Reviews and Notices.

On the Phosphates of Copper (A. SCHRAUF, *Zeitsch. f. Kryst. u. Min. P. Groth. IV*, 1.)

THIS paper consists of observations on the minerals Lunnite, Libethenite, Thrombolite, and Veszelyite.

The Lunnite group.—Hermann and after him Rammelsberg have divided this group into three leading types :—

Dihydrite	$Cu_5 P_2 H_4 O_{12}$
Ehlite	$Cu_5 P_2 H_6 O_{13}$
Phosphorochalcite	$Cu_6 P_2 H_6 O_{14}$

All analyses that have been made up to the present fall within the limits thus assigned, but it is nevertheless difficult to discover from these same analyses which variety predominates in any one locality. Besides this, phosphoric acid or water have in many cases been determined by difference, so that the total error of the analysis is accumulated in the determination of one component; a comparison of the various analyses shews great differences in the amounts found, CuO varying between 66·55% and 71·16%, P_2O_5 between 19·63% and 25·30%, and H_2O between 5·97% and 9·06%.

The morphological observations of Haidinger and of Levy shew similar discrepancies; most modern authors, with the exception of Dufrenoy have, however, ignored those of the latter, in spite of their accuracy.

To facilitate the study of these minerals it is best to unite into one group all those that have similar characteristics (monosymmetrical, $\propto P = 140°$; Sp. gr.=4·2; Cu=67—71%, H_2O=6—9%) as has been done by Dana; it is, however, preferable to restrict his name of "pseudomalachite" to the amorphous varieties, and to substitute Lunnite as the name of the entire group, which embraces amorphous, crystalline, and crystallised varieties, both aggregated and isolated crystals, which two latter are better considered separately.

The author has examined specimens from Rheinbreitbach, Ehl, Libethen, Nischne-Tagilsk, and Kreuszberg (Bohemia), but his observations also agree well with those of Breithaupt and Hermann on the crystallised varieties from Nischne-Tagilsk and Ullersreuth.

Lunnite is apparently monosymmetrical, but the right and left sides of the crystals are not quite geometrically equal. The system of parameters is therefore: Triclinic $\alpha=89°\ 29'.5, \beta=91°\ 0'.5, \gamma=90°\ 39'.5$, $a : b : c = 2{\cdot}8252 : 1 : 1{\cdot}53395$.

The larger crystals from Rheinbreitbach are polysynthetic, consisting of lamellæ lying parallel to 100. Twin crystals occur formed in accordance with the three following laws:—

(1) Twinplane 100. (2) Twinplane 010. (3) Axis of revolution the axis Y; these are the most frequent laws of twinning in the triclinic system.

Isolated Crystals.—The following is one of the numerous sets of measurements given by the author, the crystal (derived from a specimen from Ehl) being similar to the one represented in the figure (plate XIII, fig. II) except that the left side is not in its normal position, but is twinned, so that $\bar{m}_y$, $\bar{\omega}_y$, occur instead of M, Ω.

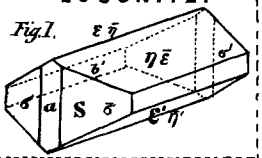
	Observed.	Calculated.		Observed.	Calculated.
a m ..	69° 48′	69° 55′	a m_y ..	69° 55′	69° 55′
a $\bar{\omega}_y$ ..	57° 29′	57° 29′	$\bar{m}_y$ $\bar{\omega}_y$ ..	47° 55′	47° 55′
m $\bar{\omega}_y$	106° 59′	106° 47′	a W ..	20° 21′	20° 19′
a D ..	74° 56′	74° 36′	a d ..	75° circa	73° 31′
D d ..	96° 45′	96° 25′	D $\bar{\omega}_y$ ..	83° 57′	83° 34′
d m ..	37° 10′	37° 28′	D $\bar{m}_y$ ..	38° 40′	38° 17′
angle $\bar{\omega}$ a m	127° 8′	126° 49′	angle $\bar{\omega}$ a d	92° 25′	92° 9′
angle $\bar{\omega}$ a $\bar{m}$	52° 11′	52° 11′	angle $\bar{m}$ a m	179° 19′	179° 0′

This last zone angle (179° 19′) is decisive evidence against the assumption of the monosymmetrical system, which would require that $\bar{m}$ a m should equal 180°. As perfectly similar results have been obtained with crystals from Rheinbreitbach by the author, and, according to the descriptions of Breithaupt and Hermann, also with specimens from Nischne-Tagilsk and Ullersreuth, it is impossible, from its morphological characters, to divide this class into two species.

