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In this table, the following abbreviations are used: Ant., antenna; App., pairs of jointed appendages, either pediform or branchial; M., Mandible; Mx., Maxilla; P., feet; M.P., feet that serve also as jaws; Mx. & L. (under Insects), maxillæ and labium; Fol. P., foliaceous or lamellar feet or appendages.

Under the Limuloids, the genus *Eurypterus* fails of antennæ; but they are present in *Pterygotus*, and are chelate; and this chelate (or thumb-and-finger) form characterizes also the modern *Limulus*, the Scorpions and the common Spiders. In the table the two pairs of maxillæ of Insects are assumed to belong to a single body segment, as held by many zoologists, including (as he himself informs the writer) Prof. S. I. Smith; the table shows that, with this admission, the thorax and head of an Insect are essentially homologous with the head of a Tetracepad Crustacean.

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ART. XXXIV.—On the Crystallization of Herderite; by  
S. L. PENFIELD.

DURING the past summer Mr. L. K. Stone of Paris, Maine, sent to Prof. H. L. Wells of the Sheffield Scientific School several specimens of an unknown mineral for identification. The specimens were collected at Paris, Me., but not at the noted Mt. Mica locality. They presented well defined, transparent and almost colorless *monoclinic* crystals, measuring up to 2<sup>mm</sup> in diameter and 6<sup>mm</sup> in length. The crystals are implanted mostly upon quartz but some are on feldspar. Their hardness is a little over 5. When tested before the blowpipe they at first sprouted and turned white, but afterwards fused at about 4 to a white, blebby enamel, tinging the flame very pale green, indicating phosphoric acid. In the closed tube at a high temperature the crystals whitened, threw off quite violently a fine scaly powder or dust and gave water which showed only a faint acid reaction. The mineral was slowly but completely soluble in hydrochloric acid. As these characters apparently did not agree with the description of any known species, the mineral was supposed to be new and accordingly the best material available for the chemical analysis was carefully selected and eventually separated from any attached quartz or gangue by means of the heavy solution. The pure mineral, amounting to about one and a half grams, and varying in specific gravity from 2.936 to 2.968, was analyzed by Professor Wells to whom the author's sincere thanks are due. The analysis revealed the interesting fact that the mine-

ral is herderite and that it contains practically no fluorine, agreeing in this latter respect with a variety described by Professor Wells and the author\* from Hebron, Me. The analyses of the minerals from both localities are as follows:

	Paris.	Hebron after deducting 5.27 per cent of impurities.	Theory for Ca[Be(OH)]PO <sub>4</sub> .
Sp. gr. ....	2.952	2.975	
P <sub>2</sub> O <sub>5</sub> .....	44.05	43.08	44.10
BeO .....	16.13	16.18	15.53
CaO .....	34.04	[34.35]	34.78
H <sub>2</sub> O .....	5.85	6.15	5.59
F .....	----	.42	----
Insoluble...	0.44	----	----
	100.51	100.18	100.00

The analyses indicate a well defined type of herderite which may well be called hydro-herderite in distinction from the variety containing fluorine. Of the two types the former, Ca[Be(OH)]PO<sub>4</sub>, occurs quite pure, as shown by the above analyses, and it may readily be told by its peculiar behavior when heated in a closed tube. We have as yet no proof of the existence of a pure fluor-herderite Ca[BeF]PO<sub>4</sub>. Mackintosh† advanced such a formula for the mineral from Stoneham, Me., but he did not make a test for water or a direct determination of fluorine, the latter being calculated, as he states, from the excess of lime. The author in connection with Mr. D. N. Harper‡ proved that the Stoneham herderite contained both hydroxyl and fluorine in the proportion of about 3:2 and proposed the formula Ca[Be(OH.F)]PO<sub>4</sub>, where fluorine and hydroxyl are regarded as isomorphous. This last type, which may be designated as hydro-fluor-herderite, may be readily distinguished by its behavior in a closed tube, as, when heated intensely, acid water is driven off, etching the glass and yielding a deposit of silica. From the quantity of hydrofluoric acid that is liberated it has been assumed that the fluorine and hydroxyl are in combination with beryllium and not with the more basic calcium.

