Notes on Minerals from Cornwall and Devon.

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Fluor Spar, Holmbush Mine, Callington.

I OBTAINED this summer a most beautiful variety of fluor spar, which was raised from the 145 fathom level of the Holmbush Mine. It is of a transparent azure-blue colour, and shows well marked fluorescent phenomena, though not so strongly as that of Weardale, Cumberland.

Some of the specimens are deep blue in one part and limpid like glass in another; it was found that while the deeply coloured part was strongly fluorescent the limpid part had little or no effect upon the refrangibility of the light passed through it.

The cube planes exhibit well marked rectangular impressions.

Minerals from the Mid-Devon Copper Mine.

There is no record of the minerals to be found at the present time on the burrows of the Mid-Devon Copper Mine, late Belstone Mine, in the parish of Belstone, near Okehampton, and so I thought it would interest the members of the Society if I exhibited and briefly described the minerals I found there this summer.

The mine is situated at the junction of the granite with the millstone grit; the lode, which is of copper pyrites and mispickel, is a flat lode of an ill-defined character, and the ore is richest for copper in the immediate vicinity of the axinite rock. I found the following minerals:—

Garnet, axinite, asbestos, dark green semi-opal, red jasper, copper pyrites, quartz and calcite. The greater portion of these minerals were raised from the 100 fathom level.

Garnet.

This mineral is very abundant, forming large rock masses; some of the crystals are large dodecahedra about ¾ of an inch in diameter, of a dull greenish-yellow colour, with very narrow {211} planes.

A few of the crystals exhibit a peculiar structure resembling the mode of growth of the capped quartz crystals from Virtuous Lady Mine, Tavistock. A smaller crystal of a dark-green colour is enveloped by a larger one more or less altered and lighter coloured, with outer faces parallel to similar faces of the inner crystal. The layer in between the two crystals is soft and brittle, so that the inner crystal can sometimes be removed. Deposited upon the larger crystals are a few smaller dodecahedra of a semi-transparent olive-green colour.

Asbestos.

This mineral is fairly abundant, sometimes verging on actinolite, but more often in tough white masses of the "mountain cork" variety in which the best crystals of axinite are found.

Semi-Opal, Jasper and Hornstone.

I found a few large lumps of dark-green semi-opal, and smaller pieces of red jasper and grey hornstone.

Mispickel.

Some of the crystals of Mispickel are well-defined, with good lustre, elongated in the direction of the c axis, and exhibiting the forms a $\{100\}$ s $\{102\}$ l $\{101\}$ m $\{110\}$ e $\{011\}$.

Copper and Iron Pyrites.

These are met with usually in the massive form mixed together.

Calcite.

In small quantities. Sometimes surrounding the crystals of axinite, whose lustre it has preserved.

Axinite.

Fine large semi-opaque dark-brown crystals of axinite are intimately associated with the garnets; some of the crystals are 1¼ inches long, and one inch broad.

The crystals exhibit the Botallack habit, but are less modified. The planes found are r $\{011\}$ v $\{100\}$ largely developed, narrow x $\{111\}$, rough c $\{1\bar{1}1\}$, small p $\{010\}$ z $\{012\}$ l $\{120\}$ u $\{110\}$ s $\{121\}$; the two latter planes are striated parallel to their own intersections. A very common aggregation is met with, of polysynthetic crystals of the above habit grown not quite parallel to the r plane. This causes the two parallel p planes to be as much as 5° or 10° out of the 180°, and the zone p v to be largely developed.

The crystals are elongated in a direction nearly parallel to the normal to the plane c.

I give here, as an addendum to the above note, a full account of this very interesting mineral, with the view of facilitating the future work of any other investigator.

Thumerstein was the first name given to axinite by Werner, 1788 (*Bergman Journ.* p. 55 and p. 262), from Thum, in Saxony, where it was found. Previous to this date this mineral had been known only as a variety of schorl.

In 1791 Delamethérie called it yanolite (violet stone), but it was not until 1822 that Haüy published the first crystallographic account of this mineral, which he had previously called axinite.

Literature (Crystallographic).

