THE PICKING TABLE

FRANKLIN-OGDENSBURG MINERALOGICAL SOCIETY, INC.,

BOX 146

FRANKLIN, NEW JERSEY

Volume 1 JUNE, 1960 Number 2

CONTACT - METAMORPHIC MINERALS - A Resume

Professor Arthur Montgomery, Lafayette College, Easton, Penna.

Metamorphism is a changing form, the formation of new minerals and structures caused by different conditions of temperature, pressure and/or solutions. If pressure aloneis involved, the metamorphism takes place near the earth's surface. There is no recrystallization, but banded schistose rocks result. When heat and pressure are combined, the reactions occur in the depths and regional metamorphism takes place. Shaly rocks are converted to schist and limestone to marble. The minerals formed are usually parallel, platy and blade-like as in gneisses; layers or bands of aggregates of such minerals typify gneisses. Franklin ore is banded; gneiss is common in the footwall. Regional metamorphism is probably one of the first steps that occurred at Franklin.

Where heat is the most important factor, the transformation is called contact-metamorphism. This usually involves contact between igneous siliceous intrusive material and limestone host rock. In its simplest form, thermal contact-metamorphism, this occurs in the absence of solutions. Since directed pressure is not a factor, there is no parallel orientation of minerals. If solutions are important, as when granite is involved and boron, water and halides are available, the process is called hydrothermal contact-metamorphism, or metasomism, and a wide variety of minerals may be fomred. The number of minerals is enhanced if the host limestone is dolomitic, as it is in part at Franklin, and thus releases magnesium as well as calcium to react with the intrusive rock.

Common hydrothermal contact-metamorphic minerals include diopside (pyroxene), grossularite and andradite garnet, idocrase, spinel, scapolite, tremolite (amphibole), epidote, graphite, wollastonite, phlogopite, apatite, magnesian tourmaline, chondrodite, sphene, zircon, pyrite, pyrrhotite, magnetite, corundum, hematite and molybdenite. Which minerals are formed depends on the composition of the original rock and intrusion, temperature and other factors. Thus if an impure clay was the starting material, chlorite would be formed at a relatively low temperature; with increasing temperature biotite, garnet, staurolite, kyanite and, finally, sillimanite would be formed in that order.

Examination of the lists of hydrothermal contact-metamorphic minerals found on Precambrian Franklin marble over a widespread region including Franklin, shows remarkable similarity in products, with minor differences due to differences in temperature or original rock composition. At Franklin, it would seem that the first step was a regional metamorphism converting the limestone into marble, followed by an intrusive of granite (and granitic pegmatitic) magma into the marble producing an intensive, and perhaps long-continued, hydrothermal contact-metamorphism. Nearly all of the rare and interesting minerals of the Franklin ore deposits were formed by such later hydrothermal contact-metamorphism. These are "contact" minerals, mostly formed by interaction of hydrothermal solutions with limestone or dolomitic host rock. The host rock supplied calcium and calcium, magnesium; the magmatic solutions brought in silica, water and rare elements like boron, fluorine and beryllium.

It seems probable that the primary difference between Franklin and Limecrest and other similar areas is due simply to the fact that the host rock at Franklin already contained great quantities of zinc, manganese and iron and thus provided different original reactants than were available elsewhere.

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PALACHE REPRINTS

Your Society has obtained a number of reprints of Palache's Professional Paper 180. A portion of these are being bound. Those interested in this outstanding work may order from F-OMS at $2.00 per copy, $5.50 clothbound.

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MEMBERSHIP REPORT

Membership as of June 1st (eight months) numbers 243 with representation from twenty states. Growth continues at an undiminished rate among both the novice and professional mineralogist. New members may now join at $3.00 which includes membership for the rest of 1960 and for 1961, if they so desire.

MINING AT FRANKLIN AND STERLING HILL - SYNOPSIS

Clarence Haight - formerly Mine Superintendent at Franklin

A mine is mysterious to many people because it cannot be seen in its entirety. If the Franklin mine was inverted and placed on the surface, it would require a building about a mile long, five hundred feet wide and one thousand feet at its peak to enclose it.

The "floors" are known as levels, and they are fifty or one hundred feet apart rather than the eight - ten feet of office buildings. There were eighteen levels at Franklin and twenty-five at Sterling Hill. The levels are connected by shafts containing the mining version of elevators for men and materials as well as water and air pipes, and phone and electric cables.

