Reviews and Notices.

On the effect produced on Mica, Gypsum, and Calcite, by the penetration of a point. (M. Reusch, *Bull. de la Soc. Min. de la France:* t. 2, p. 6, January, 1879.)—On piercing a lamina of mica or gypsum with a rather blunt-pointed needle, regularly arranged cracks are produced, having a simple relation to the crystalline axes. In Siberian mica, *e.g.* three cracks are produced, one parallel to the plane of symmetry, while the traces of the other two are normals to two of the sides of the hexagonal. In gypsum, only one crack appears, spreading a little on each side of the hole formed by the needle: it is parallel, according to M. Reusch, to a face $\alpha\frac{9}{5}$ ($\bar{5}09$) found by M. Hessenberg, in gypsum from Wosenweiter.

If a lamina of rock-salt, gypsum, or mica be placed on a glass plate as support, with or without a layer of indiarubber, and a careful blow made with a small, very blunt-pointed punch, cracks are produced, which are analogous to those made by the needle, but they have not always the same directions. With rock-salt, the cracks are parallel to the faces of the rhombic dodecahedron.

When a lamina of calcite is placed on an india rubber support, and a wooden punch, terminated by a sort of spatula with rounded edges, is so placed on the plate that the plane of the spatula about follows a plane b^1, and a slight pressure employed, a very regular fissure is produced, parallal to $\bar{b}^1$, and crossing the whole flake without breaking it.

Similar fissures are produced with sodic nitrate. Gypsum, in flakes whose cleavage is parallel to the plane of symmetry, splits under the blow of a punch according to a plane $a\frac{9}{5}$ (509,) exactly perpendicular to that plane.

Some additional remarks on the figures produced in gypsum are made by M. E. Jannettaz, whose mode of proceedure avoids any blow. His results have been long published in various journals.

R. C. B.

On the Theory of Hemitropism, and especially that of Disthene and Grey Copper. (M. Mallard, *Ibid.* p. 9.)—It has been observed by vom Rath (in the Zeitschrift of M. Groth,) that besides the two crystalline axes which have been taken by him for the axes of the Z's and Y's, and which form a right angle, there is also another crystalline reticulation (rangée du reseau crystallin,) which is nearly perpendicular to the other two, and normal to the face h^1 (100); that these three crystalline axes are not axes of symmetry: and that disthene is accordingly not rhombic, but that its crystals may be studied as tetartohedrons of the rhombic system.

The author remarks that the crystallography of disthene is of great interest. If we consider the plane parallel to the twin-plane, and which contains molecules whose centres of gravity occupy the intersections of a reticulation whose meshes are parallelograms, these intersections return to the same positions when a semi-revolution is made round an axis normal to the plane and passing through an intersection. The centres of gravity of the molecules which occupy the two reticular planes situate opposite to and respectively belonging to the two parts of the twin crystal, thus hold the same relative position as in the rest of the crystal. From this explanation it appears that the macle requires a twin-plane which is a reticulation with very small meshes, *i.e.*, a plane belonging to one of the simplest forms of the crystal; and a twin axis normal to this plane. The author has shown *(Annales des Mines)* that one of the best known exceptions; the macle of orthose by hemitropism round the vertical edge g^1 h^1 (001,) not perpendicular to a simple form (law of Carlsbad,) and in which the twin-plane is not normal to the twin-axis; is due to the reticulation plane g^1 (011) of orthose evidently having a rectangular or lozenge-shaped mesh: one of the diagonals of the lozenge, or one of the sides of the rectangle having the direction g^1 h^1, brings the intersections of the reticulation almost to the same points of space, Therefore there can be—from the theory of Bravais—a twinning of the orthose round g^1 h^1, and a union of the two parts parallel to the face g^1, which is the definition of hemitropism according to the law of Carlsbad. Moreover if the arrangement of the reticulation of orthose explains the possibility of hemitropism round the vertical edge, it explains also its existence, for the mesh of the plane of symmetry g^1 being a rectangle, the two sides of the rectangle are axes of binary pseudo-symmetry.

The same considerations should apply to disthene, since its reticulation exhibits, like orthose, three evidently rectangular directions. Twin axes can and should obtain in these three directions;—(1) a straight line normal to the face h^1 (100:), (2) a straight line parallel to the intersection of the faces g^1 (010) and h^1 (100:), (3) a straight line parallel to the intersection of the faces p (001) and h^1 (100). In each of these three cases the twin-plane will be parallel to h^1. The first case is strict hemitropism, but the other two are hemitropes not exactly normal to crystalline faces, with twin-planes parallel, not normal, to the twin axis. These three macles have been long known in disthene, and are among the principal characteristics of that substance. Moreover it must be added that vom Rath has observed a new macle of disthene, rarer than the foregoing, about a normal to the face *p*, and lastly a fifth and much rarer hemitropism, about an axis normal to a face $a\frac{3}{8}$ $(\bar{3}08$.

The preceding observations, and those which the author has made previously on the hemitropism of orthose, modify and complete in one important point, the theory of twin phenomena. It is usually said that twinning takes place about an axis normal to a face, which is then the plane of re-union. But twinning can also take place about a parallel to a crystalline axis, if that axis be an axis of binary symmetry of the reticulation of a certain face; it is then a plane of re-union, *parallel* to the twin axis.