Haüy,	1822.	Traité de Mineralogie, III. p. 22.
Haüy,	1822.	Traité de Crystallographié, p. 37.
Phillips,	1823.	Elementary Introduc. Mineral. p. 43.
Neumann,	1825.	Poggendorf's Annalen IV. p. 63.
Kupffer,	1826.	Pogg. Ann. Bd. VIII. p. 228.
Levy,	1837.	Descr. d'une Coll. de Min., Vol. II. p. 107.
Brooke & Miller,	1852.	Mineralogy, p. 348.
Des Cloizeaux,	1862.	Manuel de Minéralogie, p. 515.
Hessenberg,	1863.	Mineralogische Notizen, No. V. p. 27.
Vom Rath,	1866.	Poggendorff's Annalen, CXXVIII. pp. 20, 227.
Schrauf,	1870.	Sitzungsberichte der k.k. Akad. Wiss. LXII. Abth. p. 712.
Websky,	1872.	Min. Mitth. Tschermak, Heft. I. p. 1.
Hessenberg,	1873.	Mineralogische Notizen, No. XI. p. 30.
Frazier,	1882.	The American Journal of Science. Vol. XXIV. p. 439.

(Physical and Chemical).

Rose and Riess,		Schriften Akad. Berlin. LIX. p. 375.
Rammelsberg,	1875.	Handbuch der Mineralchemie, p. 544.

The above list includes all publications relating to axinite which contain original crystallographic, physical and chemical work.

The names of many other works are omitted, which only contain information compiled from earlier sources, or which merely mention a new locality where this mineral has been found.

The four most important and comprehensive works are those by Neumann, Des Cloizeaux, Vom Rath and Schrauf.

The valuable work by Phillips in 1823, with record of six new planes and five doubtful or vicinal faces, is entirely ignored by Neumann, who does not quote his work, and even Miller, in 1852, also omits the face

		Haüy.	Phillips.	Neumann.	Miller.	Des Cloiz.	Vom Rath.	Schrauf.	Discoverer.
v	100	*T*	*K*	*v*	*v*	g_1	*v*	*M*	Haüy.
p	010	*P*	*M*	*P*	*p*	*m*	*P*	*c*	,,
m	001	*M*	f_3	*M*	*m*	c_1	*m*	*m*	,,
x	111	*x*	d_1	*x*	*x*	i_1	*x*	*x*	,,
c	$1\bar{1}1$			*c*	*c*	*z*	*c*	*Y*	Neumann.
n	$1\bar{1}\bar{1}$	*n*	c	*n*	*n*	e_1	*n*	*n*	Haüy.
q	$2\bar{1}1$			*m*	*q*	*δ*	*q*	*q*	Neumann.
s	121	*s*	*h*	*s*	*s*	*s*	*s*	*s*	Haüy.
σ	$1\bar{2}1$							*σ*	Schrauf.
d	$\bar{1}\bar{2}\bar{1}$						*d*	*d*	Vom Rath.
o	$1\bar{1}2$		d_3	*o*	*o*	*x*	*o*	*o*	Phillips.
δ	$1\bar{1}\bar{2}$						*δ*	*δ*	Vom Rath.
i	131		a_2	*σ*	*i*	o_1	*i*	*i*	Phillips.
ψ	$1\bar{1}3$							*ψ*	Schrauf.
k	$\bar{2}2\bar{1}$						*k*	*k*	Vom Rath.
u	110	*u*	*T*	*u*	*u*	*t*	*u*	*u*	Haüy.
w	$1\bar{1}0$		*k′*	*w*	*w*	g_2	*w*	*w*	Phillips.
$h_{\frac{9}{2}}$	9 11 0					$h_{\frac{9}{2}}$	$h_{\frac{9}{2}}$	*K*	Des Cloizeaux.
α	340						*α*	*α*	Vom Rath.
h_2	230					h_2	h_2	*H*	Des Cloizeaux.
β	350						*β*	*β*	Vom Rath.
l	120	*l*		*l*	*l*	*h′*	*l*	*l*	Haüy.
h	130						*h*	*h*	Vom Rath.
y	101		d_2	*y*	*y*	*γ*	*y*	*a*	Phillips.
b	$10\bar{1}$						*b*	*b*	Vom Rath.
μ	$20\bar{1}$								Hessenberg.
f	102					*β*	*f*	*f*	Des Cloizeaux.
g	103						*g*	*g*	Vom Rath.
r	011	*r*	*P*	*r*	*r*	*p*	*r*	*r*	Haüy.
e	$01\bar{1}$		f_2	r_1	*e*	$c_{\frac{1}{2}}$	*e*	*e*	Phillips.
φ	031								Hessenberg.
π	021							*π*	Schrauf.
c_5	045		*f′*			c_5		*L*	Phillips.
z	012	*z*			*z*	e_2	*z*	*z*	Haüy.
t	$2\bar{3}\bar{1}$						*t*	*t*	Vom Rath.
ε	$1\bar{3}\bar{2}$								Websky.
ρ	$2\bar{3}1$								Schrauf.
η	$13\ \overline{46}\ \overline{11}$						*η*	*η*	Vom Rath.
θ	$3\bar{1}\bar{2}$						*θ*	*θ*	,,
ζ	$2\bar{1}5$						*ζ*	*ζ*	,,
ξ	$1\bar{6}\bar{3}$							*ξ*	Schrauf.
τ	$1\bar{8}\bar{3}$							*τ*	,,