Aggregated Crystals.—Many of the hemispherical masses of Lunnite from Rheinbreitbach consist of radiating, imperfectly developed crystals, whose free ends shew sharp bright planes on the drusy surface of the hemisphere. The author gives numerous goniometric measurements, from which he concludes that these aggregated crystals only differ from the isolated ones in not shewing the protoprism $\infty P = 141°$ —a difference by no means sufficient to admit of any division into

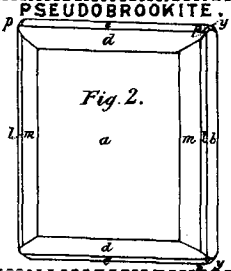
EGGONITE.

Fig. 1.



PSEUDOBROOKITE.

Fig. 2.



SZABOITE.

Fig. 3.

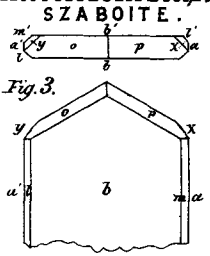


Fig. 4.

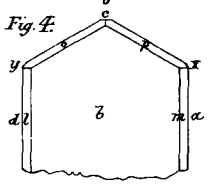
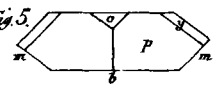
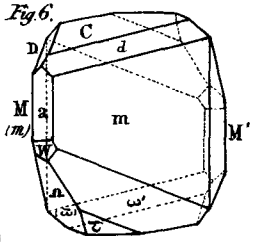


Fig. 5.



LUNNITE.

Fig. 6.



HERRENGRUNDITE.

Fig. 7.

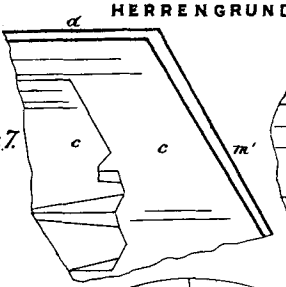


Fig. 8.

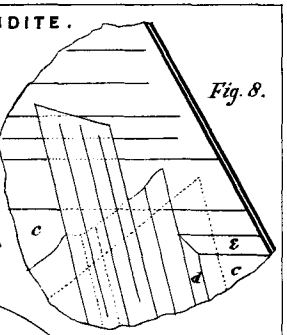


Fig. 9.

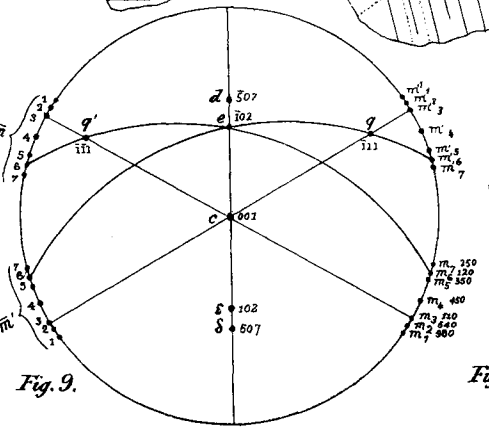
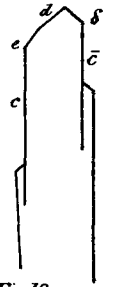


Fig. 10.



CALCITE.

Fig. 11.

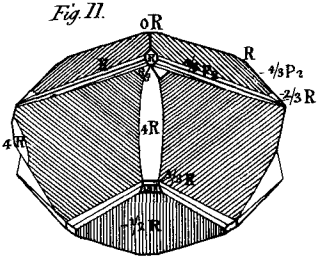


Fig. 12.

