# *The Crystallography of Plagionite: New Crystal Forms on Stephanite, Enargite and Anglesite.*

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## Plagionite.

On the British Museum specimens of plagionite from Wolfsberg, in the Harz, all the well-established crystal forms previously recorded have been detected; these are:—[1]

| | | | | |
|---|---|---|---|---|
| $c\{001\}$ | $a\{100\}$ | $p\{114\}$ | $e\{112\}$ | $n\{111\}$ |
| $x\{221\}$ | $y\{331\}$ | $s\{\bar{1}12\}$ | $d\{041\}$ | |

The doubtful forms $i\{776\}$, $z\{\bar{7}.7.16\}$ and $\delta\{0.10.3\}$ of Luedecke[2] have not been confirmed. In addition to the above, the following new forms have been observed on the Wolfsberg crystals:—

$b\{010\}$[3]. A very small, bright plane on the edge between (221) and $(\bar{2}2\bar{1})$.

$f\{\bar{1}01\}$. A small bright plane, observed on two crystals.

$g\{\bar{2}01\}$. As a narrow bright plane, and also as a large plane rounded with $a$; on three crystals.

$m\{110\}$. Usually as a narrow plane on the edge between the two sets of pyramids; on one crystal with large faces; observed on three crystals.

$l\{223\}$. As a narrow bright plane, or as striæ; on six crystals.

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[1] The letters are those used by Miller (*Min.* 1852, p. 196) and by Goldschmidt (*Index der Krystallformen*, II. p. 479): the parametral plane is that of Goldschmidt, this being the direction of cleavage, and also giving rather simpler indices; other authors have taken $e$ to be $\{111\}$.

[2] *Neues Jahrb. Min.* II. 112, 1883; *cf.* Goldschmidt, *loc. cit.* p. 480.

[3] Sandberger (*Ber. Akad. München*, XXIV. 241, 1894), mentions for crystals from Goldkronach, Bavaria, the form $\infty\breve{P}\infty$; this is, however, probaby a misprint for $\infty\breve{P}\infty$, which is a very common form on plagionite; or, again, $d$ might easily be mistaken for (010) on mere inspection of the crystals.

$h\{\bar{2}23\}$. As a narrow bright plane, or more often as striæ; on one crystal as a large face in the zone $[221, \bar{2}01]$; observed on six crystals.

$t\{\bar{4}45\}$. As a narrow bright plane, or as striæ; on three crystals.

$k\{\bar{1}11\}$. As a narrow bright plane, or as striæ; on three crystals.

Also, doubtful:—

$\{\bar{7}03\}$. As a narrow rounded plane, on one crystal measured to $c$ as 73°54′, calculated 73°43′.

$\{\bar{7}02\}$. As a narrow rounded plane, and as striæ; on two crystals; measured to $c$ as 83°49′, 84¼°; calculated 84°45½′.

$\{\bar{7}01\}$. Due to roundings and striations on $a$; several measurements between 96°8′ and 96°50′; calculated, $c : (\bar{7}01) = 96°12'$, $c : (\bar{1}5.0.2) = 96°57\frac{1}{2}'$.

{4.4.11}. As a narrow bright plane; on two crystals; measured to $c$ as 19°24′, 20°6′; calculated 19°57′ [$c : (225) = 21°36'$].

$\{\bar{1}14\}$. Several bad measurements from striæ at about this position; calculated, $c : (\bar{1}14) = 15°54'$.

$\{\bar{2}25\}$. Only as striæ; measured to $c$, 24°17′, 24°37′, 24¾°, 25°34′, 26°26½′; on four crystals; calculated 25°18′. This is near to Luedecke's $z\{\bar{7}.7.16\}$ or $\{\bar{4}49\}$.

The measurements establishing the more certain forms are:—

| | Observed Mean. | Limits. | No. of Faces. | Calculated (Luedecke). |
|---|---|---|---|---|
| $xb$ | 51° 18′ | — | 1 | 51° 26½′ |
| $ab$ | 90 0 | — | 1 | 90 0 |
| $cf$ | 42 8 | 41° 54′ — 42° 22½′ | 2 | 42 26 |
| $cg$ | 68 43 | 68 6 — 69 7 | 6 | 68 34½ |
| $cm$ | 78 21 | 77½ — 79 16 | 6 | 78 26½ |
| $am$ | 47 44 | 47 39½ — 47 46 | 3 | 47 16 |
| $cl$ | 32 32 | 31 51 — 33 37 | 6 | 32 3½ |
| $ch$ | 40 3 | 38 0 — 42 46 | 9 | 40 6 |
| $ct$ | 46 55 | 46 20 — 47 40 | 4 | 46 18 |
| $ck$ | 54 43 | 52 10 — 56 15 | 5 | 54 6½ |

The striated pyramidal zones usually give a continuous band of reflected images. Numerous measurements from the brighter parts of these bands were rejected, although in some cases they led to definite indices, except when there was a repetition of the same angle several times, or when the reflection was seen to be from a definite face and not from striæ. The forms $e$ $n$ $x$ in the zone of negative pyramids occur as definite faces on nearly all the crystals, but the faces in the zone of

positive pyramids are very badly defined; *s*, for example, being rare as a definite face.