{045}, merely reproducing in his Mineralogy (Brooke and Miller) Neumann's results in Millerian symbols. The plane *f* {045}, discovered by Phillips, omitted by Neumann, reproduced by Des Cloizeaux as c_5, again omitted by Vom Rath, but reinstated by Schrauf as *L*, is present on some of the crystals in the Cambridge Collection.

The number of definite forms at present observed on axinite are 42—

Haüy	discovered	10
Phillips	,,	6
Neumann	,,	2
Des Cloizeaux	,,	3
Vom Rath	,,	12
Schrauf	,,	6
Websky	,,	1
Hessenberg	,,	2
		42

The table on p. 205 gives a complete list of the 42 forms at present established, with the names of their first observers and the letters employed to designate the planes by Haüy, Phillips, Neumann, Miller, Des Cloizeaux, Vom Rath and Schrauf. The form ν {211}, given by Frazier, is omitted, as it is undoubtedly a mistake.

Doubtful Faces.

The following measurements were obtained by Phillips from the five vicinal or doubtful faces, i_1, i_2, i_4, i_5 in zone *pu*:—

$$\begin{cases} pi_1 = 0°40' \\ pi_2 = 5°20' \\ pi_4 = 37°32' \\ pi_5 = 41°50' \end{cases}$$

Also a_1 1° from *p* and 46°35′ from *r*.

Hessenberg, page 28 *Mineral. Not.* V. 1863, describes a doubtful face he calls β (056) on a crystal from Scopi.

Vom Rath, on p. 250 of his Memoir, describes a dull face on a crystal from Botallack, which he calls λ, lying between *w* and *q*, and probably truncating the edge between them.

Websky describes five doubtful or vicinal faces lying between *p* and *r*- viz. π_α, π_β, π_γ, π_δ, π_ϵ, on crystals from Striegau, in Silesia.

$$\begin{cases} r\ \pi_\alpha = 20°46' \\ r\ \pi_\beta = 19°25' \\ r\ \pi_\gamma = 10°21' \\ r\ \pi_\delta = 4°53' \\ r\ \pi_\epsilon = 4°9' \end{cases}$$

Elements.

It has appeared best for the practical value of this paper to choose such elements as most nearly approach the mean values of measurements obtained from crystals from different localities, instead of giving different elements for different localities; and these seem to be best obtained from the theoretical angles calculated by Vom Rath. Miller's elements have therefore been discarded, but his mode of projection and the faces he chose for his 100, 010, 001, 111 planes have been retained (see Fig. 1, Pl. V.). Schrauf, desiring to contrast axinite with sphene, has chosen different values for his elements and different axial planes, also a different position for his crystal, but since they agree less closely with the mean values found by other observers, and depict less clearly the habit of the crystal, they have not been adopted. He makes a mistake in his stereographic projection in the zone *Mc*. He places the planes $l, h_2, h\frac{9}{2}, \beta, a, \nu$, in this order instead of $l, \beta, h_2, a, h\frac{9}{2}, u$; and also transforms Vom Rath's indices of the plane $h\frac{9}{2}$ into 779 instead of 14 14 7.

$$
\begin{aligned}
011 &: 010 = 45°15' \\
001 &: 011 = 44°40\tfrac{1}{2}' \\
101 &: 001 = 56°58' \\
100 &: 101 = 40°52' \\
100 &: 010 = 77°15\tfrac{1}{2}'
\end{aligned}
$$

Combinations.