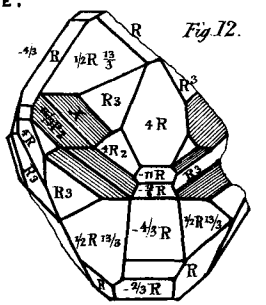
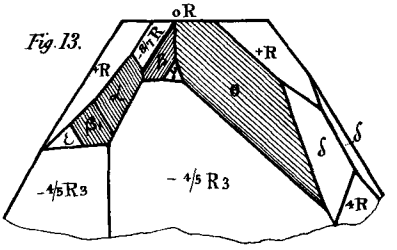


Fig. 13.



LAKE & LAKE, LITH. TRURO.

separate species, more especially as both agree absolutely in optical characters.

Chemical investigations.—The author gives a large number of analyses both by himself and by other authorities, and finally arrives at the following conclusions:—(1) The amorphous masses, reniform, in concentric layers, which so exactly resemble malachite as to entitle them to the name "pseudomalachite," consist of binary or ternary mixtures in various proportions of Phosphorochalcite ($Cu_6 P_2 H_6 O_{14}$), Ehlite ($Cu_5 P_2 H_6 O_{13}$), and Dihydrite ($Cu_5 P_2 H_4 O_{12}$). They lose perceptibly in weight on heating to 200° C, and have a sp. gr. of 4·2. (2.) The greyish-green fibrous radiating masses from Ehl, with H=2 and sp gr.=4·1, consist of superficially decomposed Dihydrite, and contain silicate of copper; the name Ehlite may be given to this variety. (3) As the proportions of water and copper increase, the crystallising power of phosphate of copper appears to decrease. (4) The crystallised varieties of Lunnite contain the smallest proportion of water, have the highest sp. gr. (=4·4) and consist mainly of Dihydrite, shewing no loss of weight on heating to 210° C. The name Dihydrite should be restricted to this variety.

Libethenite.—The hitherto published measurements of the angles of this mineral by Rose, Mohs, Phillips, etc., shew discrepancies to the amount of about 3°, an amount that cannot be due to errors of observation, and must not be ignored; two explanations alone are possible: (1) The so-called Libethenites from different localities may have different compositions. (2) The morphological structure of Libethenite may be more complicated than is generally supposed. The author now proceeds to shew that this second hypothesis is the correct one; from numerous measurements cited in the original paper, he deduces the following system of parameters:

$$a : b : c = 1{\cdot}4255 : 1 : 1{\cdot}34625.\ \beta = 90°\ 56',$$

thus referring Libethenite to the monoclinic system, whilst the peculiar position of the planes is produced by the revolution of m or M into a twin position on the planes 100 or 001—the commonest laws in the monoclinic system.

It thus appears that the earlier observations were correct, but not sufficiently numerous, and their discrepancies can be well explained by the pseudo-symmetry of the mineral. The outlines of a crystal, which may even seem to be homogeneous, are not always produced by particles (planes) in a normal position, but molecules (planes) in twinned positions may take part in the formation of the superficial layer, and lie in it smoothly without producing an entirely new crystal. Thus, positive

planes take the place of negative ones, or *vice versa*, and produce pseudo-symmetry. These multiple twins differ from ordinary polysynthetic twins, in the respect that, in the former, the twinned molecules have not been able to develope themselves fully, but only form portions of the planes; the laws, according to which twinning takes place are, however, the same in both cases, but the number of molecules involved, and the mode in which they are put together, are different. In order to distinguish this variety of twinning produced by the molecular rotations of portions of planes, the author calls this phenomenon "Polydymy."

