ART. XXII.—*Contributions to Mineralogy, No.* 52; by F. A. GENTH. *With Crystallographic Notes;* by SAMUEL L. PENFIELD.

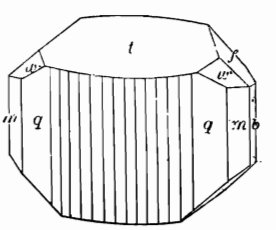
1. *On Hübnerite.*

a. FROM the North Star Mine, Sultan Mountain, Silverton, San Juan Co., Col.

The specimens which were used for crystallographic examination were from the private collection of Mr. Geo. L. English, of New York. The occurrence of well terminated hübnerite crystals is not without interest, as our knowledge of the crystallization of this species is at present confined to a description, by Professors P. Groth and A. Arzruni,* of artificial crystals. These were not sufficiently developed to admit of an accurate determination of the crystallographic constants, although the authors were able to show a close similarity in form and angles between artificial $MnWO_4$ and $FeWO_4$ and the mineral wolframite $(Mn, Fe)WO_4$.

The ore, in which the hübnerite occurs, consists mostly of quartz with galena, pyrite and tetrahedrite disseminated through it. Cavities are lined with drusy quartz and contain crystals of hübnerite, tetrahedrite and occasionally very pretty rhombohedrons of rhodochrosite. The hübnerite usually occurs in groups of radiating and divergent, long-prismatic crystals; these are often coated with a thin layer of drusy quartz, which sometimes can be removed, by gentle pressure, leaving the prismatic faces smooth and glistening but as the faces at the termination of the crystal are usually rough, the quartz coating adheres there more tenaciously. On one specimen, groups of these long-prismatic crystals, covered with quartz, were found in one cavity, while in another, less than two inches removed, short-prismatic, doubly terminated and isolated crystals were found, which were not coated and which served for accurate crystallographic measurement. These crystals, which measure about 4 mm. in the direction of the ortho-axis, have the habit shown in the accompanying figure. The forms which were observed are:

b, 010, $i\text{-}\bar{i}$	*t*, 102, $-\frac{1}{2}\text{-}\bar{i}$
m, 110, I	*f*, 011, $1\text{-}\bar{i}$
q, 830, $i\text{-}\frac{8}{3}$	ω, 111, -1



* Pogg. Ann., cxlix, p. 236, 1873.

Of these, the only faces which were suited for exact measurement were m and f; b was bright but, owing to a fine vertical striation, it gave a multiple reflection of the signal on the goniometer. By taking advantage, however, of the perfect clino-pinacoid cleavage, a face parallel to b was developed, which gave a single reflection and, when tested on the goniometer, exactly truncated the prism m. The measurements from these faces, which were taken as fundamental are:.

$m \wedge m$,	$110 \wedge \bar{1}10 =$	$100°\ 12'$
$f \wedge m$,	$011 \wedge \bar{1}10 =$	$65°\ 43'$
$f \wedge b$,	$011 \wedge 010 =$	$49°\ 5'$

from which the following axial ratio was calculated:

$$\dot{a} : \bar{b} : \dot{c} = \cdot 83623 : 1 : \cdot 86684,\ \beta = 100 \wedge 001 = 89°\ 7\tfrac{1}{2}'$$

The axial ratio established by Des Cloizeaux* for wolframite is;

$$\dot{a} : \dot{b} : \dot{c} = \cdot 83000 : 1 : \cdot 86781,\ \beta = 89°\ 22'$$

Besides the measurements given above as fundamental, the only accurate measurement which could be made was

$$f \wedge m,\ 011 \wedge 110 = 64°\ 32' \text{ calculated } 64°\ 36'$$

The faces in the prismatic zone are usually vertically striated. This is especially true of q, the obtuse edge of which is rounded as indicated in the figure. Owing to these striations, no exact measurements could be obtained from q; however, the symbol given above agreed best with the measurements and, as will be shown later, this prism is prominent on crystals from another locality. Possibly a pinacoid a, 100, i-$\bar{i}$, oscillates with q but no distinct reflection was obtained from the striated part to indicate its existence. With the exception of f, the faces which terminate the crystals are usually poorly developed; ω was determined by approximate measurements only; t usually gave no reflection whatever.