As mentioned by Luedecke[1], there is a frequent oscillation between the basal plane and the pyramids, and, as a result of this, the two faces of the form {001} are rarely parallel. This, in connection with the deep striations, renders the measurements very unsatisfactory—so much so that, although 18 crystals were measured, no attempt has been made to improve on the parameters deduced by Luedecke, which are based on only three measured angles. However, the angle for *am* given above may be taken as fairly accurate, as well as the following angle for *ac*; but, owing to the wide variation in *cn*, not much reliance can be placed on this angle.[2]

| | L. J. Spencer. | | | G. Rose. | Luedecke. | |
|---|---|---|---|---|---|---|
| | Observed. | Limits. | No. of Readings. | Observed. | Observed. | Calculated. |
| *ac* | 72° 28½′ | 72° 3′ — 72° 52′ | 9 | 72° 28′ | 72° 4°½′ | — |
| *cn* | 41 18 | 39 44 — 42 45 | 31 | 41 8 | 41 7 | 41° 26½′ |

The only determination which has been made of the specific gravity of plagionite is that made in 1831 by Zincken, who obtained the value 5·4. The following determinations have been made on Wolfsberg crystals, but they can be only considered approximate owing to the difficulty of separating pure material without destroying the rare crystals.

A group of crystals, with a little "tinder ore" attached, weighing 2·6642 grms., gave sp. gr.=5·57. Crystal fragments and isolated crystals, with a somewhat drusy surface, weighing 0·667 grms., gave sp. gr.=5·47.

Six isolated crystals, some with a drusy surface, weighing 0·4640 grm., gave sp. gr.=5·55.

The mean of these determinations, about 5·5, is thus a little higher than that given by Zincken.

The occurrence of plagionite in the stibnite deposits of Arnsberg, Westphalia, has been recorded by Sandberger,[3] and in his note he mentions that the specimens show some needles having the appearance

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[1] *Loc. cit.*

[2] These angles, $ac=72°28\frac{1}{2}'$, $am=47°44'$, and $cn=41°18'$, give the parameters $a:b:c=1·1538:1:0·8508$.

[3] *Neues Jahrb. Min.* II. 94, 1883. Compare *Ber. Akad. München*, XXIV. 241, 1894, where different symbols for the faces are given.

of federerz ("plumosite"), which he supposes to be Pisani's "heteromorphite." In Pisani's paper,[1] however, there is no mention of needle-shaped crystals,[2] and the mineral he dealt with was without doubt plagionite, as is to be seen from his minute description of the crystals, which are given as being possibly monosymmetric, and are referred to "heteromorphite" as distinct from jamesonite. He distinctly states, however, that the mineral is not plagionite; but this statement was probably influenced by the results of his analyses and by the habit of the crystals. This habit of the crystals, although it is fairly common on the Wolfsberg plagionite, has only been mentioned by Kenngott.[3] Here the pyramid $n\{111\}$ is elongated in the direction of the zone axis $[111,1\bar{1}1]$ and $c$ and $a$ are equally developed, or one is developed to the exclusion of the other.[4]

The British Museum specimens from Arnsberg agree completely with Pisani's description, and the curved, indistinct crystals were found on measurement to be plagionite. One of the three crystals measured showed the forms *c a p e n*.

According to the analysis given by Pisani, however, the composition ($7PbS.4Sb_2S_3$) of the material is much nearer to jamesonite ($2PbS.Sb_2S_3$) than to plagionite ($5PbS.4Sb_2S_3$). It would have been interesting to have had the details of the four analyses (of which the one given is the mean of three) which were made on the crystalline and massive mineral, especially as the various analyses of the Wolfsberg plagionite show very little variation amongst themselves. For these reasons the Arnsberg mineral has come to be mentioned in the text-books under both jamesonite and plagionite. It is to be noted, however, that it is correctly given as plagionite by Kaiser;[5] and in Groth's General-Register to *Zeits. für Kryst.*, Vols. 1—10, the reference here being to the abstract of Pisani's paper.