Thrombolite.—Breithaupt and Plattner described this mineral in 1838 as a Phosphate of Copper. The author finds, however, that it does not contain any phosphoric acid, but has the following composition:

Loss on ignition	(H_2O)	16·56	[Plattner 16·8]
	Cu O	39·44	[Plattner 39·2]
	Fe_2O_3	1·05	
	Sb_2O_5	6·65	
	Sb_2O_3	32·52	42·95
Loss ..	(Sb_2O_3?)	3·78	
		100·00	

This composition corresponds tolerably well with the formula $10\ CuO + 3\ Sb_2O_3 + 19\ H_2O$. The proof of the presence of antimony in thrombolite throws much light upon the remarks of Peters on the paragenesis of this mineral; he states that tetrahedrite embedded in the ore-bearing limestone of Resbanya was changed into amorphous thrombolite. Whilst the formation from tetrahedrite of a phosphate could only have been the consequence of a series of secondary re-actions, simple oxidation would suffice to convert it into Thrombolite, the sulphuric acid thus generated combining with the lime of the matrix.

Veszelyite—a species first established by the author in 1874. The following is a more complete account of the mineral:—Veszelyite forms thin incrustations upon garnet-rock, and upon the brown hæmatite which is a decomposition product of the latter; these incrustations consist of a granular aggregate of imperfectly developed crystals; isolated crystals also occur.

System triclinic; $a : b : c = 0{\cdot}7101 : 1 : 0{\cdot}9134$; $\alpha = 89°31'$, $\beta = 103°50'$, $\gamma = 89°34'$. The prism (110) predominates combined with the doma

(011). Color and streak bluish-green. Hardness 3·5—4 Sp. Gr. 3·531. The following is the analysis :—

CuO	..	37·34
ZnO	..	25·20
P_2O_5	..	9·01
As_2O_5	..	10·41
H_2O	..	17·05
		99·01

Veszelyite therefore consists of

$$\left\{\begin{array}{l} Zn_3As_2O_8 + 3\,Zn(HO)_2 + 3\,H_2O \\ Cu_3P_2O_8 + 3\,Cu(HO)_2 + 3\,H_2O \\ \qquad\qquad 3\,Cu(HO)_2 + 3\,H_2O \end{array}\right\}$$

The mineral occurs at Morawicza in the Banat; it was found by Mr. Veszelyi, after whom it has been named.

H. L.

HERRENGRUNDITE (A BREZINA, *Zeit. fur. Kryst. und Min. III*, 4, *p.* 359.) This is a new basic copper sulphate from Herrengrund in Hungary, occurring in "Grauwacke slate" with malachite and calcite. Crystals as in figs. 7 to 10, plate XIII. H=2·5; composition according to Dr. Berwerth.

SO_3	..	24·62
CuO	..	54·16
CaO	..	2·05
H_2O	..	19·61
		100·44

J. H. C.

CALCITE (J. R. MC D'IRBY, *Zeit. f. Kryst. und Min. III*, 5 *and* 6, *p.* 612.) Some remarkable calcite crystals described by J. R. Mc D'Irby of Lynchburg, Virginia, in his work "on the Crystallography of Calcite (*Inaug. diss. d. Gottingen Univ., Bonn*, 1878) are represented in plate XIII, figs. 11 to 13.

J. H. C.

PSEUDOBROOKITE (A KOCH, *Zeit. f. Kryst. und Min., III*, 3, *p.* 306.)—The figure of this mineral given by Koch is reproduced in Pl. XIII, fig. 2. The composition, &c., was given in the *Mineralogical Magazine*, vol. II, p. 248.

J. H. C.

EGGONITE (A. SCHRAUF, *Zeitschrift f. Kryst. und Min. III*, 4, 352, *fig.* 1, *pl. XIII*) was found upon single crystals of silicate of zinc from Altenberg near Aix-la-Chapelle, formed in cavities, coarsely granular, from ferriferous clay mixed with calamine. The name Eggonite (εγγονος grandchild) indicates that it was observed as third in degree in the series of the natural zinc-cadmium combinations.

Triclinic; a : b : c=1·3360 : 1 : 07989. The axis angle $\beta=90°\ 50'$: Planes observed (010) (02$\bar{3}$) (023) (32$\bar{0}$) (320) (100). Twin formation (010), changes the asymmetry into an apparent monosymmetry. H=4-5; cleavage unknown. Powder shows leaf-like particles. Color light greyish-brown; streak white; imperfect adamantine lustre; translucent to transparent. Before the blowpipe infusible, becoming gray and opaque. With soda carbonate upon charcoal melts to an enamel-like glass, and gives the cadmium incrustation. Zinc incrustation not observed. In HCl and HNO_3, insoluble; or very imperfectly so; with microcosmic salt, gives a *Siliceous* skeleton. Eggonite is therefore essentially a silicate containing cadmium: Morphologically and paragenetically Eggonite stands next to Hopeite.