The hallways from the elevators to the working areas are tunnels, called drifts. Tram cars are frequently operated in the drifts to haul materials and men. The drifts are occasionally intersected by cross-cuts, which are tunnels extending from the footwall to the hanging wall to provide access, remove broken ore, etc. If drifts are the avenues, cross-cuts are the streets.

Ore bodies do not occur in rectangular blocks as buildings do. The outerlimits of the ore bodies are usually at an angle with the horizontal. Standing within the ore body, the outer side of the body which would be above your head (has an acute angle with the horizontal) is the hanging wall; that which would be beneath your feet (forms an obtuse angle with the horizontal) is the footwall.

The method of mining is determined largely by the thickness and strength and attitude of the ore. At Sterling Hill, the long thin stringers of ore lend themselves to longitudinal stopes. Stopes are the working areas where the ore is being drilled, blasted and mined. At Sterling Hill, they usually project upward at an angle, following the veins of ore. When the ore is thick, as at Franklin, it is usually mined by transverse stopes.

Franklin was first mined by tunnels at fifty foot levels. After consolidation of the various mining companies, engineering studies led to mining by transverse stopes. In essence, this comprised removing ore in sections seventeen feet wide running from the foot wall to the hanging wall. Between each stope, a pillar was left. Each pillar was about thirty feet wide and ran from footwall to hanging wall (as much as 300 feet) and to the top of the mine (up to one thousand feet high).

When all the ore was removed except for the pillars, a system of top slicing was introduced to utilize the ore in the pillars. This comprised taking ten foot deep slices from the pillar, starting at the top of the pillar, across from footwall to hanging wall. In essence, a narrow opening of full height was first cut through the center of the drift to the hanging wall. The opening was then opened up to full (thirty feet) width from the far end and worked back to the original opening. As the load on the supports became too heavy, (at about ten foot intervals), the supports for the cleared area were blasted and the load above caved to minimize the load on the working area.

Franklin ore averaged about a ton for each seven cubic feet. Some twenty million tons of ore were removed at Franklin. The ore averaged 20% Zn. At Sterling Hill, the ore has averaged about 17% Z_n, with the probability that it may be higher in the future due to operational changes.

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MEETINGS

The excellent calibre of our speakers and interest in the Franklin minerals has resulted in the attendance of 70 - 130 at the meetings. As evidenced by the questionnaires returned, there is an unusually high interest in identification and in basic mineralogy to aid in the understanding and knowledge of the Franklin minerals.

March

Mr. Clarence Haight, former superintendent of the Franklin Mine, clarified mining operations in a talk, to a capacity audience, accompanying movies taken in the Franklin and sterling Hill mines.

April

Mr. Neil Wintringham, Consulting Mineralogist, described simple methods available to the amateur for identification of minerals with the advantages and limitations of each. See Page 5.

May

Professor Arthur Montgomery of Lafayette College provided a basic understanding of metamorphism as applied to Franklin and the many minerals found there of contact-metamorphic origin. See Page 1.

Schedule

The 1960 schedule of meetings is given on Page 12. Visitors are welcome. Subject to your advice, it is planned to have some of the 1961 spring meetings on Sunday to benefit those who are not free on Saturday afternoons. This is not feasible in the summer and fall because of traffic conditions.

MINERAL IDENTIFICATION FOR THE AMATEUR - Resume

Neil A. Wintringham

The complexity of Franklin mineralogy has led, on one hand, to positive but inaccurate statements on mineral occurrence based on faulty or inconclusive tests and, on the other hand, limitation of identification work by others who do not realize that they possess the ability to do far more than they are doing. Many tests may be performed by amateurs possessing only inexpensive equipment.

Any approach to an understanding of minerals or their identification involves a classification, such that the unknown mineral can be sorted from types and groups and finally narrowed down to one mineral. Such a classification must be based on the premise that minerals have definite chemical compositions and definite physical properties.

A few simple physical tests will usually place a mineral within a chemical group. Thus, over-simplifying, if the mineral is fairly soft and metallic and shows a metallic streak it is probably a native element or sulfide; if it is fairly hard with a colorless streak it is probably a silicate; if soft with a colorless streak, it could be a carbonate, halide, phosphate or arsenate. Oxides vary so that they could meet any of these groupings.

