ ;  $hhl, l = 2n + 1$ . Although the extinction rules are based on photographs of poor quality, and therefore subject to some question, they are consistent with space groups  $P6_3/mmc$ ,  $P6_3mc$  or  $P6_3c$ . The lattice parameters,  $a = 6.498(4)$  and  $c = 22.78(2)\text{\AA}$ , were obtained by least-squares refinement of X-ray powder diffraction data. Kittatinnyite crystals are extremely thin and composed of forms  $[0001]$  and  $[10\bar{1}1]$ . Crystals are 0.2 mm in diameter."

#### Chemical composition

"The ideal formula,  $\text{Ca}_4\text{Mn}_4^{+3}\text{Mn}_2^{+2}\text{Si}_4\text{O}_{16}(\text{OH})_8 \cdot 18\text{H}_2\text{O}$ , must be regarded as tentative, due to the assumptions on which it is based."

#### Occurrence

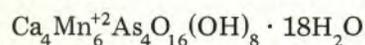
"Kittatinnyite was found in the Franklin Mine, Franklin, Sussex County, New Jersey, in that part of the mine formerly known as the Taylor Mine, prior to the consolidation of many small mines into the Franklin Mine at the end of the last century. It was found in 1874 and preserved because of the presence of an associated mineral

thought to be arseniosiderite (Palache, 1935) and now known as bostwickite (Dunn and Leavens, 1983). Kittatinnyite occurs coating fractures on massive, granular, franklinite ore which is coated with secondary calcite and, in turn, by kittatinnyite and bostwickite, both of which appear to have formed contemporaneously. The franklinite-fluorite ore is in itself very unusual at Franklin.”

### Physical and optical properties

“Kittatinnyite is bright yellow and has a highly vitreous luster. Reflectivity is enhanced by internal reflections from cleavage surfaces. Kittatinnyite looks very much like native gold in hand specimen; the translucency is apparent only under microscopic examination, in part due to small crystal size. The hardness is approximately 4 (Mohs), but could not be determined with certainty due to the small crystal size and high degree of brittleness. Crystals occur as composite, subparallel aggregates up to 0.5 mm in diameter, flattened on [0001] and approximately 2.0  $\mu\text{m}$  in thickness. The density, determined using heavy-liquid techniques, is 2.62 g/cm<sup>3</sup>. The streak is light yellow. The [0001] cleavage is perfect and easily produced. Kittatinnyite is not fluorescent in ultraviolet radiation. Optically, kittatinnyite is uniaxial (-) with  $w = 1.727(3)$ . Kittatinnyite is very weakly pleochroic with  $O =$  medium yellow,  $E =$  medium yellow, and  $E \geq O$ .”

### WALLKILLDELLITE



### X-ray crystallography

“No crystals of wallkilldellite could be found which are suitable for single crystal X-ray diffraction. The powder diffraction pattern is very similar to that of kittatinnyite, however, indicating that these minerals are isostructural. Starting with the lattice parameters of kittatinnyite, the powder diffraction data of wallkilldellite were easily indexed, and least-squares refinement of the lattice parameters gave rise to the values  $a = 6.506(7)$  and  $c = 23.49(3)\text{\AA}$ . All reflections are satisfactorily indexed using these parameters.”

### Chemical composition

“The chemical composition of wallkilldellite calculated on the basis of 14 cations, exclusive of H, ideally yields:  $\text{Ca}_4\text{Mn}_6^{+2}\text{As}_4\text{O}_{16}(\text{OH})_8 \cdot 18\text{H}_2\text{O}$ , the As and  $\text{Mn}^{+2}$  analogue of kittatinnyite.”