The most interesting feature of the herderite from this new locality is, however, its *monoclinic crystallization*. The discovery of this has led to the examination of the mineral from other localities and it has been found, as will be shown in the course of this article, that herderite is always monoclinic and not orthorhombic.

\* This Journal, III, xlv, p. 114, 1892.

† This Journal, III, xxvii, p. 137, 1884.

‡ This Journal, III, xxxii, p. 107, 1886.

Among the specimens that were examined from the new locality there were only a few small crystals that were well adapted for measurement with the goniometer and these were always so attached that only a part of their faces were developed. Some of the faces are curved and give uncertain reflections but the majority are good and they are very free from vicinal planes, which are prominent on the Stoneham herderite. In the description of the crystals the position adopted by E. S. Dana\* has been retained, and as far as possible, his system of lettering.

The habit of the crystals is shown in figures 1, 2 and 3. Number 1 is drawn with 010 in front and No. 2 with 001 vertical, these positions being chosen because they are best adapted for showing the monoclinic symmetry. Figure 3 is a basal projection and from this and the spherical projection, fig. 13, the relations of the forms and the prominent zones can readily be made out. The forms which have been identified are as follows :

<i>a</i> , 100, $i\bar{i}$	<i>e</i> , 302, $-\frac{3}{2}i$	<i>r</i> , 112, $-\frac{1}{2}$	<i>k</i> , 122, $-1\bar{2}$
<i>b</i> , 010, $i\bar{i}$	<i>t</i> , 032, $\frac{3}{2}i$	<i>q</i> , 332, $-\frac{3}{2}$	<i>w</i> , 3·12·4, $-3\bar{4}$
<i>c</i> , 001, 0	<i>v</i> , 031, $3\bar{i}$	<i>n</i> , 331, $-3$	<i>z</i> , $\bar{3}94$ , $\frac{1}{2}3$
<i>m</i> , 110, <i>I</i>	<i>s</i> , 061, $6\bar{i}$	<i>u</i> , $\bar{3}31$ , 3	

The axial ratio was calculated from the measurements which are marked by an asterisk in the table of angles. For comparison the ratios derived by Haidinger† from the Ehrenfriedersdorf and by Dana from the Stoneham herderite are also given.

Author	$a : \bar{b} : c = 0.63075 : 1 : 0.42742$	$\beta = 89^\circ 54'$
Haidinger	" " = 0.6261 : 1 : 0.4247	$\beta = 90$
Dana	" " = 0.6206 : 1 : 0.42345	$\beta = 90$

The angle  $\beta$  is very close to 90°, but there can be no mistake about the monoclinic character of the crystals as indicated by the development of the faces. As regards the forms, those shown in fig. 1 are almost invariably present. The basal plane *c* always yields good reflections and the edges which it forms with the dome *t* invariably curve and taper to a point as they approach the pyramid *z*, fig. 2. The edges between *t* and *z* were always rounded, and this is especially true in the vicinity where *c*, *t* and *z* approach one another. The pyramid *z* which, owing to the curved nature, did not yield very satisfactory measurements was surely identified by its location in the zones *m*, *e*, *k*, *t* and *m*, *v*. The pyramids *q* and *n* are commonly striated parallel to their intersection edges.

\* This Journal, III, xxvii, p. 229, 1884.  
 † Phil. Mag., iv, p. 1, 1828.

Some of the measured angles are recorded in the following table, where it will be observed that the agreement with the calculated is usually very satisfactory, thus indicating that the axial ratio is nearly correct. Where the variation is considerable the faces were always either rounded or otherwise poorly adapted for measurement.