For the production of this particular hemitropism, it is enough that the twin axis be an axis of symmetry, or of quasi-symmetry. When the axis is at the same time an axis of symmetry, there is always a more or less intimate penetration of the macled crystals. In the general case, on the contrary, and when the axis of hemitropism is only a quasi-symmetrical axis of the reticulation, there is no physical reason which will permit the two reticulations to interpenetrate, and the plane of reunion is very clearly marked.

A curious example occurs in the macles of grey copper, studied by M. Sadebek. Hemitropism takes place according to two different laws: (1) the twin axis is an octahedral axis (ternary axis;) the plane of union is either a plane a^1 perpendicular to the axis, which seldom occurs, or else a plane a^2 (211) parallel to the axis, which is the general case: (2) one of the crystals has twinned through 90° about the vertical axis; the two crystals penetrate each other, and there is no plane of union. The second law has been thoroughly worked out by Bravais under the title of molecular hemitropism. The first law is easily explained. The ternary axis may be an axis of hemitropism in the ordinary sense, since it is perpendicular to one of the faces of the octahedron, *i.e.* to one of the simplest crystalline planes. This is really what obtains in most holohedral crystals of the regular system. The spinels are almost all thus macled. But one face a^2 (211) is parallel to a diagonal of the cube, and to a diagonal of the faces of a ternary axis and a binary axis: these two lines being perpendicular, the reticulation of the plane a^2 is a rectangle, one side being a ternary axis, which is thus an axis of symmetry. Thus hemitropism can occur about the ternary axis, with the face a^2 as the plane of reunion.

But it may still be asked why, whilst holohedral crystals, as spinel, take as their twin-plane the face of the octahedron, hemihedral crystals, such as grey copper, (*Fahlerz*) take for twin-plane the face a^2, preserving the same twin-axis. To find the reason of this difference, it must be noticed that in holohedral crystals there is symmetry in the crystalline structures on each side of the twin-plane. If P is a face belonging to the portion of the crystal which is supposed to be fixed, and P' a parallel to it; after the hemitropism, P' comes to a position symmetrical with P as regards the plane normal to the twin-axis. In these tetrahedral crystals, the face P has no longer its parallel, and if hemitropism takes place with a twin-plane normal to the twin-axis, the two portions of the crystal would no longer be symmetrical with respect to this plane. If on the contrary hemitropism takes place with a twin-plane a^2, it is obvious that the two portions are symmetrical as regards this plan. In fact the twin-axis is contained in a plane of symmetry which is common, after rotation, to the two parts of the crystal. Therefore the two portions will, after rotation, be symmetrical, with respect to a plane passing through the axis and normal to the plane of common symmetry. But this plane passing through a ternary and a binary axis, is a plane a^2.

It is evident then that if, of the two possible methods of hemitropism about the tenary axis, the tetrahedral crystals solely adopt that one whose twin-plane is a^2, it is because it is the only one which makes the twin-plane a plane of symmetry.

R. C. B.

Note on the Titaniferous Peridot of Zermatt. (M. A. DAMOUR, *Ibid*, p. 15.)—Occurs embedded in veins of calc-spar traversing the large blocks of talcose schist scattered over the southern moraine of the glacier of Findelen, near Zermatt in Valais. As in the titaniferous magnesian silicate from Pfunders in Tyrol, this peridot is of a reddish colour, like Almandine Garnet, for which it might be mistaken. Powder orange-coloured. Transparent in thin slices, and shows a decided dichroism under the polarising microscope. Its form is derived from the right rhomboidal prism. Hardness between felspar and quartz. Density=3·27. On the application of heat a very small quantity of water is disengaged, without change of colour. Infusible B.B., but blackens, and loses its transparency. Powdered and treated with hydrochloric acid, is decomposed: a yellowish powder (titanic acid) remains. On evaporation, the liquid forms a jelly. Analysis as follows, at (*a*,) to which is added the analysis of the similar mineral from Pfunders (*b*)

	b	Oxygen.		*a*
Silica	36·14	19·27	21·68	36·30
Titanic acid	6·10	2·41		5·30
Magnesia	48·31	19·09	20·67	49·65
Oxide of iron	6·89	1·53		6·00
Ditto manganese	0·19	0·05		0·60
Water & volatile matter	2·23			1·75
	99·86			99·60

The oxygen ratio approaches therefore 1 : 1, which is that found in peridot-olivine.

From its physical characters and constituent elements, this mineral seems to deserve a distinct place among the peridots, and the name Titan-olivine is proposed.

R. C. B.

Mechanical separation of the various Minerals of Rocks. (M. J. Thoulet. *Ibid*, p. 17.) The author makes use of Sonstadt's solution of mercuric iodide in potassic iodide, the density of the liquid being reduced as may be desired by the addition of water. Illustrations of his apparatus are given, and a description of the method of using it. (Compare *Church Min. Mag.* Vol. 1, p. 23.)