### Physical and optical properties

“Wallkilldellite is dark red. It appears very similar to kraisslite and mcgovernite but is slightly redder than either of these minerals. It is visually indistinguishable from the unnamed  $\text{Fe}^{+3}$  analogue of hematolite (Dunn and Peacor, 1983) also known from Sterling Hill. On the only specimen known, wallkilldellite occurs as flattened, radial clusters of platy crystals without obvious morphological characteristics other than the extremely platy habit. Crystal size is approximately 0.1 mm. The hardness could not be accurately determined due to the extremely small crystal size, but we estimate that wallkilldellite is approximately 3 in hardness (Mohs). It lacks the

brittleness of kittatinnyite. The luster is vitreous on cleavage surfaces. The density, measured using heavy liquid techniques, is 2.85(5) g/cm<sup>3</sup>, compared with the calculated value of 2.90 g/cm<sup>3</sup>. The streak is light orange. The [0001] cleavage is perfect and easily produced. Wallkilldellite is not fluorescent in ultraviolet radiation. Optically, wallkilldellite is uniaxial (-) with  $w = 1.728(4)$ . Wallkilldellite is pleochroic with  $O =$  reddish orange,  $E =$  light orange-pink, and moderate absorption,  $O > E$ .”

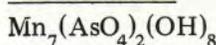
### Occurrence

“Wallkilldellite occurs in the Sterling Hill Mine, Ogdensburg, Sussex County, New Jersey. The one occurrence known was discovered in the mid-1970's and preserved for posterity by John L. Baum. The matrix consists of typical, massive, granular, franklinite/willemite ore which also has abundant calcite. This matrix is nearly identical to that for ogdensburgite (Dunn, 1981) and both minerals may have come from the same paragenesis. The surface of the ore is covered with carbonates, followed by a very atypical, finely-fibrous, light yellowish-green adamite-group mineral with approximate cation ratios for Zn:Cu:Mn = 2:2:1. Wallkilldellite is the last mineral to form in this assemblage and occurs as radial, irregular aggregates of platy crystals approximately 0.5 mm in maximum diameter, but most are considerably smaller. This mineral is extremely rare.”

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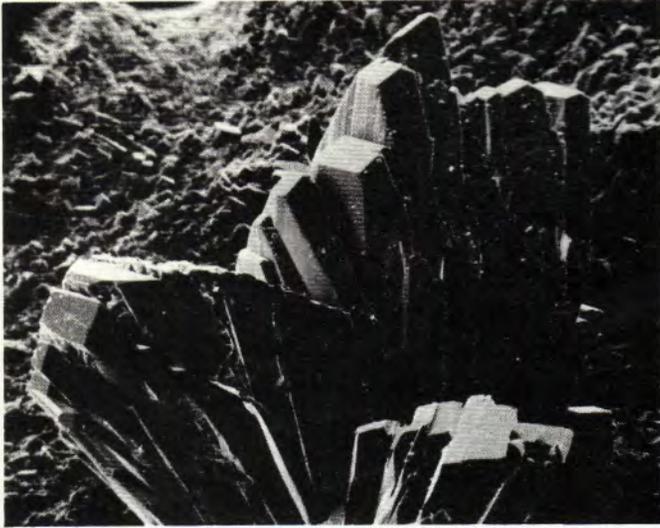
The recent discovery of unusually well developed allactite crystals at Sterling Hill prompted a new study of this species by Pete J. Dunn of the Department of Mineral Sciences, Smithsonian Institution. A subsequent paper on this study appeared in the *Min. Rec.*, 14, 4, 251-252, from which the following abstraction was prepared:

### ALLACTITE



### Introduction

“The recent discovery of a large number of specimens of dark red allactite at Sterling Hill, Ogdensburg, Sussex County, New Jersey, prompted an examination of previously found allactite samples from both Franklin and Sterling Hill. This new occurrence was called to the author's attention by John Kolic, a miner in the Sterling Hill mine, who found the material in late 1981 in seams in franklinite-calcite ore with minor willemite, sphalerite and serpentine. The ore has been fractured and surfaces are coated with microcrystalline druses of calcite and secondary willemite. Allactite is implanted on this willemite-calcite druse and forms divergent clusters up to 3.0 mm, of red to reddish brown crystals in divergent or sub-parallel growth (Fig. 1). The color of this allactite is, like many manganese silicates at Franklin and Sterling Hill, somewhat dependent on the type of illumination; crystals appear red in sunlight and rather brown under fluorescent light.”