Cleavage sections, parallel to b, show with the polarizing microscope an extinction, inclined about 17° from the vertical axis, in the obtuse angle β. This direction corresponds to the axis of least elasticity c. In convergent polarized light an obtuse bisectrix could be seen, but the section was too small to admit of a measurement of the angle of the optical axes. The sections transmit a brown light. The pleochroism is marked; for rays vibrating parallel to c green; parallel to b yellowish brown, but varying somewhat, even in the same section. An increase of color is probably due to a slight percentage of FeO, the lighter colored material is probably nearly pure $MnWO_4$.

* Ann. Chimie et Phys., IV, xix, p. 168, 1870.

Some groups of radiating crystals of a brownish yellow color, not over 2^{mm} in diameter have been noticed, which probably are also hübnerite.

An analysis of the radiated variety of a brownish black color, yielding a pale grayish brown powder, and having the specific gravity 6·713 gave, after deducting 3·608 per cent quartz:

WO_3	74·75
FeO	2·91
MnO	21·93
CaO	0·11
MgO	trace.
	99·70

b. From Cement Creek on Bonita Mountain near Silverton, San Juan Co., Colorado.

This variety we have not been able to obtain in isolated crystals. It is associated with quartz and pyrite and occurs in a radiating and divergent mass, up to 40 to 50^{mm} in length, with distinct clino-pinacoid cleavage. Color hair-brown to reddish and yellowish brown, in thin splinters transparent, luster submetallic, inclined to silky. The fine powder is of isabella color. Sp. gr.=6·891.

The analysis gave, after deducting 2·4 per cent of quartz:

			Harry F. Keller.*
WO_3	76·63		76·14
FeO	1·61	—1·63	2·11
MnO	21·78		21·63
CaO	0·09		0·12
MgO	trace		trace
	100·11		100·00
			Sp. gr.= 6·780

c. From Bonito Mountain near White Oakes, Lincoln Co., N. M.

This variety occurs in fissures in granite. The crystals are long prismatic and for the most part coated with drusy quartz. The prismatic faces are usually vertically striated, but a few crystals were found which gave very good reflections. In the prismatic zone *b*, *m* and *q*, were observed, but *q*, which is new, was the most prominent. The symbol 830, $i\text{-}\frac{8}{3}$, approximates to 310, $i\text{-}\bar{3}$, which has been observed on wolframite, but four independent measurements, where the reflection from *q* were sharp and distinct, gave $q \wedge b = 72° 55'$; $72° 46'$; $72° 41'$ and

* After deducting 2·13 per cent of quartz, the analysis of Harry F. Keller of the same variety (megabasite from Bonita Mountain near Silverton, Col., in Franklin Institute Journal, August, 1889), gave the above composition.

72° 21′, average 72° 41′, calculated for 830 ∧ 010 = 72° 35½′, while for 310 ∧ 010 the calculated angle is 74° 26′. The crystals are usually terminated by *t*, or by *t* and a pyramid *d*, 112, in the zone *t*, *b*. The dome *t* was either dull or had a sort of undulatory surface, so that it gave no distinct reflection. The pyramid *d* gave only faint reflections and yielded the following measurements.

	Measured.	Calculated.
d ∧ *b*, 112 ∧ 010 =	68° 51′ and 69° 20′	69° 4½′
d ∧ *q*, 112 ∧ $\bar{8}30$ =	108° 28′	108° 14

Only the thinnest cleavage splinters of this material were at all transparent, so that no attempt was made to study the optical properties.

Color iron black to brownish black, luster submetallic, inclining to adamantine. Powder greenish gray. Sp. Gr. = 7·163 — 7·091.

The analysis gave, after deducting 0·34 per cent of quartz:

	I. Lincoln Co., N. M. (Genth.)	II. Mammoth Dist., Nevada.
WO_3	76·33	74·88
FeO	3·82 — 3·98	0·56
MnO	19·72 — 20·08	23·87
CaO	0·13	0·14
MgO	trace	CuO 0·08, 0·08
	100·00	99·61

d. From Monmouth District, Nye Co., Nevada.