The following is a list of the faces which have been found on crystals from the undermentioned localities. The usual prominent faces are printed in thicker type.

Botallack.—**p** ϕ **r** *z* **m**, *l u v w*, *s* **x** *y c*, *g* μ *b*, *o n*, *d*. (Vom Rath, Fig. 17.) See Fig. 3, Pl. V.

Belstone.—**p r** *x*, *l o v*, *s*, *c*.

Dauphiné.—*e* **p r** *z* **m**, *l* β $h\frac{9}{2}$ *u a v w*, *i* **s** *x y*, *f*, *o*, *g*, *k*, *d*, ξ, *t*. (Vom Rath, Fig. 18.) See Fig. 4, Pl. V.

Baveno, and Oisans.—**p r**, *l* **u** *v x n*. (Strüver.)

Santa Maria.—**p r**, **u** *v w*, *s x* **y**, *o*.

Striegau.—**p** π **r** *m*, *l u w*, *s* **x**, *f*. (Websky, Fig. 3B.) See Fig. 8, Pl. V.

Scopi.—**p r** *m*, β **u** *v* **w**, *s x* **y**, *t*, *n*. (Hessenberg.)

Hartz.—**p r**, **l u** *v*, **s x**, *c*.

Poloma.—*e* **p** ϕ **r** *z m*, **l u** *v w*, *s y c* σ, *o n*, ρ, *t*, *d*. (Schrauf, Fig. 19.) See Fig. 6, Pl. V.

Lake Onega.—*e* **p** π **r** *m*, *h l* **u** *v*, *s x y*, ξ, *r*. (Schrauf, Fig. 20.) See Fig. 7, Pl. V.

Nordmarken.—**p r** *m*, **l u**, *s y*, *f*, *g*.

Filipstad, Wermland.—**p r** *m*, **s u**.

Kongsberg.—p *r z m*, *l* u *v*, *s x y*, *o*, *n d*. (Vom Rath.)
Pyrenees.—p *r*, l u *v*, *s x*. (Schrauf.)
Bethlehem.—*e* p ϕ r z *m*, *l* u *v* w, s *x y c* σ, *d m b*, δ *o*. (Frazier, Fig. 2.) See Fig. 5, Pl. V.

The following is a list of calculated angles :—

$ep = 45^\circ 19'$
$p\phi = 18^\circ 36'$
$\phi\pi = 8^\circ 11'$
$\pi r = 18^\circ 27'$
$rc_5 = 6^\circ 19'$
$c_5 z = 12^\circ 2'$
$zm = 26^\circ 21'$
$me' = 44^\circ 45'$

$eh = 46^\circ 13'$
$hs = 22^\circ$
$sg = 57^\circ 29'$
$ge' = 54^\circ 18'$

$el = 48^\circ 25'$
$lx = 32^\circ 30'$
$xf = 38^\circ 40'$
$f\zeta = 13^\circ 23'$
$\zeta\psi = 9^\circ 3'$
$\psi e' = 37^\circ 59'$

$eu = 55^\circ 9'$
$uy = 49^\circ 40'$
$yo = 35^\circ 58'$
$oe' = 39^\circ 13'$

$ev = 75^\circ 24'$
$vq = 31^\circ 39'$
$qc = 24^\circ 6'$
$ce' = 48^\circ 51'$

$eb = 53^\circ 9'$
$b\theta = 14^\circ 33'$
$\theta w = 37^\circ 12'$
$w\rho = 22^\circ 48'$
$\rho\sigma = 14^\circ 15'$
$\sigma e' = 37^\circ 54'$

$pb = 80^\circ 39'$
$bn = 31^\circ 55'$
$nd = 22^\circ 19'$
$dp' = 45^\circ 7'$

$p\mu = 78^\circ 40'$
$\mu k = 38^\circ$
$kt = 13^\circ 49'$
$tp' = 49^\circ 31'$

$ph = 21^\circ 1'$
$hl = 7^\circ 54'$
$l\beta = 3^\circ 58'$
$\beta h_2 = 2^\circ 23'$
$h_2 a = 2^\circ 41'$
$ah_2^9 = 2^\circ 8'$
$h_2^9 u = 4^\circ 24'$
$uv = 32^\circ 47'$
$vw = 42^\circ 15'$
$wp' = 60^\circ 29'$