**Figure 1.** Allactite from the new find at Sterling Hill, New Jersey. Width of cluster is approximately 1 mm.

### Chemistry

“The samples studied were chemically analyzed using an ARL-SEMQ electron microprobe. The resultant data indicate that there is remarkably little solid solution of octahedral cations for Mn. The substitution is apparently limited to small amounts of Zn, Mg, Fe and Ca.”



**Figure 2.** Allactite, Franklin, New Jersey (NMNH R18244). Width of vertical crystal is approximately 0.5 mm.

### Paragenesis

The *in situ* occurrence of allactite from both Franklin and Sterling Hill has, for the most part, gone unrecorded. A review of such parageneses indicates that allactite might have been moderately abundant in the arsenate assemblages at Franklin, as reflected by the diversity of asso-

*The Picking Table, Spring, 1984*

ciations and ore textures. Observations of a number of varied parageneses suggest that chlorophoenicite was the most common arsenate at both Franklin and Sterling Hill (Dunn, 1981) and it appears that allactite and sarkinite were next in relative abundance. However, it must be clearly stated that all these arsenates are rare minerals and the above observations concern only their *relative* abundance. In almost all cases, allactite is found in the presence of carbonate minerals.

In addition to the parageneses noted by Palache (1935) allactite from Franklin apparently occurred with quite a variety of associated minerals, including pyroaurite, chlorite, leucophoenicite, hodgkinsonite, adelite, barite, friedelite and caryopillite (both arsenian) and others. Franklin allactite crystals are typically bladed, conform to the morphological description and crystal drawing of Palache (1935), and occur as acicular to bladed crystals in sub-parallel and slightly divergent aggregates. Representative SEM photomicrographs of Franklin allactites are shown in *Figures 2, 3 and 4*.



**Figure 3.** Allactite, Franklin, New Jersey (NMNH R5413). Width of largest crystal is approximately 0.5 mm.

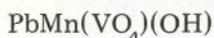
Sterling Hill allactites mimic those from Franklin in most respects; the stout crystals from the new occurrence (*Fig. 1*) are atypical. Such stout crystals have been found only rarely at Sterling Hill in past years. Allactite has been found in at least ten Sterling Hill occurrences in recent years. These occurrences, like those at Franklin, have carbonates present, usually in the form of calcite lining veins and solution pockets. Common associations include barite, kraisslite, rhodochrosite and sarkinite, the latter almost as abundant as allactite. Less common associations include friedelite, covellite, fluorite, secondary copper minerals, chlorophoenicite and others.



Figure 4. Allactite, Franklin, New Jersey (NMNH 148712). Width of specimen is approximately 1.5 mm.

A paper entitled "Pyrobelonite from Franklin, New Jersey," by Pete J. Dunn of the Department of Mineral Sciences, Smithsonian Institution, Washington, DC., recently appeared in the *Min. Rec.*, 14, 3, 203-204, from which the following is abstracted.

## PYROBELONITE



### Introduction

"In his monograph on the minerals of Franklin and Sterling Hill, Palache (1935) described two occurrences of descloizite, one from each deposit. The material from the Franklin deposit was restudied because of its intense red color and uncommon morphology. It was called to the author's attention by Alice Kraissl of River Edge, New Jersey, who generously provided material for study. This material was found to be pyrobelonite, thus providing a third occurrence of that species."

### Description

"Franklin pyrobelonite, is bright red, very similar in hue to microcrystals of proustite, but lacking a semimetallic luster. The crystals are well-formed, prismatic in habit, and appear to taper to a dipyrmaid; but the tapering is gradual, giving the crystals a pointed appearance (Fig. 1)."