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[1] *Comptes Rendus*, LXXXIII. 747, 1876.

[2] The abstract of Pisani's paper in the *Neues Jahrb. Min.* 300, 1877, mentions needle-shaped crystals, and it is probably hence that the mistake arose. Koort (*Beitr. z. Kenntn. des Antimonglanzes, Inaug.-Diss.*, Berlin (Freiberg i. B.), 1884, p. 10), mentions acicular and capillary stibnite from this locality.

[3] *Ber. Akad. Wien*, XV. 236, 1855: figs. 5 and 6, plate I.

[4] The figure of a plagionite crystal given in Dana's *Mineralogy*, editions 2 to 5, more or less illustrates this case.

[5] *Zeits. für Kryst.* XXVII. 50, 1896, footnote 2.

## Stephanite.

To the new forms determined by Prof. Miers[1] on the British Museum specimens the following may be added.

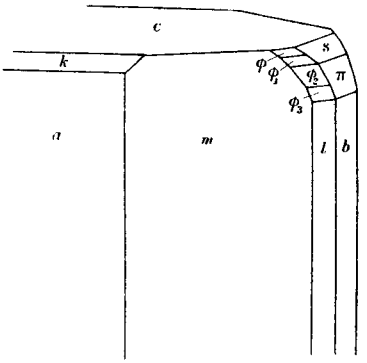
A small bright crystal of stephanite from Chili showed the new forms {551} and {10.10.13} as narrow faces in the zone [001, 110].

| | Measured. | Calculated. |
|---|---|---|
| $c$ : (551) ... ... | 81° 23′ | 81° 10′ |
| $c$ : (10.10.13) ... ... | 44 36 | 44 42 |

The crystal was twinned on $\pi(130)$, and showed twin lamellæ parallel to $m(110)$; the other forms[2] present were $c\,M\,h\,l\,P\,p_2\,r_1\,m\,k\,d\,b$.

## Enargite.[3]

A well-developed, isolated, but singly-terminated, prismatic crystal of enargite from Peru (probably Morococha), with large $a\,m\,c$, narrow $b\,l\,h\,d\,k$, and small $s$, showed the new forms $\pi\{031\}$, $\phi\{132\}$, $\phi_1\{394\}$, $\phi_2\{131\}$ and




$\phi_3\{392\}$. The two quoins of the crystal formed by the basal plane and the prism $m$ (namely by (001) (110) ($\bar{1}10$) and (001) ($1\bar{1}0$) ($\bar{1}\bar{1}0$)) are rounded by these small, rather rough and curved, but bright faces, which lie in the zones $[cb]$ and $[cl]$. The position of $\pi\{031\}$ is fixed by—

| | | Measured. | Calculated. |
|---|---|---|---|
| $c\pi$ | (001) : (031) .. | $68\frac{1}{4}°$ | 68° $8\frac{1}{3}'$ |

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[1] *Zeits. für Kryst.* XVIII. 68, 1891.

[2] The letters for the forms are those used by Dana (*System of Mineralogy*, 6th Ed.); and the above angles are calculated from the parameters he gives.

[3] *cf. Min. Mag.* XI. 69, 1895.

The other faces were then determined by the zones $[m\phi_3\pi\phi_1']$, $[m\phi_2\phi']$, $[m\phi s\kappa']$ and $[a\phi_2{}^3]$, and confirmed by the angular measurements, which, however, in some cases depended on maximum illumination. Another similar crystal, from the same locality, showed the forms *c k μ u a r m l b o*, together with indefinite rounded planes in the zone $[cl]$.

## Anglesite.

A specimen, of unknown locality, recently presented to the Museum by Mr. H. J. Gardiner, F.G.S., shows numerous well-developed crystals of anglesite on a matrix of pyrites, the latter being coated with a thin green layer of sulphate of iron. The crystals are of prismatic habit (in the direction of the zone axis [100]), and are terminated, often at both ends, by an acute pyramid; the only forms present being $o\{011\}$ and the new form $I\{255\}$. The faces are striated parallel to the intersections of the dome and the pyramid; the domal faces are much smoother and brighter than the pyramidal faces. The following measurements were obtained from one crystal:—

| | | Measured. | Calculated (Kokscharov). |
|---|---|---|---|
| $011 : 0\bar{1}1$ | ... | 104° 18′ | 104° 24½′ |
| $011 : 255$ | ... | 21 51<br>21 57<br>22 0 | 21 55⅔ |