$pi = 24^\circ 33'$
$is = 8^\circ 45'$
$sx = 16^\circ 7'$
$xy = 29^\circ 48'$
$yc = 36^\circ 11'$
$c\sigma = 23^\circ 27'$
$\sigma p' = 41^\circ 9'$

$pf = 82^\circ 31'$
$fo = 25^\circ 6'$
$op' = 72^\circ 16'$

$\phi s = 30^\circ 58'$
$sw = 86^\circ 48'$
$w\eta = 39^\circ 28'$
$\eta\phi' = 22^\circ 46'$

$\pi i = 39^\circ 52'$
$iu = 19^\circ 44'$
$u\mu = 37^\circ 17'$
$\mu n = 38^\circ 6'$
$n\varepsilon = 28^\circ 2'$
$\epsilon\pi' = 22^\circ 59'$

$\pi s = 27^\circ 34'$
$sv = 54^\circ 17'$
$vk = 44^\circ 45'$
$kd = 21^\circ 13'$
$d\xi = 10^\circ 51'$
$\xi\pi' = 21^\circ 20'$

$\pi x = 39^\circ 35'$
$xw = 80^\circ 9'$
$w\pi' = 60^\circ 20'$

$ri = 36^\circ 29'$
$il = 18^\circ 54'$
$lr' = 124^\circ 37'$

$rs = 36^\circ 25'$
$su = 27^\circ 57'$
$ub = 47^\circ 14'$
$b\delta = 30^\circ 13'$
$\delta r' = 38^\circ 11'$

$rx = 40^\circ 47'$
$xv = 45^\circ 53'$
$vn = 49^\circ 32'$
$nr' = 43^\circ 48'$

$ry = 58^\circ 45'$
$yq = 27^\circ 39'$
$qw = 29^\circ 18'$
$wt = 20^\circ 1'$
$td = 11^\circ 46'$
$d\varepsilon = 22^\circ 5'$
$\varepsilon r' = 10^\circ 26'$

$rf = 47^\circ 40'$
$fc = 39^\circ 14'$
$c\rho = 23^\circ 37'$
$\rho r' = 69^\circ 29$

$rg = 44^\circ 32'$
$go = 25^\circ 16'$
$o\sigma = 35^\circ 52'$
$\sigma\xi = 55^\circ 9'$
$\xi r' = 19^\circ 11'$

$zs = 49^\circ 52'$
$sh_2 = 23^\circ 14'$
$h_2 z' = 106^\circ 54'$

$zx = 48^\circ 11'$
$xb = 74^\circ 15'$
$bz' = 57^\circ 34'$

$zv = 88^\circ 36'$
$v\theta = 27^\circ 39'$
$\theta\delta = 30^\circ 32'$
$\delta z' = 33^\circ 13'$

$zy = 55^\circ 9'$
$gn = 82^\circ 36'$
$nz' = 42^\circ 15'$

$zg = 30^\circ 54'$
$gc = 44^\circ 8'$
$cd = 63^\circ 37'$
$dz' = 41^\circ 21'$

$ms = 72^\circ 12'$
$sl = 21^\circ 37'$
$lm' = 86^\circ 11'$

$mx = 65^\circ 1'$
$xu = 30^\circ 33'$
$um' = 84^\circ 26'$

$mg = 24^\circ 12'$
$gf = 10^\circ 37'$
$fy = 22^\circ 9'$
$yv = 40^\circ 52'$
$v\mu = 20^\circ 9'$
$\mu b = 14^\circ 48'$
$bm' = 47^\circ 13'$

$m\psi = 26^\circ 47'$
$\psi o = 11^\circ 13'$
$oc = 21^\circ 57'$
$cw = 37^\circ 5'$
$wk = 18^\circ 20'$
$kn = 14^\circ 9'$
$n\delta = 13^\circ 48'$
$\delta m' = 36^\circ 41'$

$m\sigma = 68^\circ 36'$
$\sigma\delta = 50^\circ 40'$
$\delta m' = 60^\circ 44'$