Measured.		Calculated.	Measured.		Calculated.
$c \wedge a$ , 001 $\wedge$ 100	= 89° 54'	*	$m \wedge n$ , $\bar{1}10 \wedge \bar{3}31$	= 22° 23'	22° 36'
$c \wedge e$ , 001 $\wedge$ 302	= 45 25*		$n \wedge n$ , $\bar{3}31 \wedge \bar{3}\bar{3}1$	= -----	59 3
$b \wedge v$ , 010 $\wedge$ 031	= 37 57*		$c \wedge k$ , 001 $\wedge$ 122	= -----	28 35½
$c \wedge m$ , 001 $\wedge$ 110	= -----	89° 55'	$k \wedge k$ , 122 $\wedge$ 122	= -----	44 3½
$m \wedge m$ , 110 $\wedge$ 110	= 64 25	64 29	$r \wedge k$ , 112 $\wedge$ 122	= 11 3	10 35½
$b \wedge m$ , 010 $\wedge$ 110	= 57 47	57 45½	$c \wedge t$ , 001 $\wedge$ 032	= 32 46	32 40
$c \wedge r$ , 001 $\wedge$ 112	= 21 52	21 49	$t \wedge t$ , 032 $\wedge$ 032	= 65 36	65 20
$r \wedge r$ , 112 $\wedge$ 112	= 22 43	22 52½	$b \wedge s$ , 010 $\wedge$ 061	= 21 17	21 18
$a \wedge q$ , 001 $\wedge$ 332	= 50 8	50 11	$a \wedge v$ , 100 $\wedge$ 031	= 89 55	89 56
$q \wedge q$ , 332 $\wedge$ 332	= 48 20	48 22	$a \wedge w$ , 100 $\wedge$ 3·12·4	= 72 34	72 35
$c \wedge n$ , 001 $\wedge$ 331	= 67 7	67 20	$c \wedge w$ , 001 $\wedge$ 3·12·4	= -----	54 2
$n \wedge n$ , 331 $\wedge$ 331	= 58 56	58 59	$w \wedge w$ , 3·12·4 $\wedge$ 3·12·4	= -----	97 36
$b \wedge n$ , 010 $\wedge$ 331	= 60 30½	60 30½	$c \wedge z$ , 001 $\wedge$ 394	= -----	47 26
$c \wedge n$ , 001 $\wedge$ 331	= -----	67 29	$b \wedge z$ , 010 $\wedge$ 394	= 49 ..	49 22½

*Optical properties.*—Sections parallel to the clinopinacoid show inclined extinction. With yellow light, Na flame, the axis of greatest elasticity, which is the acute bisectrix, was found to make an angle of  $+2\frac{1}{2}^\circ$  with the clino axis, hence, as the axial inclination  $\beta$  is approximately  $90^\circ$ ,  $c$  is inclined  $2\frac{1}{2}^\circ$  to  $\bar{c}$  in the acute angle  $\beta$ . The plane of the optical axes is the clinopinacoid and the double refraction is negative and rather strong. For the determination of the mean index of refraction a prism was prepared with its edge parallel to the ortho axis. Owing to the character of the material the prism was small and its optical orientation only approximately correct. The results of the measurements are given in tabular form below. Two plates were prepared, one at right angles to the acute bisectrix, the other parallel to the base, which is approximately at right angles to the obtuse bisectrix. The first of these was so small that the divergence of the optical axes could not be observed in air but was determined in  $\alpha$ -monobrom-naphthaline ( $n_D = 1.6572$ ). The results are as follows, all made with yellow light, Na flame:

