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tion and in one operation from tables of the Descending Exponential,[6] the operation of calculating a series of values from the exponential equation involves less labor than from a cubic equation. (3) Altho extrapolation is, in general, an operation beset with many pitfalls, nevertheless, if an extrapolation is unavoidable, it is more reasonable to employ a function of proper general form than to take some random function which can not be expected to fit the experimental results except over a small part of the range of observation.

MINERALOGY.—*Hodgkinsonite, a new mineral from Franklin Furnace, N. J.* C. PALACHE, Harvard University, and W. T. SCHALLER, Geological Survey.

The mineral here described was sent to the Harvard Mineralogical Museum for identification in April of this year by Mr. J. J. McGovern of Franklin Furnace, New Jersey. On being informed that the mineral was of a new species, material for further study and for analysis was freely supplied by Mr. H. H. Hodgkinson, M. E., Assistant Underground Superintendent of the mine, who first found the mineral in the mine workings and whose name it bears. Mr. Hodgkinson states that the new mineral was found in the northern part of the ore body, in that part of the Parker Mine formerly known as the Hamburg Mine and quite near the hanging wall of the west leg of the ore body, between the 850- and 900-foot levels. The locality was marked by a number of slips and faults, along some of which the mineral occurs. It has been found in a number of specimens during the year but nowhere in abundance.

Hodgkinsonite is a hydrous silicate of zinc and manganese crystallizing in the monoclinic system. It occurs in seams in massive granular ore of the typical willemite-franklinite mixture; the seams are generally very thin with but a film of the mineral which is always associated with white barite and not uncommonly with plates of native copper. Locally the film thickens to a narrow vein and then the new mineral may show individuals up to 2 cm. across, sharply angular in form and apparently with

[6] Such, for example, as those in Becker and Van Ostrand's hyperbolic functions (Smithsonian Mathematical Tables, Washington. 1909).

crystal faces but in reality determined in their outline almost wholly by the older platy barite which encloses them. The clear pink color and brilliant cleavage of hodgkinsonite, together with the snow white barite make such specimens both striking and attractive in appearance. One mass of ore with a surface 20 cm. square is at least half covered with hodgkinsonite. In one case only has such a vein been found in which the angular cells formed by the intersecting barite plates were not wholly filled by hodgkinsonite so that the latter was free to develop crystal planes. From this specimen three crystals of good quality were detached and these served to establish the axial ratio of the species.

Other crystals were found occupying cavities in thicker veins free from barite. These crystals, the largest 1 cm. long, were much affected by solution, the faces being generally dull or facetted. They were accompanied by black rhombohedral crystals of pyrochroite and scalenohedral crystals of calcite, both later in age and encrusting hodgkinsonite. The latter is implanted directly on willemite or franklinite and in one specimen on manganese garnet. The association and mode of occurrence both indicate a pneumatolytic origin for the new mineral.

Hodgkinsonite is monoclinic with normal symmetry. The highly perfect cleavage, normal to the symmetry plane, has been taken as the basal pinacoid. The elements were calculated from the angles of the forms taken as (110), (011), and (221) together with the inclination of the cleavage (001) to the prism zone. These angles follow.

$(001)\left\{\begin{array}{l}\varphi = 90^\circ\ 00' \\ \rho = 5^\circ\ 27\tfrac{1}{2}'\end{array}\right\}$ Average of 2 readings on 2 crystals.

$(110)\left\{\begin{array}{l}\varphi = 33^\circ\ 10' \\ \rho = 90^\circ\ 00'\end{array}\right\}$ Average of 7 readings on 3 crystals.

$(011)\left\{\begin{array}{l}\varphi = 4^\circ\ 42' \\ \rho = 48^\circ\ 16'\end{array}\right\}$ Average of 2 readings on 1 crystal.

$(221)\left\{\begin{array}{l}\varphi = 34^\circ\ 48' \\ \rho = 69^\circ\ 48'\end{array}\right\}$ Average of 4 readings on 2 crystals.

The axial elements thus calculated are:

$p_o = 0.7254 \qquad q_o = 1.1114 \qquad \mu = 84^\circ\ 33\tfrac{1}{2}'.$

$a : b : c = 1.539 : 1 : 1.1165 \qquad \beta = 84^\circ\ 33\tfrac{1}{2}'.$

The forms observed are $c(001)$, $m(110)$, $s(011)$, $r(221)$, $t(\bar{4}01)$, $x(\bar{3}05)$, $q(552)$, $u(\bar{3}22)$. The last four of these forms were found only on the etched crystals, which had been measured with considerable care before the better crystals were found. These four high-index forms are no doubt vicinal and due to etching of the crystals; they are nevertheless retained in the table of measurements and a figure showing them is given since they are characteristic of most of the specimens.

In the following table may be found all the observations made on these crystals, together with the calculated angles for the various forms.