R. C. B.

Anatase, from Diamantino (Brazil). (M. E. Bertrand. *Ibid.* No. 2, Feb., p. 30)—These crystals exhibit only the octahedral faces b^2 (114): on fracture they were found to be almost entirely converted into needles of rutile: there were two very clear and brilliant cleavages, making an angle of 136°36′, a characteristic of the cleavages b^1 (112) of Anatase. This confirms Damour's observation, that the crystals known as "Captivo di cobre," are pseudomorphs of anatase in rutile. Specimens crystallographically identical, *i.e.* having only the faces b^2, come from Binnen in Valais, these are usually called Wisérine.

R. C. B.

Pyroelectricity of Topaz, Blende, and Quartz. (C. Friedel. *Ibid.*, p. 31.) —The author makes his observations on a crystal whilst it is being warmed by a heated hemisphere of metal, which is placed over it, instead of on a previously warmed crystal during its cooling. With topaz he finds that a pyro-electrical axis exists perpendicular to the cleavage, and therefore coinciding with the axis of hemimorphism shown by the hemihedral faces. His observations appear to be at variance with those of Ries and Rose, according to whom there exists a series of central analogous poles along the axis of the crystal, and two series of analogous poles on the obtuse edges of the prism, but possibly their experiments were made on imperfectly homogeneous crystals, a condition often exhibited by topaz. Blende from Europa Point, in large slices cut perpendicular to a diagonal of the primitive cube, gives electrical tensions of contrary sign with the two opposite faces: the diagonals of the cube are therefore pyroelectrical axes. M. Hankel found that during the cooling of right-handed quartz, a negative tension was exhibited on the middle and left side of the faces *p* (the upper part of the crystal being considered), and on the right side a feebly positive or negative tension, or none at all. The faces $e\frac{1}{2}$ exhibit an analogous electricity, positive being replaced with negative. The prismatic faces are divided into two portions of opposite electricities by a diagonal going from the right-hand above to the left-hand below; the part adjacent to the faces *p* is negative: that adjacent to $e\frac{1}{2}$ is positive.

The author finds that the alternate edges of simple crystals are of opposite sign, and are the same in their whole extent. The edges of the rhombohedral faces always gave a positive tension on contact with a warmed proof plane; the opposite edges gave a negative tension. The horizontal axes of the trigonohedron, *i.e.* the diagonals of the base of the hexagonal prism of quartz, are therefore axes of pyroelectricity. The two extremities of the principal axes of the crystal present no electrical difference.

On Chromite.—(M. J. THOULET. *Ibid.* p. 34.)—This mineral is transparent when cut into thin slices, like the ordinary rock-sections for the microscope. With transmitted light its tint is yellow, blended with red; it often shows more or less perfect sections of octahedra, and many straight or curved fractures filled with the surrounding rock, sometimes serpentinous, as in the chromite from Röros in Norway, sometimes calcareous, as in that from Negropont. The sides of the crystals lining these fissures are frequently impregnated to a certain depth with oxide of iron, giving rise to a dark, sometimes black color. Under reflected light, it has a violet-rose or greyish colour, while the spots impregnated with iron have their characteristic blue metallic reflection. This mineral is very slowly attacked by hydrochloric acid when powdered. From the result of actual experiments, it seems that it is irregularly attacked, owing to the separation of some elements in preference to others. Chromate of iron from Negropont, purified as much as possible from foreign matter, after a digestion for three weeks in hot hydrochloric acid, gave the following composition on analysis—

Sesquioxide of chromium	67·0
Magnesia	·4
Alumina	16·8
Protoxide of iron	19·9
	104·1

Chromite belongs to the group of spinels, where the relation between the oxygen of the base and that of the acid is 1:3; but in this case, the relation is 1:6·3, and it is evident that the mineral has been attacked by the acid. Another specimen from Baltimore gave 38 to 40 per cent. of sesquioxide of chromium. M. Fischer, of Fribourg, has already observed this admixture of oxide of iron. In the specimen studied by the author, the particles, notwithstanding their long digestion, when they were quite transparent under the microscope, still adhered to the magnet in an evident though feeble manner.

The index of refraction was obtained by placing the previously polished slice vertically in the centre of a very correct Babinet's goniometer, furnished with an apparatus capable of making a series of horizontal, vertical, and rotary motions. On the plate was directed a pencil of monochromatic light, polarised perpendicular to the plane of incidence, having traversed a Nicol with the smaller diagonal horizontal. The pencil, after reflection, is received in a microscope provided with a Nicol analyser. Examined in this manner, some substances give a total extinction, or nearly so (*e.g.*, specular iron, chromite, titanic iron, oxide of iron, &c.); others never extinguish, but reduce the brilliancy (pyrites, mispickel, galena, &c.) The former exhibit, after reflection, rectilinear, the latter an elliptical polarisation. The angles of incidence which produce either a complete extinction or a diminution of brightness vary sufficiently in the above minerals to constitute specific characters for the recognition of each. Now in transparent substances the tangent of the angle of incidence at which extinction takes place is equal to the index of refraction. The chromite gave an extinction at an angle of 64° 30′: hence its index=2·0965.