For comparison we have examined the hübnerite from Riotte's original locality. The specimens at our disposal showed no distinct crystals but only cleavage masses, implanted on quartz. Color brownish black to iron-black, powder greenish-gray. A little of the manganese is higher oxydized, as the mineral evolved some chlorine, when treated with hydrochloric acid. The analysis is given under II above

2. *Hessite from Mexico.*

Prof. Carlos F. de Landero of Guadalajara kindly presented a specimen of hessite from a recent occurrence at the Refugio Mine, San Sebastian District, State of Jalisco, Mexico, which was analyzed by Mr. Jas. S. de Benneville. It is granular, of a dark lead gray color, and so very largely and intimately intermixed with quartz, that no pure material could be picked out for analysis. The composition of the mixture was found to be

SiO_2	33·33		
Al_2O_3	0·70		
CaO	0·49		
Fe	0·16		
Cu	trace		
Pb	1·21	equivalent of Te	0·75
Ag	39·42	" "	23·38
Te	25·53		
Se	trace		24·13
	100·84		

This would represent: 62·80 per cent Ag_2Te, 1·96 per cent PbTe with 1·40 per cent of tellurium, which may be present as native tellurium or perhaps as tellurous oxide. The presence of some incrustations, resembling tellurite, would indicate that the latter supposition is probably the correct one.

3. *Bismutite.*

Associated with the phenacite of Mount Antero in Chaffee County, Colorado, are quartz, orthoclase, scales of muscovite, hematite, and a grayish or yellowish green bismuth mineral in prismatic form. The hematite occurs in small brilliant crystals, the largest not over 4^{mm} broad and about 1·5^{mm} thick, the combination being short prisms terminated by a flat rhombohedron. Of the bismuth mineral only one fragment of a crystal was observed of a darker greenish color and having angles agreeing with the sulphide Bi_2S_3, from the alteration of which it probably had been derived. Other small crystalline masses were observed, resembling bundles of deeply striated crystals, the largest about 30^{mm} in size, but, unfortunately, throughout the whole mass, contaminated with salts of lead, copper, zinc, ferruginous clay, etc. Examining the association it appears that quartz, muscovite in hexagonal plates and hematite are the oldest, after which the bismuth mineral was deposited, and upon this, the most recent phenacite, which frequently is found upon the bismuth mineral and between its fissures,—or the phenacite has crystallized around fragments of the same.

It was impossible to obtain the bismuth mineral in a state of purity. The best gave the composition given below, after deducting in analysis I, 5·11 per cent of impurities, such as hematite, muscovite and ferruginous clay—in analysis II, 4·22 of the same.

The sp. gr. of the material for analysis was found to be: 6·293, while the darker greenish crystal yielded: 7·330. The analyses gave:

	I		II	
	a	*b* Less impurities	*a*	*b* Less impurities
Impurities ..	5·11		4·22	
[Ignition, 9·18]				
H_2O	2·02	2·11	2·33	2·43
CO_2	7·16	7·47	6·85	7·14
CuO	0·31	0·32	0·32	0·33
PbO	4·83	5·04	4·63	4·82
Bi_2O_3	80·13	83·64	80·41	83·81
ZnO	0·86	0·90	0·86	0·89
SO_3	0·50	0·52	0·56	0·58
	100·92	100·00	100·18	100·00

The lead is probably present as $PbCO_3$ and $PbSO_4$, the copper as malachite, the zinc as $ZnCO_3$ and the bismuth as hydrated-carbonate, but the material is too impure to attempt the construction of a formula.

4. *Natrolite.*

Associated with aegirite, eudialyte, titanite, etc., natrolite occurs at Magnet Cove, Ark., in large colorless, cleavable masses, the individuals being about 50^{mm} in length and $5{\cdot}8^{mm}$ broad. The cleavage, although apparently perfect, does not yield good surfaces for reflecting light. The angle between the cleavages is very near 90°, but most of the measurements which were made are near 91° and 89°. The crystals are colorless, some portions, however, are more or less opaque. It was found that the latter contain a minute quantity of lime, while the colorless portion is free from it. The spec. gravity was found to be 2·243. The analysis gave :

H_2O	9·81
SiO_2	47·97
Al_2O_3	26·51
Na_2O	15·98
	100·27

Chemical Laboratory, 111 S. 10th St.,
Philadelphia, October 25th, 1891.