$bc = 97^\circ 19'$
$bo = 78^\circ 18'$
$bk = 38^\circ 49'$
$\beta o = 22^\circ 26'$
$cu = 80^\circ 26'$
$\delta v = 58^\circ 51'$
$\eta n = 41^\circ 3'$
$\eta s = 132^\circ 40'$
$\eta v = 80^\circ 2'$
$\eta x = 119^\circ$
$fs = 52^\circ 19'$
$fz = 37^\circ 36'$
$gp = 84^\circ 42'$
$gw = 79^\circ 12'$
$gx = 45^\circ 50'$
$lz = 70^\circ 49'$
$nq = 57^\circ 10'$
$ns = 77^\circ 58'$
$os = 76^\circ 43'$
$ov = 70^\circ 3'$
$ox = 61^\circ 51'$
$oz = 55^\circ 12'$
$qs = 67^\circ 56'$
$qx = 52^\circ 58'$
$st = 69^\circ 35'$
$\tau p = 23^\circ 59'$
$\tau r = 24^\circ 9'$
$\tau y = 75^\circ 10'$
$\xi u = 64^\circ 27'$
$\xi b = 75^\circ 38'$
$\mu q = 47^\circ 46'$
$\mu r = 101^\circ 15'$

The faces in the zone *pv* are often deeply striated parallel to the intersection of *l* and *u*. The faces in the zone *pz* are channelled and striated parallel to the intersections of the planes *p* and *r*. The face *p* often bears crossed striations at an angle of 77°3′ and parallel to the edge *rx* and *xn*. All the faces are more or less rounded.

The face *c* is often dull, and *v* is sometimes rough. The crystals from Botallack and Belstone are grown nearly parallel to the plane *r*, and generally elongated in the direction of the normal to *c*.

Cleavage; *m*, *v* and *w* fair, *r* indistinct and interrupted, traces along *p* and *y*. Fracture; conchoidal to uneven. Brittle. Transparent to translucent on the edges. Lustre; highly vitreous.

Colour; clove-brown of various shades, inclining to plum-blue to pearl grey. It exhibits trichroism. On looking through a crystal in the direction of either optic axis, a dark violet stripe is seen, interrupted at the point occupied by the axis (Miller).

The acute bisectrix is negative, and normal to the plane *x*. The planes of the red and the green axes appear to be orientated nearly identically like those of the mean. The dispersion, scarcely perceptible in oil, is on the contrary very strong in air. $\rho < \nu$.

$2H$ ranges between 82°15′ and 84°50′

$2E$,, ,, 148°53′ and 172°10′

(Des Cloizeaux.)

Hardness; 6·5 to 7. S. G.; 3·29 to 3·30. Crystals from Oisans, analysed by Rammelsberg before calcination, had a density of 3·295, which was reduced after fusion to 2·812. Acquires vitreous electricity by friction. Pyro-electric, the faces *n* contain the antilogous poles and the angles *uxp* and *u′ x′ p′* the analogous poles (Riess and G. Rose). (See Fig. 2, Pl. V.)

Before the blowpipe intumesces and fuses easily to a dark-green glass. With fluor spar and bi-sulphate of potash imparts a green colour to the flame. Hardly acted on by acids. After fusion gelatinises with H Cl.

The following analyses and remarks on the chemical composition are by Rammelsberg—

1. Oisans, Dauphiné.
2. Treseburg, Harz.
3. Berkutzkaja Gora, near Miask.

	1.			3.
	a.	*b.*		
Silica	44·57	43·46	43·73	43·72
Boracic Acid	4·50	5·61	—	—
Alumina	16·37	16·33	15·66	16·92
Sesquiox. of Iron	9·67	2·80	11·94	10·21
Protox. of Iron	—	6·78	—	—
Protox. of Mangan.	2·62	2·62	1·37	1·16
Lime	20·19	20·19	18·90	19·96
Magnesia	1·73	1·73	1·77	2·21
Potash	0·11	0·11	—	—
Water	—	1·45	—	—
	99·76	101·08	94·18	93·37

Rammelsberg considers the water present as water of constitution.

Nos. 2 and 3 have not been examined with regard to the protoxide of iron and the water.