TABLE 1

ANGLE TABLE FOR HODGKINSONITE

	CALCULATED		MEASURED		LIMITS		NO. OF FACES
	φ	ρ	φ	ρ	φ	ρ	
$c(001)$....	90°00′	5°27½′	90°00′	5°27½′		5°27′– 5°28′	2
$m(110)$...	33 08	90 00	33 10	90 00	33°08′–33°11′		7
$s(011)$....	4 53½	48 15½	4 52	48 14	3 34 – 6 23	47 28 –48 47	12
$r(221)$....	34 49	69 49	34 48	69 48	34 45 –34 51	69 35 –69 59	4
$t(\bar{4}01)$....	–90 00	70 28	–90 00	70 09		70 03 –70 15	2
$x(\bar{3}05)$....	–90 00	18 52	–90 00	18 13		17 36 –18 35	3
$q(552)$....	34 29	73 33	34 30	72 34	34 01 –35 10	71 45 –73 23	4
$u(\bar{3}22)$...	–41 47	56 16	–43 15	55 25	42 59 –43 31		2

The crystals are acute pyramidal in habit as shown in figure 1, and are dominated by the equal development of unit prism m and pyramid r. On the etched crystals this pyramid is replaced by a group of facets whose average position corresponds to the symbol (552). The clinodome and prism faces are always smooth but often dull and poorly reflecting. The faces of other forms are minute and of the poorest quality. Figure 2 shows one of the etched crystals, doubly terminated and with the small faces of uncertain forms characteristic only of specimens of this type.

The perfect cleavage of hodgkinsonite is parallel to the basal pinacoid. The density is 3.91, determined by a pycnometer on a gram of small fragments which were later used for analysis. The hardness is a very little less than 5.

The optical characters have been only imperfectly determined. The optic axial plane is parallel to (010). The mean refractive index is 1.73, determined by the immersion method. The color of the mineral varies from a bright pink to a pale reddish brown, the luster is vitreous, the streak white.

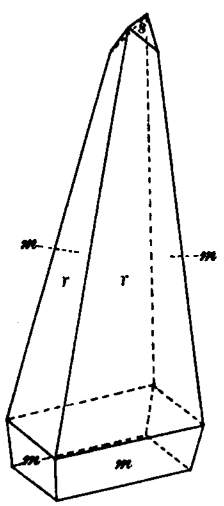

Fig. 1

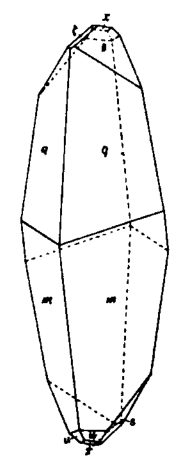

Fig. 2

Fig. 1. Hodgkinsonite. Common habit of implanted crystals, showing basal cleavage when removed from the matrix. Forms $m(110)$, $s(011)$, $r(221)$. On etched crystals r is replaced by $q(552)$ without change of habit.

Fig. 2. Hodgkinsonite. Doubly terminated etched crystal. Forms: $c(001)$, $m(110)$, $s(011)$, $x(\bar{3}05)$, $q(552)$, $u(322)$.

The mineral decrepitates when held in the blowpipe flame, wherein it fuses readily and quietly to a brown enamel. Heated in a closed tube, hodgkinsonite decrepitates strongly, splitting up into numerous thin cleavage scales which on further heating yield water and become brown in color. The mineral is readily soluble in acid, yielding gelatinous silica.

The chemical analysis of hodgkinsonite was made on carefully selected cleavage fragments of a clear pink color and gave the following results. Quarter gram samples were used as the total amount of available material was only somewhat over a gram.

ANALYSIS AND RATIOS OF HODGKINSONITE (BY W. T. SCHALLER)

	1	2	3	AVERAGE	RATIOS	
SiO_2	19.92	19.89	19.77	19.86	0.331	1.02
MnO	20.39	20.97		20.68	0.291	
ZnO	52.93	*		52.93	0.653	2.98
CaO	0.99	0.88		0.93	0.017	
MgO	0.04			0.04	0.001	
H_2O			5.77†	5.77	0.321	0.99
				100.21		

* A duplicate determination of ZnO, of which a small amount was lost, gave 51.38 per cent.

† Determined directly by fusing the mineral with sodium carbonate and collecting the water in a calcium chloride tube. A determination of the loss on ignition, corrected for oxidation of the manganese, gave the value 4.68 per cent.

A doubtful trace of lead was encountered but iron and chlorine were absent. No water was given off by the mineral at 110°.

The ratios yield sharply the formula $3\ RO.SiO_2.H_2O$ where R is chiefly zinc and manganese. If the manganese, calcium and magnesium be arbitrarily taken together then the ratio of MnO + CaO + MgO to ZnO is 309 to 653 or 1 : 2.11 or nearly 1 : 2. The formula may then be written $MnO.2ZnO.SiO_2.H_2O$ which may, as the water is all constitutional, be interpreted as $Mn.(ZnOH)_2.SiO_4$.