From prism:  $\alpha = 21^\circ 58'$ ,  $\delta = 14^\circ 16'$ , hence  $\beta = 1.632$

$$2Ha = 70^\circ 44' \quad \text{hence} \quad 2Va = 71^\circ 59'$$

$$2Ho = 105 \quad 1 \quad \text{hence} \quad 2Vo = 107 \quad 21$$

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$$179^\circ 20'$$

$$\text{Theory,} \quad 180 \quad 00$$

Also from  $2Ha$  and  $2Ho$  there were calculated for comparison  $2Va = 72^\circ 12'$  and  $\beta = 1.628$ . The first of these agrees

very well with the value given above, the second varies 0.004 from  $\beta$  derived from the prism and the mean of the two determinations 1.630 may be accepted as very nearly correct. The dispersion was  $\rho > v$  and was decidedly inclined, the borders of one hyperbola being much more brilliantly colored than the other.

*Herderite from Hebron, Maine.*

The occurrence of this hydro-herderite has already been referred to and the analysis given. The habit of the crystals is represented in fig. 4. Only a very little of this material was found, and the crystals were not well adapted for accurate measurement. As stated in the original description, one of the best measurements that was made was  $n \wedge n$ ,  $331 \wedge 331 = 102^\circ 22'$  which does not agree well with the angle calculated by Dana,  $103^\circ 24'$ , but does, however, compare very favorably with the angle calculated from the hydro-herderite from Paris. If the crystals are twinned about the basal plane, according to a method to be described later, the calculated angle should be  $102^\circ 25'$  and if they are simple,  $102^\circ 41'$ .

*Herderite from Stoneham, Maine.*

On the crystals from this locality the following forms have been identified:

$b, c, m, e, s, v, t, q, n$  and  $n$

corresponding to the herderite from Paris, and in addition:

$l, 120, i\bar{2}$	$e, 502, \frac{1}{2}\bar{1}$	$p, 111, -1$	$x, 562, 3\bar{2}$
$d, 101, -1\bar{1}$	$u, 011, 1\bar{1}$	$q, 332, \frac{1}{2}$	

Of these all except  $d$ , which is mentioned by Hidden,\* were observed by Dana, while the prism  $\mu, 130$  and the pyramid  $y, 3\bar{3}$  observed by him have not been found by the writer, and the position of  $y$  in the monoclinic system cannot therefore be determined. Figures 5 and 6, which, except for the lettering, have been copied from Dana, represent the prevailing combinations. The crystals are penetration twins and imitate orthorhombic symmetry, similar to the crystals of stilbite. The twinning plane can be either the base or the orthopinacoid;  $\beta$  being very near  $90^\circ$ , and the character of the faces such that sufficiently accurate measurements cannot be made to determine this point. Considering the faces in the upper front and lower rear segments as in normal and parallel position, the lettering on the remaining faces has been underlined

\* This Journal, III, xxxii, p. 209, 1886.

to signify that they are in twin position. Fig. 7 represents a fragment which was detached from a specimen in the Brush collection. It illustrates monoclinic symmetry in the development of  $e$ ,  $q$  and  $n$  larger than  $e$ ,  $q$  and  $n$  and also in the occurrence of the positive pyramid  $x$  between  $b$  and  $q$  and not between  $b$  and  $q$ . A thin section was prepared from this crystal parallel to  $b$  and it showed no indication of twinning. Fig. 8 represents the development of the forms on a crystal in the Bement collection. This was so attached that the majority of its faces could be observed and the monoclinic character is well shown by the occurrence of  $d$  and  $p$  in the upper front and lower hind segments only.

Fig. 9 represents a crystal in the Bement collection which is reported as being the largest herderite ever found at Stoneham and has already been described in this Journal by Mr. Hidden.\* Its actual dimensions parallel to the crystallographic axes are  $a$  23<sup>mm</sup>,  $b$  25<sup>mm</sup> and  $c$  18<sup>mm</sup>. The crystal was attached at one extremity of the  $a$  axis and has been drawn with  $0\bar{1}0$  in front. It is twinned, and what is undoubtedly the line of twinning may be distinctly traced across the  $m$  and  $x$  faces, as indicated by the dotted line in the figure. That portion of  $x$  above the twinning line is quite perfect, and with reference to the upper half of the crystal, it is situated in its normal position for monoclinic symmetry as a positive hemi-pyramid. The lower portion, however, is very uneven and vicinal and occupies the position of a negative hemi-pyramid, but this has not been included in the list of forms, as this is the only occurrence of it that has been observed and it is not a perfect face but rather an attempt to complete the  $x$  face in the upper portion of the twin.