In 1 b :—

$$\begin{array}{ccccccccccc} H, K & : & \overset{II.}{R} & : & (R_2) & : & (B_2) & : & Si & \text{or} & \overset{I.}{R} : \overset{II.}{R} : (R_2) : Si \\ 1 & : & 3 & : & 1 & : & 0{\cdot}45 & : & 4{\cdot}1 & & 1 : 3 : 1{\cdot}45 : 4{\cdot}1 \end{array}$$

that is to say— $1 : 3 : 1{\cdot}5 : 4.$

If one assumes that axinite in reality contains nearly 2 per cent. of water (its determination being very difficult on account of the contemporaneous change of the protoxide of iron into sesquioxide), it is a uni-silicate.

$$\overset{I.}{R}_2\ \overset{II.}{R}_6\ (R_2)_3\ Si_8\ O_{32}$$

in which $\overset{I.}{R}$ contains very little K; $\overset{II.}{R}$ = Mg, Mn, 2 Fe, 8 Ca; $(R_2) = (B_2)$ and 2 (Al_2).

The calculated quantity of boracic acid is 6 per cent. (Rammelsberg.)

Axinite occurs in attached crystals or small masses, sometimes fibrous, usually in veins or beds in granite, gneiss, mica and hornblende schists, clay-slate, diorite and diabase. Commonly associated with quartz, albite, orthoclase, epidote, garnet, asbestos, prehnite, tourmaline, &c.

Localities.

England—*Cornwall.*—In dark clove-brown crystals, sometimes 1¼ inches across, at Botallack Rocks, Roscommon Cliff, Trewellard Cliffs, and Wheal Cock, St. Just; in granite associated with asbestos, epidote, garnet and apatite.

In light grey violet crystals at Boscawen Cliffs, St. Buryan and Lamorna Cove, with epidote, quartz and schorl.

Also at Carharrack, St. Day; Camborne Vean, Camborne; St. Columb;

Trevascus Mine, Gwinear; Wheal Crofty, East Illogan; Lizard; Marazion, Penzance, and in indurated clay-slate at Lostwithiel.

Devonshire.—In dark clove-brown crystals similar to the Botallack ones at Mid-Devon Consols Mine, Belstone, with asbestos, garnet and calcite, also at Sticklepath, Okehampton, Brent Tor, Tavistock.

France.—Most beautiful crystals of a translucent violet-brown colour, sometimes 2 inches across, from Saint Christophe, Oisans, Département de l'Isère, associated with albite, prehnite, quartz and chlorite; at Montanvert, Savoy, and also *Italy*, Baveno.

Switzerland.—At Berg Sella, Saint Gothard; and also at Scopi, near Santa-Maria, Medelser Thal, the Cantons Grisons and Uri.

Germany.—Saxony, Thum, near Ehrenfriedersdorf, with mispickel, blende, pyrrhotine and quartz, also at Schneeberg, Schwarzenberg, Grünstädtel.

In well-developed crystals, from 2 to 10 mm. across, on orthoclase with albite, epidote, quartz and stilbite at Striegau, Silesia, (Websky), *Hartz*, near Heinrichsburg in Selkethal, Falkenstein, Taunus, Treseburg, Bodethal; with asbestos and prehnite, Wormke, near Schierke; with prehnite on greenstone, Samson Mine, Andreasberg.

In small violet-blue crystals with harmotome and epidote at Bergmannstrots.

Austria.—In dark-brown opaque crystals not strongly lustrous, with calcite, apatite, gold, copper pyrites and malachite, on green hornblende schist, at Poloma, near Betler, Hungary (Schrauf), and at Wallamühle, near Röschitz, Moravia; and Gömörer, Hungary; Monzoni, Tyrol.

Russia.—In dark reddish-brown crystals (habit between that of Botallack and Poloma), in amygdaloidal cavities, on Wolf Island, Onega Lake; also at Berkutzkaja Gora, near Miask, Urals.

Sweden.—Similar to Dauphiné crystals with yellow garnet and idocrase at Phipsburg; also with magnetic iron at Nordmark, and Grundsjö Mine, near Filipstad, Wermland.

Norway.—Small crystals with black mica, quartz and native silver in a white laminated calcareous rock, at King Louis Mine, Kongsberg; also with felspar and epidote at Arendal.

Spain.—Upon a gangue of quartz at Mount Ereslids, near Baréges, Pyrenees, and also at Arbizon, Hautes Pyrenees.

United States.—In small colourless to pale brown crystals, sometimes highly brilliant, with asbestos and hornblende, near Bethlehem, Northampton County, Pennsylvania (Frazier); also at Wales, Maine; and Cold Spring, New York.

South America.—With smaltine and grey cobalt at La Bintre Mine, Coquimbo, Chili.