R. C. B.

On the resistance to change offered by the faces of Crystals in their Mother-Liquor.—(M. Lecoq de Boisbaudran. *Ibid.* p. 37.)—The author finds from many experiments,

(1.) That different isomorphous crystals are not equally acted upon by a solution of one of them.

(2.) An extremely small variation in the concentration of the solution does not cause a sudden transition from a state of very slow solution of crystalline surface, to that of a very slow deposition, but that each face remains intact, without loss or gain, in a mother-liquor whose density varies within certain limits, of small extent it is true, but still easily observable.

(3.) This resistance to change varies for each system of faces, so that a change in the external conditions (such as an alteration in the composition of the liquid, in the temperature, &c.) very often changes the relative resistances of two given systems of faces.

(4.) A mobile equilibrium does not exist between a crystalline face and its mother-liquor; a continual change of molecules does not obtain, but there is either a continuous erosion or deposition, or else—between the limits of resistance—neither.

Great precautions were taken, the experiments being conducted in a deep vault under a rock, closed with double doors.

R. C. B.

Hemihedral Forms of Alums.—(By the same. *Ibid.* p. 41.)—The author obtained an octahedron of alum with four smooth faces and four rugose, representing the union of two inverted tetrahedra. It had been obtained by immersing for some hours an octahedron of potash-chrome-alum in a slightly supersaturated solution of basic alumino-ammonium alum, giving cubes on crystallisation.

R. C. B.

Retinite, from Russia.—(M. F. PISANI. *Ibid.* p. 42.)—Under the name of manganese garnet, the author had a large specimen of somewhat testaceous structure, and in some measure polished: its colour was like that of a garnet, but its density was less, and it swelled up greatly before the blowpipe, becoming white before melting.

Density = 2·31. On analysis it gave:—

Silica..	67·50
Alumina	16·34
Ferric oxide	1·16
Lime	2·20
Soda	3·92
Potash	3·88
Loss on ignition	5·90
	100·90

The somewhat testaceous structure of this specimen connects it with perlite, but its composition is rather that of a retinite.

R. C. B.

Wagnerite from Bamle. (By the same. *Ibid.* p. 43.) The name Kjérulfine has been given to a fluo-phosphate of magnesia, containing much lime, from Bamle, in Norway. Under the name of "crystallised Kjérulfine" the author had received large crystals, up to many kilograms in weight, in rhomboidal prisms of 122°. The interior was sometimes in great part homogeneous, composed of a yellow vitreous substance, which is almost pure Wagnerite, and sometimes traversed by whitish veins, containing much lime (mixture of apatite), sometimes almost entirely formed of a whitish or rosy matter, which is principally apatite. Some crystals, yellow inside, are enclosed in a white stony crust of apatite. Hence it appears that the crystals of Wagnerite from Bamle are frequently pseudomorphs. Density = 3·12.

The analysis of this Wagnerite gave:—

Magnesia	34·7
Lime	3·1
Phosphoric acid	43·7
Magnesium	6·8
Fluorine	10·7
Residue	0 9
	99·9

These numbers agree with the usual formula of Wagnerite, and prove that Kjérulfine is not a particular species, but a Wagnerite. Moreover the prism of these crystals is the same as the derived prism $g^3 = (210)$ prevailing in the Wagnerite from Werfen in Saltzburg, where this mineral was first found.

R. C. B.

Occurrence of Gold in certain Minerals of the United States.—(M. M. CHAPER. *Ibid.* p. 44.) A discussion on the occurrence of gold in copper and iron-pyrites, and as telluride.

R. C. B.

Crystalline form of Ferromanganese.—(M. E. MALLARD. *Ibid.* p. 47.) The advantage in using spiegeleisen in the Bessemer process having been attributed to the manganese, it was sought to increase the proportion of this metal. Under the name of ferromanganese certain crystalline products are prepared, containing from 11 to 85 per cent. of manganese.

From the examination of two excellent sets of specimens in the École des Mines, the author finds that with a proportion of from 11 to 52 or 55 per cent. of manganese, the substance retains the same crystalline form, that of a prism of 112° 33′, modified by tangent faces on the acute angles of the prism. If the prism be designated by *m* (110), the modifying faces will be indicated by g^1 (100), and these last are usually very much developed. Between 52 and 55 per cent. of manganese, the crystalline form undergoes a sudden change. The structure, till now decidedly lamellar, becomes rod-like and cylindrical; the small parallel rods are hexagonal prisms with faces forming angles of about 120°, without clear terminations. They are very difficult to measure, the faces being slightly rounded do not always give clear images. The results of two measures made on relatively very good specimens are as follows:—

I.	II.	MEAN.
61° 14′	61° 20′	61° 17′
60 29	59 50(?).. ..	60 9
59 20	60 01	59 40
59 00	59 7	59 4
61 12	60 47	61
58 42	58 57	58 50

However, these measures show that the form is that of a rhombic prism of 120°, modified by the tangent faces g^1.