As has already been stated the material from Stoneham is a hydro-fluor herderite with  $\text{OH} : \text{F} =$  about 3 : 2 and it presents an excellent opportunity for comparison with the hydro herderite from Paris, and of observing the variations in the physical properties produced by the partial substitution of fluorine for hydroxyl. Unfortunately the crystal faces have such a strong tendency to vicinal development that it is difficult to obtain reliable measurements. Owing to the absence of visible reëntrant angles on twin crystals the inclination  $\beta$  must be very near  $90^\circ$  but it could not be accurately measured. On two crystals which were selected on account of the perfection of their faces the following measurements were made, of which those under I are especially good :

\* Loc. cit.

	Measured		Calculated, Dana.	Calculated for hydro-herderite.
	I.	II.		
$m \wedge m, 110 \wedge 1\bar{1}0 =$	----	$63^\circ 57'$	$63^\circ 39'$	$64^\circ 29'$
$n \wedge n, 331 \wedge 3\bar{3}1 =$	$58^\circ 19'$	58 21	$58 17\frac{1}{2}$	58 59
$q \wedge q, 332 \wedge 3\bar{3}2 =$	----	47 58	47 52	48 27
$s \wedge s, 061 \wedge 0\bar{6}1 =$	137 12	----	137 2	137 23 $\frac{1}{2}$

It will be observed in the above that the measurements agree very well with the angles calculated by Dana but vary considerably from those found on hydro-herderite. The axial ratio established by Dana is therefore retained, and is repeated below along with the author's ratio for hydro-herderite :

Hydro-fluor-herderite  $a : b : c = 0.62060 : 1 : 0.42345 \beta = \text{nearly } 90^\circ$   
 Hydro-herderite " " =  $0.63075 : 1 : 0.42742 \beta = 89^\circ 54'$

The partial substitution of fluorine for hydroxyl has had, therefore, an appreciable effect upon the axial ratio, shown especially by a perceptible shortening of the  $a$  axis. It may also be pointed out that the specific gravity of the Stoneham mineral, 3.006–3.012, is greater than that of the hydro-herderite from Paris and Hebron, 2.952–2.975, which might be expected, as fluorine with an atomic weight of 19 is heavier than hydroxyl with a molecular weight of 17.

*Optical properties.*—Several clinopinacoid sections that were prepared showed an inclined extinction of about  $+2^\circ$  when measured with yellow light. Sections from twin crystals like figs. 5 or 6 revealed the twinning beautifully in polarized light. Fig. 14 represents an ideal section, the opposite portions I and I as also II and II extinguishing simultaneously. Fig. 15 represents the actual disposition of the Parts I and II in a section from a crystal like fig. 6, the arrows indicating the directions of extinction.

The mean index of refraction was determined by means of a prism cut with its edge parallel to the ortho axis and the divergence of the optical axes by a plate cut normal to the acute bisectrix. The results, all determined in yellow light, Na flame, are as follows :

	Hydro-herderite.
From prism $\alpha = 22^\circ 55'$ $\delta = 14^\circ 24'$ hence $\beta = 1.612$	$\beta = 1.630$
$2Ea = 128^\circ 25'$ hence $2Va = 67 56'$	$2V = 71^\circ 59'$
$2Ha = 66 0$ hence $2Va = 68 7$	71 59

The double refraction is negative. The dispersion is  $\rho > \nu$  and is distinctly inclined. The indices of refraction have been determined by Bertrand\* as follows :

$$\alpha = 1.621 \qquad \beta = 1.612 \qquad \gamma = 1.592$$

\* Bull. Soc. Min. de France, ix, p. 142, 1886.