T. A.

ON SOME METAMORPHIC ROCKS OF THE HIGH ALPS (By DR FR. ROLLE, *Imp. Geolog. Institute of Vienna, Report of Meeting, May* 31, 1879.)—The crystalline and semi-crystalline rocks of the High Alps of the Grisons, Tessin, and Chiavenna are all sedimentary deposits, more or less metamorphosed. The Casanna schists, consisting of quartz and mica, and lying between garnet-bearing mica-schist and "Verrucano," represent the Carboniferous group. The green schists ("Chlorogrisonite") above the "Verrucano" and the Triassic limestones and dolomites, are variable aggregates of plagioclase, epidote, actinolite, magnetite, specular-iron, and cyanite. They are divisible into *Valrheinite* (plagioclase, epidote, chlorite), *Cucalite* (plagioclase, epidote, and a small proportion of actinolite), *Paradiorite* (plagioclase, actinolite, and some epidote), and *Hypholite* (actinolite in prevalence, plagioclase, and magnetite.) The essential components of the grey schists are quartz, mica, and an opaque substance. They probably consist of detrital gneiss and mica-schist, subsequently metamorphosed. The origin of the green schists may have been connected with the eruption of pyroxenic volcanic ash.

COUNT M.

ON SOME SPECIMENS OF NEPHRITE (By DR. FR. BERWERTH, *Imper. Acad. Sciences, Vienna, Report of Meeting, July* 17, 1879.)—Crystalline

portions of a block of New Zealand Nephrite, weighing 123·32 kilogrammes, proved to be identical with *actinolite* both in crystallographic and chemical constitution. The crystals are separately imbedded in compact Nephrite. The largest of them measure five millimeters in length. Under the microscope they offer the same characters as the crystals of actinolite embedded in the talcose and chloritic schists of the Alps. The chemical composition is the same as that of the actinolite of Arendal, analysed by Rammelsberg. It answers to the formula—Si_{20} Fe_2 Ca_5 Mg_{11} H_6 O_{61}.

The compact portion of the block seemed to be a compound of compressed and intricate fibres, including some few scattered crystals of Actinolite. The chemical formula for the compact mass is Si_{10} Fe_2 Ca_5 Mg_{11} H_8 O_{62}. This is the same as that of several fragments of nephrite found in lacustrine habitations. A variety of nephrite, called "Kawakawa" by the New Zealand natives, has been analysed, and its formula ascertained to be Si_{20}, Fe Ca_5 Mg_{12} H_6 O_{61}.

COUNT M.

THE MELAPHYRE OF HALLSTATT, UPPER AUSTRIA (By F. VON HAUER, *Imper. Geolog. Institute, Vienna, Report of Meeting, July* 31, 1879.)—In the winter of 1878 melaphyre was met with in the Salt-mines of Hallstatt. It is dark-green, compact, of amygdaloid structure, and in a state of advanced decomposition. Its cavities and fissures are filled with pellucid rock-salt and some gypsum. Microscopic examination of thin slices shows it to be composed of small crystals of plagioclase, a chloritic mineral, and a small proportion of magnetite, interspersed with larger crystals of plagioclase, decomposed pyroxene, and a substance showing many grey points. In some cases, yellowish-brown, partially decomposed pyroxene is discernible; and the structure of some decomposed portions proves that olivine was present previous to the decomposition. The whole is impregnated with rock-salt and gypsum. Silica occurs in cavities, either amorphous, or as quartz. The results of chemical analysis are:—Substances (1) soluble in water (chloride of sodium and gypsum) 10·90 per cent; (2) soluble in chlorhydric acid, after treatment with water (sesquioxide of iron, alumina, lime, and magnesia,) 35·55 *p.c.*; (3) insoluble in chlorhydric acid (silica, lime, alumina, and magnesia, 47·10 *p.c.*; water and the alkalies (calculated by the difference) 9·45 *p.c.* A direct determination of the silica gave 44·25 p.c., hygrometric water, 1·26 *p.c.*, loss by ignition, 7·45 *p.c.* Another specimen gave 2·54 *p.c.* of chloride of sodium and traces of gypsum.