It is a curious point that with a continually varying chemical composition the crystalline form should change suddenly. Troost and Hautefeuille have shown that iron, manganese, and carbon form real stable chemical combinations in ferromanganese. This fact is also proved by the complete disappearance of magnetism, which takes place with proportions of manganese varying between 20 and 34 per cent. In trying to explain the permanence of the crystalline form with a variable composition, it might at first be thought that the crystals have a composition different from that of the mass whence they separate. But careful analyses made in the laboratory of the École des Mines have shown that the crystals have exactly the same composition as the mass. It must be admitted, then, that these crystals are formed by definite compounds, which unite in variable proportions, and take the crystalline form of the predominating compound.

R. C. B.

Brushes of Polychroic Crystals.—(M. A. BERTIN. *Ibid.*, March, p. 53.) A physico-mathematical essay on the theory of the "brushes" given by biaxal crystals. The substances whose optical deportment is studied are andalusite, cordierite, epidote, mica, axinite, topaz, diopside, acetate of copper, clinochlore, platino-cyanide of yttrium, and "Sel de Senarmont," this last being the salt which de Senarmont prepared in 1854, by colouring nitrate of strontia with logwood.

"Brushes" exhibited by Uniaxal Crystals.—(M. E. BERTRAND. *Ibid,* p. 57.)—The author remarks that up to the present time brushes not only had not been observed in uniaxal crystals, but even their very existence seemed improbable. But they do exist, and in a very plain manner. The platinocyanide of magnesium crystallises in square prisms, and cleaves perpendicular to the optic axis. If a cleavage slice, as thin as possible, be held very close to the eye, a reddish-violet disk on a vermillion ground is observed, with ordinary light. With polarised light, two red brushes on a carmine ground appear, the middle line of the two brushes being perpendicular to the plane of polarisation. This is to be explained by the fact that this substance is very strongly dichroic, and a thin plate parallel to the axis absorbs all colours except red, while a slice perpendicular to the axis allows blue and violet rays in addition to pass. In fact, a somewhat thick slice, perpendicular to the axis, examined with the spectroscope, shows only the extreme red end of the spectrum, but on its thickness being reduced, the violet end appears, and absorption of the intermediate part alone obtains. Consequently if a thin plate of the platinocyanide, perpendicular to the axis, be examined with ordinary light, the rays which arrive at the eye parallel to the axis, or nearly so, will appear violet: but as the rays depart more and more from the normal to the plate, the blue and violet rays will be more and more absorbed, since they depart from the direction of the axis, and also because they traverse a greater thickness. Thus a violet disk on a red ground is seen.

The absorption of the blue and violet rays increases very rapidly in this magnesium salt, with the thickness of the plate and its obliquity to the optic axis; so that with a very small angle these rays are completely absorbed, and a very small disk is seen on a red ground. In tourmaline, a negative crystal, the phenomena are not so apparent, for a much greater obliquity in the ray is required to render the absorption manifest. It also absorbs rays parallel to the axis more than those perpendicular to it, so that it is opaque parallel to the axis, and becomes more transparent as the ray diverges: but as the obliquity of the ray increases, it traverses a greater thickness, so that the absorptive power of the tourmaline is increased.

The phenomenon is visible, with both ordinary and polarised light, in tourmaline, the coloured uniaxal micas, especially in pennine, and generally in all uniaxal dichroic crystals: but to observe it in these crystals, the plate must be inclined successively in different directions, so as to have a sufficient obliquity.

The appearance of brushes with polarised light in the case of the platinocyanide of magnesium is due to the blue rays reaching the eye in a direction oblique to the axis not being absorbed when these rays are in the plane of polarisation, or nearly so; but when perpendicular, or nearly so, to the plane of polarisation, they are completely absorbed. Two red brushes on a violet ground then appear, their middle line being perpendicular to the plane of polarisation.

A similar phenomenon is observed with ordinary light, when a Nicol or a tourmaline is held between the eye and the crystal. If the crystalline plate be placed between two Nicols or parallel tourmalines, the brushes remain the same, but the rings are divided into four parts. If the two Nicols are at right angles, or if the polarising microscope, or the tourmaline forceps, be employed, and the two planes of polarisation are at right angles, the black cross and rings appear on a uniformly red ground, for those blue rays which are not absorbed by the first piece of apparatus, are cut off by the second. On the analyser being turned through a right angle, the field is divided into four sectors, alternately red and violet. Pennine, Biotite, alurgite, &c., examined with the polarising microscope in converging light act similarly, when the analyser is turned.

R. C. B.

On Crystallized Chromate of Baryta.—M. L. BOURGEOIS (*Ibid.* p. 83.) —A mixture of two equivalents of baric chloride, one equivalent of potassic chromate, and one equivalent of sodic chromate, was melted at a bright red heat, and then allowed to cool slowly, when the interior was found to contain some bright prismatic crystals. They were released from their gangue by extracting with boiling water, which dissolved the chlorides. Spec. Grav. = 4·6: colour varies from fine green to sulphur-yellow. Easily dissolve in hydrochloric or nitric acid, giving an orange solution. Concentrated sulphuric acid decomposes the crystals, with formation of baric sulphate and chromic acid. Attacked by potash with difficulty, forming an alkaline chromate and baryta. The crystals contain 60·4 p.c. of baryta, and 39·6 of chromic acid: formula therefore = $BaCrO_4$. They belong to the type of the right prism with rhombic base. Angle of this prism $m = (110)$ is 102° 11′. At the extremities of the prism and on the obtuse angles a, very small faces sometimes occur, containing an angle of about 103° 30′: on the acute angles e there are also small obscure faces, whose angle is about 114°. In baric sulphate, $m\ m = (110)\ (\bar{1}10) = 101^\circ 42'$: $a^2\ a^2$ on $h^1 = (102)\ (10\bar{2}) = 102^\circ 18'$: $e^2\ e^2$ on $g^1 = (201)\ (20\bar{1}) = 113^\circ 26'$. So that the chromate and the sulphate of baryta are isomorphous.