The divergence of the optical axes has been measured by Des Cloizeaux.\* His optical preparation was undoubtedly cut from a twin crystal, for he states that on both sides of the bisectrix two sets of rings were visible, which may readily be understood by reference to fig. 14, as a section parallel to the ortho-pinacoid would be approximately normal to two bisectrices. He gives  $2Ea$  for the inner hyperbolæ  $121^{\circ} 22'$  and for the outer  $130^{\circ} 2'$ . The true value should be about midway between these. From the study of the optical properties we learn, therefore, that, by the partial substitution of fluorine for hydroxyl, the position of the axes of elasticity has not materially changed but the mean index of refraction  $\beta$  and the divergence of the optical axes have decreased.

*Herderite from Auburn, Maine.*

The material from this locality as shown by the closed tube reaction is a hydro-fluor-herderite, and as far as known to the author is represented by a single specimen in the Bement collection and two crystals belonging to Mr. T. F. Lamb of Portland, Maine. On the specimen in the Bement collection there is one crystal which is almost colorless and transparent and has the habit shown in fig. 10. It is attached to albite and a large imperfect herderite and measures parallel to the axial directions  $a$   $8^{\text{mm}}$ ,  $b$   $8^{\text{mm}}$ , and  $c$   $11^{\text{mm}}$ . It is twinned and shows a reëntrant angle formed by the faces of the dome  $b$ , 301. This form is strongly vicinal in its development, and was not identified by measurement but by its position in the zones  $v$ ,  $m$ . Some of the large faces are dull and not adapted for measurement but the forms  $m$ ,  $n$  and  $q$ , except for a slight striation parallel to their mutual intersections, are remarkably perfect and yielded the following measurements:

		Stoneham herderite.	Hydro-herderite.
$m \wedge m$ , upper crystal	63° 53'	63° 39'	64° 29'
$m \wedge m$ , lower crystal	63 52	" "	" "
$n \wedge n$ , upper crystal	58 31	58 17½	58 59
$n \wedge n$ , lower crystal	58 30	" "	" "
$q \wedge q$ ,	47 54	47 52	48 22
$m \wedge n$ ,	22 22	22 33	22 35
$m \wedge q$ ,	39 36½	39 42	39 39

From the values of  $m \wedge m$  and  $n \wedge n$ , which are undoubtedly very accurate, it may be assumed that this variety contains less fluorine than the Stoneham mineral as the values are slightly greater and thus approach the hydro-herderite. The crystals from the collection of Mr. Lamb are in habit similar to the one

\* Bull. Soc. Min. de France, vii, p. 132, 1884.

just described, but they are not so perfect and they do not show the reëntrant angle.

*Herderite from Greenwood, Maine.*

In this township herderite has been found at two localities. At one of these it is a hydro-herderite and, as represented by a small specimen in the Brush collection and by several crystals belonging to Mr. Geo. L. Noyes of Norway, Me., it occurs in crystals measuring 15<sup>mm</sup> in diameter, but poorly developed and presenting no forms that could be accurately measured on the reflecting goniometer; with the contact goniometer, however, the following were identified: *b*, 010; *c*, 001; *t*, 032 and  $\beta$ , 364,  $\frac{2}{3}$ -2. The development of the forms is shown in fig. 11,  $\beta$  having been observed only on crystals from this locality.