The physical form of the mineral can often narrow the possibilities. Aragonite is frequently acicular or needle-like. Millerite is found in paillary, or hair-like form. Tremolite is an example of a columnar or bladed mineral. Fibrous forms are shown by sussexite, willemite, anthophyllite, iodocrase (cyprine), and others. Hydrohetaerolite is botryoidal. Willemite, mcgovernite and magnesium chlorophoenicite may be found in radiate form. Epidote and quartz are found in druzy coatings. Kyanite, as found at Sterling Hill, is representative of foliated minerals while phlogopite is micaceous.

Cleavage, the tendency of some minerals to break along one or more smooth planes, is most important and an excellent clue to identity. Some examples of types of cleavage shown by Franklin minerals are as follows:

Direction of Cleavage	Type of Cleavage	Mineral
1	Basal	Graphite, Molybdenite, Micas
2 at 90°	Prismatic	Feldspar
2 near 90°	Prismatic	Pyroxenes
2 not near 90°	Prismatic	Amphiboles
3 at 90°	Cubic	Galena
3 not at 90°	Rhombohedral	Calcite

Parting must not be confused with cleavage.

Hardness, resistance to scrathcing, is very useful when measured properly. No substanc will scratch an object harder than itself. Thus if the unknown mineral is scratched by a pocket knife (H 5.0) but not a copper penny (H 3.0), the hardness of the mineral is between three and five. Always check that the substance scratched actually has a permanent scratch, not just material that has powdered off on it.

Specific gravity, a number indicating how many times heavier a given volume of the mineral is than the same volume of water, can be measured precisely with a balance to distinguish among many minerals. With experience, one can estimate "heft" fairly closely in the field.

Luster is frequently useful. Sphalerite, despite the many colors it exhibits at Franklin, can usually be detected by its resinous luster. The olivines show a typical greasy luster. Talc and kyanite have a pearly luster, quartz and garnet a vitreous luster.

Color is often an aid to identification, even at Franklin where many minerals are notorious for their variety of color. Most metallic minerals have a constant color, though a fresh surface should be used. On fresh breaks, chalcopyrite is brassy-yellow, pyrite pale brass yellow and pyrrhotite bronze yellow. On freshly separated plates, graphite is iron-black, molybdenite is blue-gray. Some colors, such as the blue of cyprine, are quite distinctive.

Streak, the color of the powdered mineral (determined by stroking lightly on a piece of unglazed porcelain), is particularly useful in separating franklinite (dark brown streak), magnetite (black streak) and spinel (colorless to pale streak). Hematite, regardless of its apparent color, always has a red-brown streak. Magnetic properties, properly determined, are also very helpful in the spinel series.

Fusibility, flame tests and bead tests can be helpful and are easily performed. Chemical testing requires care and experience, both in performance and evaluation. Dilute hydrochloric acid is very useful in testing carbonates. A drop of cold acid causes calcite and aragonite to effervesce strongly; other carbonates react only when powdered or if the acid is warmed.

Crystallography should be viewed by the amateur as a tool, not as the incomprehensible answer.

Fluorescence and phosphorescence are extremely useful with many minerals at Franklin, but great care must be taken to avoid relying entirely on these phenomena for mineral identification.

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SQUARING AWAY

Lest there be some misunderstanding, the list of validated species is that of Professor Frondel, not your editor. Every effort is being made to present information as objectively as possible and to separate opinion from fact.

Jim Allen, a professional mineralogist, writes that he has biotite from Buckwheat. I believe that I have biotite, also, a large huge mass of very dark green (black in mass) sheets with large rhodonite crystals, which has the optics and chemical characteristics of biotite. However, these will not go on the validated list until X-rays have been run and at least one specimen has been examined by Dr. Frondel, or the data have been published in a scientific journal.

The question arose recently again at Franklin as to the exact nature of the so-called "beta" willemite. Professor Frondel states unequivocally that it is willemite, with exactly the same structure as other willemite. It is not a polymorph; a synthetic polymorph is known and this material was examined most carefully with this in mind. Presumably it does contain a different activator or activator system than more commom willemite specimens, though this remains to be investigated. The term "beta" is grossly inaccurate and misleading. A new term for common usage is highly desirable to distinguish this material. Golden - or yellow - phosphorescing willemite is the best suggestion at hand, though it is rather awkward. Your suggestions would be appreciated.