R. C. B.

EPISTILBITE.—(C. A. TENNE.—*Neues Jahrb. für. Min.* 840, 1879.)—The author in a short communication to Prof. C. Klein, states the results of his examination of the specimens of Epistilbite in the collection of the University of Göttingen.

The mineral is oblique, and the crystals hitherto regarded as single are really twins on (100,) which are partly contact and partly penetration twins. The plane of the optic axis lies in the clinopinacoid. The first mean line is inclined to the principal cleavage at an angle from 81° to 81° 30'.

T. D.

A NEW MICROSCOPE FOR PETROLOGY.—At our last meeting a new Microscope was exhibited, which has been specially designed for this study at the request of Mr. Rutley, of H. M. Geological survey, by Mr. Watson, of Pall Mall, who was kind enough to attend and explain its construction. By its arrangements the angles of the most minute crystals may be measured with facility and accuracy. The stage centres by means of two screws so as to revolve truly about the optical axis of any objective, and the arrangement of the polarizing apparatus is such that it may be thrown in and out of the field of view instantly, and the phenomena of plane and circularly polarized light applied to the object under investigation. There is also an arrangement for use as a stauroscope shewing the rings and interference crosses with convergent polarized light. It is furnished with graduations shewing the amount of rotation of the prisms, and also with a wedge of quartz and graduations for measuring depth or thickness as suggested by Mr. Sorby.

These arrangements are made on a plan calculated not to impair the instrument for any of the ordinary purposes of microscopy, and are so far very satisfactory.

I may mention that the diagrams accompanying Dr. Trechmann's paper, which were so highly complimented at the meeting, were (I believe) made with one of these instruments.

J. H. C.

◆

FINNISH MINERALS.—(F. J. Wiik, *Groth. Zeits, für Kryst. und Min. Band II, Heft.* 4 *and* 5)—*Euralite.*—By this name has been distinguished a mineral of secondary formation from the Eura-Kirchspiele in the S.W. district of Finnland. It forms a dark-green apparently dense mass, which in three different sections appear distinctly crystalline under the microscope; with a radiated lamellar texture similar to pyrophyllite. H = 2.5, G = 2·62 : B.B melts readily; disolves perfectly in HCl. An analysis gives the following composition, from which it will be seen the mineral approaches Delessite.

	OBSERVED.	CALCULATED.
SiO_2	33·68	33·45
Al_2O_3	12·15	12·26
Fe_2O_3	6·80	6·37
FeO	15·66	16·59
MgO	17·92	18·43
CaO	1·34	1·43
H_2O	11·49	11·47
	99·04	100·00

It may be expressed by the following formula.

$\mathrm{R}_9 \, \not{\mathrm{R}}_4 \, \mathrm{Si}_4 \, \mathrm{O}_{29} + 8$ aq. in which $\mathrm{R} = \frac{18}{28}$ Mg. $\frac{9}{28}$ Fe and $\frac{1}{28}$ Ca : $\not{\mathrm{R}}$ $\frac{3}{4}$ Al and $\frac{1}{4}$ Fe. Euralite is found in a Diabase, containing olivine, similar to the olivine diabase of Delarne in Sweden. The olivine is distinctly crystalline and contains nearly as much oxyde of iron as that of Asbyn in Sweden, according to Strüve 36·36 p.c. : the Felspar, parallelopipedon in form contains about 13 p.c. CaO : has a sp. gr. = 2·71 and is Labradorite. The Augite which exhibits a dark violet color in section has a sp. gr 3·24 and the following composition SiO_2 50·18, FeO 18·35, MgO 11·31, Ca O 19·49 = 99·33 giving the formula 3 $CaSiO_3$, 3 $MgSiO_3$, $2FeSiO_3$.

Sillimanite (Fibrolite).—In the pegmatite granite of St. Michael, small colorless needle-like crystals are observed without terminations, strongly marked by the repeated combination of the prisms in oscillatory combinations. In polarised light these needles show that they belong to the rhombohedral system ; they have a distinct fracture. Their composition like that of the Xenolite of Peterhof ($Al_2Si_3O_{12}$) gives the following analysis SiO_2 47·33, Al_2O_3 (with a trace of Fe_2O_3) 52·21 = 99·54. At Henriksnäs near Knopis a fibrolitie mineral is also found.

