NOTES AND NEWS

VASHEGYITE AND BARRANDITE IN NEVADA

H. G. Clinton, *Manhattan, Nevada.*

The aluminum phosphates vashegyite ($4\ Al_2O_3 \cdot 3\ P_2O_5 \cdot 30\ H_2O$), barrandite ($(Fe, Al)_2O_3 \cdot P_2O_5 \cdot 4\ H_2O$), and utahlite ($Al_2O_3 \cdot P_2O_5 \cdot 4\ H_2O$), are all found in the Vashegyite Gem Mine at Manhattan, Nevada. These phosphates are of rather rare occurrence. Vashegyite has been reported from only one other locality, Vashegy, Hungary; barrandite is found only at Přibram, Bohemia; while utahlite is found elsewhere only in Tooele County, Utah.

The Vashegyite Gem Mine is an open cut in altered slate near a porphyry contact. The vein is two to three inches wide and occupies a fracture that strikes in a northeast-southwest direction across the bedded formation and dips to the north. The main mineral in the vein is variscite, variety utahlite, which occurs in lenticular masses. The utahlite is often "frozen" to one or both walls, but is divided in the vein into various shapes by fibrous crusts and loose aggregates of aragonite. In color the utahlite varies from dark emerald green to light pea green. It may be also yellow, purple, blue, brown or pink. Much of this is gem material and is cut by lapidaries at Idar, Germany.

The vashegyite, which is white or yellowish white in color, occurs as a filling in the vein at the east end of the fracture where a quartz ledge forms the foot wall and extends downward for a distance of about three feet where it passes over into utahlite. The utahlite in turn grades into turquoise by the addition of fourteen per cent aluminum oxide and the loss of about twelve per cent of phosphorus pentoxide.

At one point the green opal distributed between the layers of vashegyite gave place to blue opal, which is turn became brown as it approached a seam of barrandite. It was not of gem quality, however, and disappeared with the vashegyite.

Lying in a horizontal position in the north wall is a fissure, three eights of an inch thick filled with barrandite, while a massive vertical ledge of white quartz, twelve inches in thickness, is cut by the seam of barrandite. On the south side of this quartz ledge the barrandite is green in color, while that in the seam proper as well as the material to the north is yellow, the outer edges grading over to red.[1] Most of this massive quartz ledge above the barrandite is replaced by yellow barrandite and associated with this mineral are brown crystals of jarosite[2] ($K_2O \cdot 3\ Fe_2O_3 \cdot 4\ SO_3 \cdot 6\ H_2O$). Probably turgite will also be found with the jarosite but it has not yet been reported. The mineral dahllite is found in lustrous silver white crusts in the cavities and cracks in the quartz of the altered slate, also in the barrandite.

The open cut is now twenty feet long by eight feet wide, with a depth of, twelve feet at the deepest place. Near at hand is a large intrusion of rhyolite. The metamorphism due to heat, pressure, and the chemical action of solutions have brought about the following changes:

Mudstones have been altered to pink and cream colored, silky schists.
Slate replaced by barrandite and by blue opal.
White quartz replaced by barrandite. Slate altered to black jasper.
Quartz and schists altered to limonite and sericite.

[1] Described by Earl V. Shannon, *Am. Mineral.*, vol. 8, p. 182, 1923.
[2] Found by W. F. Foshag.

The minerals thus far found in this open cut are: utahlite in five colors; barrandite, green, red and yellow; turquoise; opal, blue, green, brown; vashegyite; dahllite; jarosite; quartz; francolite; limonite; manganese oxide; chrysocolla; jasper; chalcedony; metacalciowardite; chlorophanite; sericite; calcite; and aragonite.

PERCENTAGES FOR COMPARISON

	Al_2O_3	P_2O_5	CO_2	Fe_2O_3	CaO	Cl	H_2O
Barrandite	12.5	40.7	..	26.2	..	..	20.6
Utahlite	32.3	44.9	..	..	..	..	22.8
Turquoise	46.8	32.6	..	..	..	..	20.6
Vashegyite	29.7	30.9	..	..	..	..	39.2
Dahllite	..	39.0	6.0	..	53.7	..	1.3
Francolite	..	41.0	..	..	53.8	6.8	0.0

PARAGENESIS OF THE DEPOSIT

The fracture resulted from a displacement in the Black Mommoth Hill. The bedded formations in the north wall were contorted and the layers separated in places by an intrusion of rhyolite. The quartz ledge was formed prior to the tilting and fracture. The hot aqueous solutions entering with the rhyolite dissolved the aluminum phosphates in their passage through the surrounding limestones, slates and schists. After entering this fracture the solutions probably remained practically stationary except for small amounts that slowly seeped into the intersecting fissures. Elevated temperatures were no doubt maintained for a very long period by the massive intrusive which cooled very slowly.

The solutions in contact with the quartz ledge of the foot wall reacted and dissolved some of the silica which later separated as opal after the aluminum and phosphorus had deposited as vashegyite. Neither of these two minerals was deposited in a continuous mass over the allotted space, but first one, then the other would be formed covering small areas from two to four square inches each. The thickness of the layers varies from that of a sheet of paper to a quarter of an inch, with opal usually, but not always, constituting from four to ten times the volume of the vashegyite. It is also to be noted that the same solutions that deposited white vashegyite gave rise to green, blue and brown opal. The coloring matter in the opal came in part from the copper mineral chrysocolla, and in part from the barrandite. As the fissure containing these minerals stands nearly vertical ample proof is furnished that the solutions at this point were of a jelly-like consistency.