The melaphyre appears to constitute a *Massif* amidst the saliferous rock, striking S.E.—N.W.: near its south-eastern termination it takes the form of a breccia, with fragments enclosed in the salt-rock. Westward it is separated from the overlaying, feebly saliferous rock, by a seam of gypsum. These melaphyres may be of Triassic age.

COUNT M.

On the Diffusion of Cerium, Lanthanum, and Didymium.—(A communication from Prof. A. Cossa, of Turin.—*Bull. de la Soc. Min. de France*, 4, 1879.) In 1846, Wöhler observed that apatites from Arendal, in Norway, contained 2 to 3 per cent. of a crystallised phosphate of cerium, irregularly distributed in a state of mechanical mixture, and which he called Cryptolite. It may be separated from the apatite by dilute nitric acid, in which it is insoluble. In 1851, Weber found the oxides of cerium and yttrium in apatite from Snarum. In 1872, Church found phosphate of cerium in apatite from Jumilla. The author has analysed fourteen specimens from the most diverse localities, and finds that they all contain phosphates of cerium, lanthanum, and didymium, united molecularly to phosphate of lime, and that cryptolite therefore does not really exist. His observations were made with a small spectroscope, and verified in the case of the apatites from Snarum, Bamle, and Canada, by chemical analysis, the details of which are given. The three apatites just mentioned furnished solutions which exhibited clearly the system of brilliant striæ characteristic of the electric spectrum of lanthanum.

The presence of cerium, didymium, and lanthanum has been found in many apatites which do not exhibit an absorption spectrum, and also in three specimens of limestone, viz.: saccharoid marble from Carrara, a shelly limestone from the province of Avellino, and lastly in a stalactitic deposit in an earthenware pipe leading from a Roman aqueduct near Cividale, in Frioul. These last experiments were made with the greatest precautions on about two kilos. of limestone each time; each kilo. gave about 2 cgrms. of oxalates of cerium, lanthanum, and didymium.

Experiments were made on the Scheelite of Traversella, which contains about 0·22 p.c. of oxides of cerium, lanthanum, and didymium; and on that from Meymac (department of Corrèze), in which the proportion is much less.

The author then describes how he has artificially produced didymiferous Scheelite and crystallised tungstate of didymium. For this purpose amorphous tungstate of lime, obtained by double decomposition, was melted with chloride of sodium, and a small quantity of tungstate of didymium was added, when crystals of Scheelite were obtained, perfectly transparent and spectroscopically identical with crystals from Traversella.

R.C.B.

On the Hemihedral Forms of Alums (M. G. UZIELLI, *ibid.*)—With reference to the previous observations of M. Lecoq de Boisbaudran, the author remarks that, in crystals of chrome alum, striæ occur on the planes perpendicular to the face $a'=(111)$ which lies on the bottom of the vessel, and also on faces symmetrically placed with regard to that face.

If an octahedron rest on one of its faces a', the six oblique faces are inclined to that face; the striæ then appear only on the three faces visible in the perpendicular projection of the crystal on the plane of the face a'. As these three faces belong to a tetrahedron derived from the cube, and the striæ are normals to the edges of the face a', *i.e.* they are in planes perpendicular to the faces of the rhomboidal dodecahedron; the fact can be explained by the ordinary laws of hemimorphism.

At the conclusion of this paper, some remarks are made by M. Lecoq de Boisbaudran, in which he states that he found no striæ in the crystals prepared by himself, but there were four rugose, dotted faces, and four smooth ones. M. Uzielli's striæ have no connection with the internal structure, and they have always a fixed orientation with respect to the lower face of the crystal; so that they are simply furrows cut by currents produced in the liquid by change of density. They follow the direction of gravity, and similar furrows occur also in the erosion of other substances.