At the second locality it is a hydro-fluor-herderite and is represented only by a single specimen belonging to Mr. Noyes. This shows several herderites attached to a large quartz crystal. The largest herderite measured parallel to the axial diameters *a*, 9<sup>mm</sup>; *b*, 5<sup>mm</sup> and *c*, 3 $\frac{1}{2}$ <sup>mm</sup> and had the habit shown in fig. 12. The crystals were not well adapted for measurement with the reflecting goniometer and they were not detached from the quartz, but the forms were identified by approximate measurements made from wax impressions of the faces. The following were observed: *b*, 010; *m*, 110; *l*, 120; *e*, 302; *u*, 011; *n*, 331; *n*, 331; *q*, 332; *r*, 121, 2-2 and *p*, 391, 9-3. The last two have been observed only on the crystals from this locality. The forms *q*, *r* and *p* round into one another and in this respect the crystals resemble those from Paris, where the positive hemi-pyramids are curved and indistinct.

*Herderite from Ehrenfriedersdorf, Saxony.*

The material from this locality is extremely rare and the author has had no opportunity of examining it. It is undoubtedly monoclinic and the orthorhombic habit described by Haidinger is the result of twinning. In the description given by Des Cloizeaux\* of the optical properties it is very evident that he was dealing with a twin crystal as he states that about the acute bisectrix three sets of ring systems were observed. The following values for 2E are given 124° 35', 123° 10' and 122° 24'. From the axial ratio given on page 331 it would be expected that the composition of the mineral is intermediate between that of the Stoneham and Paris herderite.

*Conclusions.*—As has been shown, herderite is a mineral of variable composition and it seems best to designate the dif-

\* Loc. cit.

ferent varieties by a suitable prefix. As we speak of fluorapatite and chlorapatite, so we can distinguish hydro-herderite, fluor-herderite, if the pure compound is ever found, and for the isomorphous mixture of the two, hydro-fluor-herderite. The axial ratios and other physical properties vary with the composition and the results which have been given in the course of this article will serve as an additional contribution to our knowledge of the isomorphism of fluorine and hydroxyl.

The following is a list of the twenty-nine forms which have been observed on the different varieties of herderite, the accompanying letters signifying the prominent localities: A. Auburn, E. Ehrenfriedersdorf, P. Paris, S. Stoneham and G. Greenwood. The relations of these may be seen by reference to the spherical projection, fig. 13.

<i>Pinacoids.</i>			<i>Pyramids.</i>		
<i>a</i> , 100, $i\bar{1}$	E. P.		<i>r</i> , 112, $\bar{1}$	A. P.	
<i>b</i> , 010, $i\bar{2}$	A. P. S. G.		<i>p</i> , 111, $\bar{1}$	E. S.	
<i>c</i> , 001, <i>O</i>	A. E. P. S.		<i>q</i> , 332, $\bar{3}$	A. P. S.	
<i>Prisms.</i>					
<i>m</i> , 110, <i>I</i>	A. E. P. S. G.		<i>n</i> , 331, $\bar{3}$	A. E. P. S. G.	
<i>l</i> , 120, $i\bar{2}$	S. G.		<i>o</i> , 441, $\bar{4}$	E.	
$\mu$ , 130, $i\bar{3}$	S.		<i>k</i> , 122, $\bar{1}\bar{2}$	P.	
<i>Ortho-domes.</i>					
<i>d</i> , 101, $\bar{1}\bar{1}$	S.		<i>w</i> , $3\cdot12\cdot4$ , $\bar{3}\bar{4}$	P.	
<i>e</i> , 302, $\bar{3}\bar{1}$	A. P. S. G.		<i>y?</i> { 131, $\bar{3}\bar{3}$	S.	
<i>e</i> , $\bar{3}02$ , $\bar{3}\bar{1}$	S.		{ $\bar{1}31$ , $3\bar{3}$	S.	
<i>b</i> , $\bar{3}01$ , $3\bar{1}$	A.		<i>q</i> , 332, $\bar{3}$	P. S. G.	
<i>Climo-domes.</i>					
<i>u</i> , 011, $1\bar{1}$	S. G.		<i>u</i> , $\bar{3}31$ , $3$	A. S. G.	
<i>t</i> , 032, $\bar{3}\bar{2}$	A. E. P. S.		<i>3</i> , $\bar{3}64$ , $\bar{3}\bar{2}$	G.	
<i>v</i> , 031, $3\bar{1}$	A. P. S.		<i>r</i> , $\bar{1}21$ , $2\bar{2}$	G.	
<i>s</i> , 061, $6\bar{1}$	E. P. S.		<i>x</i> , $\bar{3}62$ , $3\bar{2}$	S.	
			<i>z</i> , $\bar{3}94$ , $\bar{4}\bar{3}$	P.	
			<i>p</i> , $\bar{3}91$ , $9\bar{3}$	G.	