None of the solutions in the fissure removed from the influence of colloidal silica formed vashegyite. Instead, in the absence of silica, the aluminum phosphates formed utahlite and turquoise (see table showing percentages).

In places the walls of the fissure are altered to black jasper. Solutions absorbing a portion of this black pigment and combining with the green of the chrysocolla gave a very beautiful emerald green color to the utahlite near the walls. Intermingled with the green are spots of velvety brown with streaks of yellow, pink and purple.

Near the western end of the open cut is a zone of sheeting consisting of several fractures now filled with quartz which crosses the fissure at right angles. The circulating solutions entering these fractures brought in some calcium and chlorine. These newly added elements did not combine with the alumina, but after all the alumina and part of the phosphorus pentoxide had been thrown out of solutions as utahlite, the calcium and chlorine united with the remaining phosphorus pentoxide to form francolite.

The francolite is often in the center of a lens of utahlite, but it also occurs nearly pure and at times contains isolated spots of the new mineral metacalciowardite which has not yet been described.

A fissure at the east end of the deposit permitted a portion of the solutions to pass through some limonite from which they extracted enough iron to form barrandite. The mineral dahllite was not formed from solutions passing through the main fissure but from solutions originating near the surface.

A study of this deposit indicates how minute changes may produce a number of different minerals from the same solution. If this main fissure had been two inches farther north, so as to have missed the quartz ledge of the foot-wall, neither opal nor vashegyite would have been formed. Transposing the body of limonite in the north wall to the position occupied by the quartz ledge would have filled the main fissure with barrandite. Had the zone of sheeting been two feet farther west the chlorine-calcium solutions could not have entered the fracture and there would have been no francolite.

Following the period of formation this deposit was overlain by not less than five hundred feet of limestones, slates and schists, all of which have been eroded. It is expected that other rare or new minerals will be found with greater depth.

Mr. A. W. Quinn has been appointed instructor of mineralogy and petrography in the department of geology of Brown University. Mr. Quinn takes the place of Dr. M. E. Hurst who has joined the staff of the Ontario Bureau of Mines.

Mr. James H. C. Martens has accepted the position of assistant professor of mineralogy and petrography in the department of geology at West Virginia University.

Two offices have recently been opened by E. Leitz, Inc., where a complete stock of Leitz products will be on display, one in the Peoples Gas Building, 122 South Michigan Ave., Chicago, Illinois, and the other in the Investment Building, Washington, D. C.

Dr. George Perkins Merrill, head curator of geology in the U. S. National Museum, died suddenly of a heart attack in Auburn, Maine, on August 15, 1929. He was an indefatigable worker and during his long and active career contributed more than 150 papers on mineralogical and geological subjects, about 60 of these pertain to meteorites. His larger contributions include such well known works as: Stones for Building and Decoration; Rocks, Rockweathering and Soils; The Non-metallic Minerals—their Occurrence and Uses; Hand-book and Descriptive Catalogue of the Collections of Gems and Precious Stones in the U. S. National Museum; Contributions to the History of American Geology; The First One Hundred Years of American Geology; History of American State Geological and Natural History Surveys; and Minerals from Earth and Sky.

Attention is again called to the necessity of sending at once to the Secretary, Prof. Frank R. Van Horn, Case School of Applied Science, Cleveland, Ohio, titles of papers to be presented before the annual meeting. A preliminary list of titles will appear in the December issue of the Journal.

BOOK REVIEWS

THE MINERAL WEALTH OF THE BLACK HILLS. JOSEPH P. CONNOLLY AND CLEOPHAS C. O'HARRA. Bulletin No. **16**, SOUTH DAKOTA SCHOOL OF MINES. 418 pages+64 plates. Published May **1929.**

Many papers have been published from time to time on the economic geology and mineralogy of the Black Hills region but bulletin No. 16 is the only recent publication which covers all phases of the subject.

When the mineral wealth of this region is mentioned the casual reader, no doubt, has visions of rich gold deposits and also possibly of important lithium minerals. These impressions are but natural as the Black Hills produce annually more than one eighth of the gold mined in the United States and since 1875 the value of this metal alone has exceeded $274,000,000. Also the largest lithium producing mine in the World is located here and the size of the spodumene crystals has not been equalled elsewhere. (One crystal had a length of 42 ft. and a cross section of 3×6 ft. Theoretically such a crystal should yield about 90 tons of spodumene but it was so badly weathered that only 37 tons of commercial spodumene were obtained. Dr. Schaller has called attention to a still longer crystal, one measuring 47 feet in length).

This, however, is only part of the story. Over one hundred different species including both primary and secondary minerals have been listed as occurring in the pegmatites of the Black Hills, while the value of the mineral production since mining began fifty-four years ago has totaled approximately $335,000,000. Aside from gold, in the period from 1875–1928, the value of the production of silver, tungsten, mica, cement, gypsum, building stone, sand and gravel, clays, petroleum and natural gas, and coal has been, in each case, in excess of $1,000,000. Many other minerals of economic importance have been recovered but the values have been less than those mentioned above.

The bulletin is written in a semi-popular style and covers not only the geology and mineral production of the region but also touches upon such phases of petrology as the origin of the pegmatites. The magmatic crystallization theory and the hydrothermal replacement theory are discussed with special reference to their application to the dikes of the Black Hills.

The bulletin contains 64 plates as glazed inserts and these contribute much to the interest and attractiveness of the volume. A copy of bulletin No. 16 can be purchased for the nominal sum of eighty cents, plus postage, by addressing the South Dakota School of Mines at Rapid City, South Dakota.

W. F. H.