## Chemistry

"Franklin pyrobelonite was chemically analyzed using ARL-SEMQ electron microprobe. Calculation of the formula, on the basis of three cations, yields:  $(\text{Pb}_{0.93}\text{Zn}_{0.02}\text{Ca}_{0.02}\text{Fe}_{0.02}\text{Mn}_{0.01})_{\Sigma 1.00}\text{Mn}_{1.00}[(\text{VO}_4)_{0.86}(\text{SiO}_4)_{0.14}]_{\Sigma 1.00}(\text{O}^2\text{H})_{0.86}$ , in close agreement with the theoretical composition of pyrobelonite,  $\text{PbMn}(\text{VO}_4)(\text{OH})$ ."



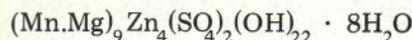
Figure 1. Pyrobelonite crystals from Franklin, New Jersey. Alice Kraissl Collection. Length of longest crystal is approximately 300 microns.

## Occurrence

"Franklin pyrobelonite occurs with an assemblage described by Palache (1935, page 110, last paragraph) as noteworthy for its unique and well-formed hodgkinsonite crystals. Palache mentions that it was found in 1927 as a vein assemblage. The paragenesis consists of willemite-franklinite ore (notable for the absence of calcite) which is encrusted with a druse of light brown garnet. Euhedral tephroite crystals, together with clinocllore and willemite prisms, appear to have grown simultaneously with the garnet, which persisted and partly coated both tephroite and willemite. Pyrobelonite crystals (Fig. 1) were next formed and are distributed randomly upon the matrix, except for a tendency for preferential growth upon the terminal faces of tephroite crystals. Hodgkinsonite formed subsequent to pyrobelonite and overlies pyrobelonite. The hodgkinsonite crystals, illustrated by Palache (1935, Fig. 172a and 172b), are markedly different from common hodgkinsonite crystals (Dunn and Bostwick, 1982). Barite is the final phase formed, partly coating younger phase with white sub-translucent crystals of pseudocuboctahedral habit."

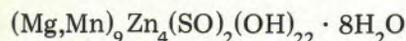
The crystal structure of lawsonbauerite and its implied changes to the structure of mooreite have been recorded in a paper in the *Am. Min.*, 67, 1029-1034, in an article entitled "The crystal structure of lawsonbauerite, and its relation to mooreite" by Allan H. Trieman and Donald R. Peacor, both of University of Michigan. The abstract follows:

### LAWSONBAUERITE



AND

### TORREYITE

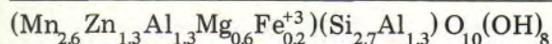


### Abstract

"Lawsonbauerite,  $(\text{Mn,Mg})_9\text{Zn}_4(\text{SO}_4)_2(\text{OH})_{22} \cdot 8\text{H}_2\text{O}$ , is monoclinic, space group  $P2_1/c$  with  $a = 10.50(5)\text{\AA}$ ,  $b = 9.64(5)\text{\AA}$ ,  $c = 16.41(8)\text{\AA}$ ,  $\beta = 95.21(10)^\circ$ , and  $Z = 2$ . Like the closely related mineral mooreite, it contains brucite-like sheets of octahedrally coordinated Mg and Mn atoms, in lawsonbauerite, the sheets are parallel to (100). Two ninths of the sites are vacant, and oxygen atoms of the vacant sites are coordinated to tetrahedrally bonded zinc atoms above and below the sheet. Zinc atoms on adjacent sheets are bonded in a "cis" arrangement to an interlayer  $[(\text{Mn,Mg})(\text{OH})(\text{H}_2\text{O})_4]^{-2}$  octahedron, which provides the only linkage between successive sheets. Sulphate groups present in the inter-sheet region are loosely held by hydrogen bonds. Apart from its chemistry, lawsonbauerite differs from mooreite by having more vacancies in the octahedral layer, and therefore a different arrangement of vacancies, zinc tetrahedra, and interlayer cations. The revision of the lawsonbauerite formula required by this structure analysis should also be applied to the isostructural mineral torreyite,  $(\text{Mg,Mn})_9\text{Zn}_4(\text{SO}_4)_2(\text{OH})_{22} \cdot 8\text{H}_2\text{O}$ , which has  $\text{Mg} > \text{Mn}$ ."