As regards the localities where this rare mineral is found, those in Maine are all within a few miles of one-another, Greenwood, Hebron, Paris and Stoneham being in Oxford County while Auburn is an adjoining township in Androscoggin County. These localities have something in common with the only other known one for herderite, the tin mines of Ehrenfriedersdorf in Saxony, since both are regions of granites and gneisses, and the mineral occurs associated with cassiterite, topaz and beryl in both cases.

As regards the position of herderite in a natural system of classification it seems most closely related to the monoclinic wagnerite-triplite-triploidite group. Although a close relation can be seen between the *a* and *b* axes the relations of the vertical axes and of the inclination  $\beta$  are not so clear.

		<i>a</i>	<i>b</i>	<i>c</i>	$\beta$
Hydro-herderite,	Ca[BeOH PO <sub>4</sub>	0.6307	1	0.4274	89° 54'
Hydro-fluo herderite, Ca[Be(OH . F)] PO <sub>4</sub>		0.6206	1	0.4234	very near 90°
		$\frac{1}{2}a$	<i>b</i>	<i>c</i>	
Wagnerite,	Mg[MgF] PO <sub>4</sub>	0.6362	1	1.5059	71° 53'
Triplite,	R[RF] PO <sub>4</sub>	?	?	?	?
Triploidite,	R[ROH] PO <sub>4</sub>	0.6190	1	1.4925	71 46
Sarkinite,	Mn[MnOH] AsO <sub>4</sub>	0.6672	1	1.5154	62 13 $\frac{1}{2}$

R = Mn and Fe

In this group fluorine and hydroxyl are isomorphous, and triploidite described by Brush and Dana,\* being isomorphous with wagnerite and having undoubtedly the same structural formula as triplite, gave the first instance in which this fact was observed.

In conclusion the author takes pleasure in expressing his sincere thanks to Messrs. C. S. Bement of Philadelphia, Pa., G. L. Noyes of Norway and T. F. Lamb of Portland, Me., for the loan of specimens from their private collections and to Mr. L. K. Stone of Paris, Me., for the supply of material from the new locality.

Laboratory of Mineralogy and Petrography,  
Sheffield Scientific School, January, 1894.

ART. XXXV.—*Additional Note on Leucite in Sussex Co., N. J.*; by J. F. KEMP.

IN the Journal for April, 1893, pp. 298-305 the writer described a "Basic Dike near Hamburg, N. J., which has been thought to contain Leucite." The paper dealt with a dike that cut blue, apparently Lower Silurian limestone, was 15-20 feet wide and situated about one and one-half miles northwest of Hamburg, N. J. The dike contained some curious spheroids that strongly suggested leucite, but which were altered in every case to a mass of analcite, calcite, and feldspar. From this it was concluded that fresh material would be necessary to decide the presence of this rare and interesting mineral, although the nearness of the elaeolite-syenite at Beemerville, gave additional reason to suspect it. The past summer, being again in the region, the writer visited the extensive quarries for limestone, that have been opened up at Rudeville, which is over on the opposite side of an Archæan ridge (Hamburg Mountain), from Hamburg and the first mentioned dike. The white crystalline limestone is cut by a dike about 12 feet wide,

\* This Journal, III, xvi, p. 42, 1878.