Titanite and *Orthite.*—At Eresby in Pargas-Kirchspiele brown titanite crystals are found in limestone of a rhombohedral-like form. The combination ∞ P, O P (110·001) gives

	OBSERVED.	CALCULATED (*Descl.*)
$110:1\bar{1}0$	66° 25′	66° 29′
110:001	65° 30′	65° 35′

In other limestone deposits of S Finnland (Kyrkslälz Mäntzäla, Karis) occurs a darker titanite of an entirely different form—namely, tabular-like, from the preponderance of an ortho-pinakoid (100) of which the following forms occur,(110), (111), $(11\bar{1})$, (112), $(11\bar{2})$, (001), (010) : hence is assumed the fundamental form of Descloizeaux.

The crystals are often twins according to (100). The following angles have been measured.

	OBSERVED.	CALCULATED.
100 : 110 =	33°	33°15′
100 : 111 =	35	35·5
111 : 1ī1 =	43·20	43·48
111 : 110 =	27·18	27·14
110 : 11ī =	44·–	44·7
111 : 112 =	12·20	12·35

The difference in these two forms, appears to depend on the fact that the one is found in the limestone, whilst the other is surrounded by scapolite. Titanite in fact conducts itself here in a similar way to pyrites, magnetite, garnet, &c., which as isolated crystals in metamorphic schists show themselves in the simplest form, but wherever they occur in mass or in crystalline (eruptive) rocks, take for the most part the more complicated ones. This relation proves clearly the influence of external media upon secondary crystalline forms indicated by Blum, which deserves from both a geological and crystallographic point of view every consideration.

As a further proof of this influence may be cited in addition that in the limestone of Pargas the scapolite crystals have taken principally the deutero-prismatic form whilst in those of the island of Laurin Kari the proto-prismatic form predominates. In the last scapolite referred to we discover small orthitic crystals of a similar tabular form to those of the titanite crystals mentioned above. In a crystalline fragment with the forms (100:210:011, 10ī. 110) the following angular measurements have been made.

	OBSERVED.	CALCULATED. (*Koksch.*)
110 : ī10 =	70°45′	70°48′
100 : 210 =	35·20	35·8
210 : 10ī =	47·6	47·50

Phlogopite.—In the greater number of the lime-deposits of S. Finnland those varieties of mica are found which occupy a position between Biotite and muscovite. Those examined have an angle for the optical axis varying from 10° to 30°, the angle lying in the brachy-diagonal section. They are not as a rule distinctly crystallised; in the Pargas variety alone is there any approximation to a distinct crystalline form, and a considerable crystal from this situation shows a combination of surfaces according to Tschermak's indication: (ī11) (112)–(132)–(023) (021) (001. The crystal is prolonged to a pyramidal surface and exhibits the same monoclinic aspect as the Biotite of Vesuvius, a twin striation similar to that of aragonite passes through the crystal in the direction of a surface (130).

Plagioclase and *Orthoclase.*—Descloizeaux's optical distinction as well as the distinction pointed out by vom Rath in the application of the Pencline law have been applied in the determining the place of these in the series instead of depending as formerly on the sp. gr. The deviations of the anomalous twinning-axes as well as the optical *angle of divergence* at (010) from the angle (001 : 010) are given in degrees, from which it is to be noted that those at the obtuse angles in the direction between the corners 001:010 and 010:110 are marked with −v, those at the acute angle with + v.

	Sp. Gr.	Direction of Anom. Twin-line at 010.		Direction of Opt. Ang. of Diver. at 010.	
Albite, Somero	2·622	20°	(−v)	20°	(−v)
Oligoclase (green), Silbole	2·643	9−7	(−v)	15−10	(−v)
Oligoclase (white), Kimito	2·664	5−4	(−v)	0	
Andesine (red), Slansvik	2·670	0		10	(+v)
Labradorite (green), Logo	2·699	1−2	(+v)	15	(+v)
Anorthite (Lepolite), Logo	2·7−2·8	14−15	(+v)	35−40	(+v)

Therefore the sectional directions of the anomalous twin surfaces (the rhombic section of Rath) and those of the plane of the optical axis uniformly change; so that the plagioclases form in this respect a series which would not be opposed to the theory of Tschermak

Amphibole and *Pyroxene.*—Analyses of these are here given as well as that of a Hypersthenic looking mineral.

	1	2	3
SiO_2	51·88	52·80	51·47
CaO	23·88	19·08	17·51
MgO	17·09	18·31	11·98
FeO	4·32	5·52	15·06
MnO	0·89	——	——
Al_2O_3	1·19	6·10	3·91
	99·25	101·81	99·93

	4	5	6	7
SiO_2	51·74	52·05	49·1	48·64
CaO	1·79	1·35	3·9	3·23
MgO	16·45	17·24	9·4	16·54
FeO	20·35	20·72	28·8	27·42
MnO	0·41	0·26	——	——
Al_2O_3	8·55	9·46	7·3	4·33
	99·29	101·08	98·5	100·16

1 Malacolite, colorless or lightly colored in the limestone of Wampula. —(Suchsdorff).

2 Malacolite, green, from Javastly, sp. gr. = 3·045.—(Rengvist).

3 Augite, green crystal in orthoclase, from Helsingfors.—(Serenius).

4 and 5 Anthophyllite (rhombic) dark brown with a bluish flash of color, sp. gr. 3·022 – 3·045 (4 by Resenius, 5 by R. Stadius).