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Modern mineralogy is based on the internal structure of the mineral. Wherever applicable, this takes precedence over chemical composition and optical properties -- and there are many good reasons for this. This is the reason for the discrediting of ferroschallerite as a species (originally so designated because of chemical composition and optical properties that are frequently related to composition) and its reclassification as a friedelite.

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Desaulesite has been discredited as a mineral species by Dr. Frondel as an amorphous mixture devoid of internal structure.

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There has been discussion recently that the mineral recently identified as kyanite and previously listed as mariposite might be margarite. Dr. Frondel reports that this was considered as a strong possibility after it was found that the "mariposite" contained no chromium. The Ogdensburg mineral has some physical properties resembling the brittle micas. Dr. Frondel assures us, however, that the X-ray pattern and optical properties are those of kyanite and cannot be those of margarite.

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Good news for the serious amateur as well as all professional mineralogists! the manuscript for Volume III of Dana (the silicates) is expected to be complete by midsummer.

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FIELD TRIPS

The conduct of our members on field trips is making new friends for us and simplifying the problem of return visits. The April trip to the Franklin Rifle Range provided outstanding specimens of norbergite-chondrodite; the April trip to Faber's Quarry yielded excellent specimens of tremolite. Some twenty other mineral species were found at each location. Possibilities at the June 11th field trip to B. Nicols Quarry and vicinity, now owned by Colloids, Inc., are excellent.

Your membership card will be your admittance to Buckwheat Dump on July 3rd. The Franklin Town Council generously passed an ordinance permitting such meetings for a moderate fee paid by your Society.

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ORIGIN OF ORES

Your Society has purchased the fifty reprints available of a paper by H. G. Bachman of Gottingen, Germany on "The Origin of Ores", which appeared in the June issue of "Scientific American". There is no specific reference to Franklin, it is simply an extremely well written review paper on the several ways in which ores are usually formed. Twenty cents, while they last.

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RESEARCH PROBLEMS

The following will serve to illustrate some of the research problems that are on our agenda.

.....Determination of the relative presence of norbergite and chondrodate in Franklin humites; correlation if any with fluorescence, color and specific locality. (X-ray, optics)

.....Identification of the mineral, associated with hyalophane, which fluoresces a powdery blue and has been called berylite, anorthite, etc. This study has been undertaken by F-OMS member James Allen of Sioux City, Nebraska, a professional mineralogist.

.....Investigation of the "pyraboles' - pyroxenes and amphiboles - determine which are present, their association and specific localities. This is a major project, requiring numerous chemical analyses. It is hoped, for example, to validate anthophyllite, hornblende and actinolite in this study.

.....Investigation of the garnets, micas and hydromicas. It is expected that almandite and biotite will be validated and hoped that several rare species of garnet will be found. This work is scheduled to be done at Harvard this fall.

.....Investigation of the possible presence of annabergite niccolite. This study has been undertaken by F-OMS member Professor Ralph Holmes of Columbia University.

..... Investigation of clays. (X-ray)

..... Investigation of minerals in and on camptonite and on gneisses.

You are invited to be a contributor to these and other projects. Information and specimens are needed.

MINERAL ASSOCIATIONS

Dr. Montgomery spoke regretfully of the trend by professional mineralogists away from the descriptive mineralogy exemplified so well by Palache in his Professional Paper 180. The amateur mineralogist can gain greatly by careful visual examination of specimens. The minerals associated and the manner of their association is extremely rewarding in aids in identification and order of formation of minerals.

Mr. Wintringham in his excellent paper on identification of minerals quite properly did not mention mineral associations as a tool for identification. However, in a specific locality, especially Franklin, a knowledge of associations is generally the one most helpful factor in sight identification. The best way to learn sight identification of Franklin minerals is to see as many as you possibly can, supplementing any questionable identifications by tests, such as those described by Mr. Wintringham.

It does not take long to realize that one is more apt to find nasonite in association with axinite, johannsenite, manganophyllite than calcite norbergite, tremolite and graphite. Arsenopyrite and loellingtite can usually be surmised from the associations, the former if it is found with corundum, rutile, etc. or realgar; the latter if with "black" willemite, brownish fluorite, etc. Examination of the matrix associations left no doubt that manganberzelite came from Franklin, not Sterling Hill. Associations are not a substitute for analysis, they are a supplement and can save fruitless expenditure of time and money for more useful and rewarding purposes.