The mineral name grovesite, used to describe a Mn-chlorite recently found to occur in Franklin, has lost its status as a species name as noted in a recent paper entitled "Polytypes of Pennantite," by Peter Bayliss, which appeared in the *Can. Min.*, 21, 545-547. An abstract of that paper follows:

### GROVESITE = ZINCIAN PENNANTITE-1a



### Abstract

The name grovesite is relegated to a synonym for the mineral *zincian pennantite-1a*, a variety of Mn-chlorite. Pennantite-IIb and pennantite-Ia, the trioctahedral Mn-chlorites, occur at Benalt mine, North Wales; pennantite-Ia occurs at Bald Knob, North Carolina, and zincian pennantite-Ia,  $(\text{Mn}_{2.6}\text{Zn}_{1.3}\text{Al}_{1.3}\text{Mg}_{0.6}\text{Fe}^{+3}_{0.2})(\text{Si}_{2.7}\text{Al}_{1.3})\text{O}_{10}(\text{OH})_8$ , occurs at Franklin, New Jersey. Unit-cell dimensions ( $e.g.$ ,  $a$  5.45,  $b$  9.50,  $c$  14.40Å,  $\beta$  97.3°) of both polytypes are similar. Indexed X-ray powder diffraction data are given for both polytypes.

*The Picking Table, Spring, 1984*

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

Saturday

March 17, 1984 FIELD TRIP: Mineral Exchange Program - SWAP & SELL - FOMS Members Only. ---  
Hardyston Township School - 10:00 a.m. to 2:00 p.m.

MICRO-GROUP: Hardyston Township School - 10:00 a.m. to noon. THIS MEETING ONLY.  
Micro-mineralogy study sessions will return to Kraissl Hall next month.

LECTURE: "Franklin mineral research: current investigations." by Dr. Pete J. Dunn of  
the Department of Mineral Sciences, Smithsonian Institution, Washington, DC.

Saturday

April 21, 1984 FIELD TRIP: Old Andover Iron Mine - Limecrest Road, Andover, NJ - 9:00 a.m. to noon.

MICRO-GROUP: Kraissl Hall, Franklin Mineral Museum, Franklin, NJ - 10:00 a.m. to noon.

LECTURE: "The Franklin (Farber) Quarry Species List." by Dr. Philip P. Betancourt of  
Temple University.

Saturday

May 19, 1984 FIELD TRIP: Buckwheat Mine Dump - Evans Street, Franklin, NJ - 10:00 a.m. to noon.

MICRO-GROUP: Kraissl Hall, Franklin Mineral Museum, Franklin, NJ - 10:00 a.m. to noon.

LECTURE: "Let's Take a Closer Look at some Franklin Rarities." by Omer Dean, Norwalk, CT

Sunday

May 20, 1984 FIELD TRIP: Limecrest Quarry - Limestone Products Corporation of America, Limecrest Road,  
Sparta, NJ - 9:00 p.m. to 3:00 p.m. - Interclub Outing.

Saturday

June 16, 1984 FIELD TRIP: Franklin Quarry (formerly Farber quarry) - Limestone Products Corporation of  
America, Cork Hill Road, Franklin, NJ - 9:00 a.m. to noon.

MICRO-GROUP: Kraissl Hall, Franklin Mineral Museum, Franklin, NJ - 10:00 a.m. to noon.

LECTURE: To be announced.

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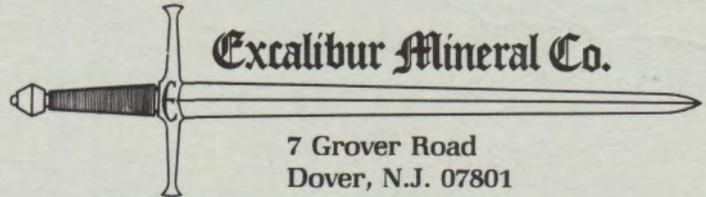
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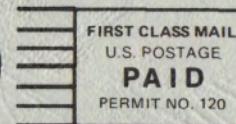
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