6 Hornblende, Anthophyllite-like (Monoclinic) fracture in the direction of the prism, cleavage in the orthopinakoid direction. Greenish black without change of color.

7 Hypersthene (?) dark green texture, radiating (F. J. Wiik).

The last named minerals from their distinct cleavages, though very similar to each other, can be clearly made out by optical means, the rhombic anthophyllite conducts itself in polarised light similar to bronzite; the hornblende (No. 6) to diallage, from which it distinguishes itself by its cleavage according to the hornblendic prism.

Similar anthophyllite-like amphiboles occur in small fragments in the Gabbro-like rock of Kurei. They are impregnated by small needle-like microlithes, brown in color and lying in the direction of the vertical axis of the mother mineral, sometimes they are light green and are then usually normal or placed obliquely to that direction. The amount of iron exercises an effect upon the crystallographic direction of the minerals. It may be remarked that the anthophyllites from Stansvik and Kurei are accompanied by an apparently pyrargyrite-like mineral derived from cordierite, epidote. A crystal from Heponselkä exhibited the following surfaces, (001), (100), ($\bar{1}01$), (101), ($\bar{2}01$), ($\bar{2}11$), (110), (210), (320), ($\bar{2}21$), ($\bar{1}11$), (011), ($\bar{3}11$), ($\bar{4}12$). T. A.

THE FORMULAS OF LEPIDOLITE.—In the article by Rammelsberg (*Monats ber. d. Berlin, Akad*, 1878) on the composition of Lepidolite it is stated at the conclusion: "Tschermak has lately employed the analyses made by Berwerth to deduce from them the composition of Lepidolite. As these analyses, with the exception of those of Zinnwald, in relation to the Lithia are incorrect, so also must the formulas founded upon them by Tschermak be so." With reference to this observation Prof. Tschermak makes the following remarks:—

Those who have read my treatise "On the chemical composition of Mica" will have remarked that in it the composition of Lepidolite is not deduced exclusively from Berwerth's analyses, but that I used all recent analyses of potash micas containing Lithia to discover the chemical combinations which occur chiefly in potash micas, whether they abound in or are poor in Lithia. If therefore in one of the analyses used by me a single quantity may not be perfectly correct, it does not follow from this that the assumed formula is so.

As to the disputed estimation of the Lithia in the analyses of the Lepidolite of Paris and Rozena, a certain and unprejudiced judgment will be impossible, until Herr Berwerth has made new analyses.

The objection on the contrary which Rammelsberg raises against the formula supported by me may now be tested, as it rests upon the calculations assumed by him. I cite therefore the values reckoned and found by Rammelsberg, as well as those by myself, and the calculations of Berwerth, all in relation to the lepidolite of Paris.

	Rammelsberg.		T.	Berwerth.	T.
	Calc.	*Found.*	*Calc.*	*Found.*	*Calc.*
Fluorine ..	5·64	5·60	5·53	5·15	5·17
Silicic Acid	50·76	..	50·90	50·39	50·77
Alumina..	28·93	28·43	28·09	28·19	28·01
Potash ..	11·93	10·89	11·65	12·34	12·78
Soda ..	0·88	0·75	0·77	..	..
Lithia ..	4·23	4·04	4·09	5·08	4·08
Water ..	..	1·12	1·30	2·36	1·36
	102·37	..	102·33	103·51	102·17

From this comparison it is apparent that my formula which Rammelsberg declares incorrect, gives quantities which agree better with his analysis than those reckoned according to his formula; farther that my formula gives a percentage of water which is wanting in Rammelsberg, though all appearances point to its being present.

In the same way the data in reference to the lepidolite of Rozena may be added

	Rammelsberg.		T.	Berwerth.	T.
	Calc.	*Found.*	*Calc.*	*Found.*	*Calc.*
Fluorine..	8·13	7·12	6·88	7·88	8·08
Silicic Acid	50·07	51·70	50·72	50·98	51·04
Alumina	28·54	28·03	27·99	27·80	28·17
Potash ..	11·19	10·29	10·95	10·78	10·28
Soda ..	1·21	1·10	1·20	..	..
Lithia ..	4·17	3·75	4·07	5·88	4·92
Water ..	..	0·30	1·08	0.96	0·91
	103·31		102·89	104·28	103·40

Here again is brought out the advantage of my formula, whilst it may be mentioned in reference to the quantity of water that Rammelsberg's method gives no satisfactory estimation.

After having thus shown how unjust is the reproach against my formula, it may again be stated here, viz., 3 $(Si_6, Al_6, K_6, O_{24}) + (Si_{10}, H_8, O_{24})$. With the first constituents it is also to be understood that the isomorphous Natrium and Lithium compounds are to be found. The second of the combinations cited will appear in the fluor-containing potash micas partly in the combination Si_{10}, O_8, Fl_{24}. In the estimations of Rammelsberg's analyses previously communicated as to the lepidolite of Paris the relations of the alkalies assumed are K. Na. Li as 10 : 1 : 11 for those of Rozena 6 : 1 : 7, whilst the relation of the hydrogen and the compound of fluor in both cases is 2 : 3 and 1 : 1. The estimate of Berwerth's analysis is derived from my treatise."

T. A.