Examination of the nature of the mineral associate tells much about how the specimen was formed. If crystals of calcite or goethite are impaled on millerite, it is obvious that the millerite formed first and the other mineral at a later date. As Dr. Montgomery pointed out, if colorless sphalerite is associated with franklinite, it is clear that the sphalerite formed at a later date than the franklinite, as sphalerite has an affinity for iron and would have taken some into solid solution with resultant color formation.

The few samples are cited to illustrate the reward of utilizing our powers of observation: If they are combined with simple types of identification tests or an elementary concept of the chemical reactions involved in mineral formation and alteration, the returns in understanding are rich indeed.

PROJECTED SYMPOSIUM

Plans are under consideration for a symposium on Franklin mineralogy and geology to be held next year, in Franklin, under F-OMS sponsorship.

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MUSEUM

An independent organization, the Franklin Mineral Museum, Inc. has been formed and incorporated as a non-profit organization of New Jersey. The prime projected site of the museum, the chemical laboratory of the New Jersey Zinc Company, has been required unexpectedly and unavoidably for other purposes. Future availability will be known within a year; in the meantime, other sites are being investigated and preparations basic to a museum are in progress.

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COLOR SLIDES AND POSTCARDS

The postcard program has been postponed for the time being. One set of color slides has been prepared and arrangements are being made for others.

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BARYLITE:

This mineral fluoresces lavender under the iron spark. Fluoresence is absent under short wave and long wave ultra violet radiation with analyzed specimens.

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CALENDAR OF EVENTS FOR 1960

March 26	Meeting. C. Haight, former mine superintendent, will show and discuss movies taken in the Franklin and Sterling Hill mines. Willemite display.
April 9	Field Trip. Rifle Range Quarry, Franklin, New Jersey 9 AM - 1 PM.
April 23	Meeting. N. Wintringham, American Cyanamid, will discuss practical means of identifying minerals. Display of Parker Shaft minerals.
May 7	Field Trip. Farber's Quarry, Franklin, New Jersey 9 AM - 12AM.
May 21	Meeting. A, Montgomery, Lafayette College, will discuss contact-metamorphic minerals. Display of franklinite and zincite.
June 11	Field Trip. B. Nicol Quarry and vicinity, Franklin, New Jersey 9 AM - 3 PM.
June 25	Meeting. J. Rodda, New Jersey Zinc Company, will discuss chemical reactions at Sterling Hill. Display of native elements.
July 3	Field Trip. Buckwheat and Parker Dumps, Franklin, New Jersey 9 AM - 3 PM.
July 23	Meeting. R. Metzger, New Jersey Zinc Company, will speak. Display of rhodonite and hemimorphite.
August 27	Meeting. H. Millson, American Cyanamid, will discuss luminescence. Display of hodgkinsonite and axinite.
September 24	Annual Meeting. Mr. N. Yedlin will discuss micromount mineralogy - Franklin minerals. Kiwanis minerals exhibit.
November 19	Meeting. R. Holmes, Columbia Univerity, will discuss niccolite and aspects of basic mineralogy.

Meetings held at Legion Home, off Route 23, Franklin, at 2 PM.
Visitors welcome at meetings; members only at field trips.

FRANKLIN-OGDENSBURG MINERALOGICAL SOCIETY, INC.

BOX 146

FRANKLIN, NEW JERSEY

The Franklin-Ogdensburg Mineralogical Society is a new organization established to provide a framework for a series of active programs designed to benefit the community, the collector and those interested in the minerals, mineralogy and geology of Franklin and Sterling Hill, New Jersey.

1. To establish, in cooperation with other interested groups, and maintain a sound, permanent museum of Franklin minerals in Franklin, New Jersey

2. To develop new information on Franklin minerals and mineralogy, through cooperative scientific programs with universities, and other organizations and individuals.

3. To obtain and make available accurate up-to-date information on Franklin minerals and mineralogy.

4. To facilitate collecting of Franklin minerals while conserving material for future collectors.

5. To facilitate identification of Franklin minerals.

6. To promote fellowship and the advancement of mineralogy and geology by providing meetings of those interested in the Franklin area.

Any adult interested in any of these or related programs is invited to join us. Membership dues of $2.00 or questions concerning the Society may be address to:

Franklin-Ogdensburg Mineralogical Society, Inc.

Box 146

Franklin, New Jersey