R. C. B.

On the Optical Properties of Isomorphous Mixtures (M. G. WYROUBOFF, *ibid.*)—The researches of De Senarmont and Des Cloiseaux have shown that optical isomorphism is quite different from geometrical. The phenomena of isomorphism may be considered under three heads,—geometrical, chemical, and optical,—independent in so far that an identity in each can exist without entailing an identity in the others. Thus regarded, isomorphism ceases to be a general law which must be continually supported with new hypotheses, and becomes a series of special laws.

The author divides those substances which can crystallise together, and produce isomorphous compounds, into three groups:—those which are chemically, geometrically, and optically identical; next those agreeing only in composition and form, and lastly those which are similar in composition, but differ in form and optical deportment. Red light was always employed by the author, in order to eliminate dispersion, and in cases where there was not sufficient transparency, the measurements were made in oil.

Group 1.—Optical properties are numerous and complex: they include the index of refraction (and consequently the angle of the axes in biaxial

bodies), the properties of double refraction and dispersion, and the orientation of the plane of the axes. All these points assist in the determination of species, but, for the present purpose, the first-named has a constant value. The index of refraction and the angle of the axis vary under conditions which are far from being understood—not that they are to be excluded from the conception of optical isomorphism, but they are secondary, the position of the plane of the axes remaining characteristic, and it is to this that attention will be confined. Two substances are selected because they form perfect crystals, and belong to the same series as the very curious double sulphate of soda and potash. The optical axes of the sulphate and the chromate of potash have the same orientation, parallel to $h'=(010)$: there is a difference only in the position of the acute bisector, and in the sign of the double refraction, which in the case of the sulphate is positive, and perpendicular to $p=(001)$, while in the chromate it is negative and perpendicular to $g'=(100)$.

When the two salts crystallise together, 6 p.c. of chromate suffices to alter the optic axes of the sulphate, the obtuse axes of which gradually approach, and when the proportion of chromate reaches 44 p.c., the axes of the pure chromate are obtained. At this point the salt is geometrically still the sulphate; the crystals are mostly combinations of m, e', g', with this last face much developed. With a slight addition, however, the form changes; the face g' disappears, and the faces $e'=(101)$ prevail; the crystals also lose their transparency, and do not regain it till the quantity of sulphate has decreased to 3, or even 2 per cent.

Group 2.—In this case a mixture of the sulphates of potash and ammonia is employed, their form being exactly the same, but the optic axes are differently oriented—parallel to $h'=(010)$, with the positive acute bisector parallel to $p=(001)$, in the former; parallel to $g'=(100)$, with the positive acute bisector perpendicular to h', in the latter. 2 p.c. of sulphate of ammonia suffices to bring the obtuse axes of the sulphate of potash nearer, this effect proceeding regularly at the rate of 4° 40′ for each per cent. of ammonic sulphate, or by 1° 10′ for each thousandth of ammonia. On reaching 18 p. c. (=7 p.c. of NH_4), they cross, and give an almost uniaxal salt. Their plane then becomes parallel to p, and they diverge more and more, proceeding this time more rapidly, at the rate of 6° 30′ for each percentage of sulphate of ammonia. They thus come to form a right angle with about 30 p.c. of sulphate, presenting probably an obtuse bisector, the acute bisector being perpendicular to h'. To attain the optical properties of pure sulphate of ammonia, the axes must again cross, and then diverge in a plane parallel to g'. But the last phases of the transformation are difficult to follow, for when the quantity of sul-

phate of ammonia exceeds 30 p.c., the crystals become small and indistinct, and form complex macles.

Group 3.—To this group belong the mixtures of the sulphates of potash and soda, and of the chromates of the same bases. The two sulphates, chemically isomorphous, are not geometrically so, since the sulphate of potash has (for the prism) an angle of 120° 24′, and that of soda an angle of 129° 20′; the orientation of the optical axes is also different. The same remark applies to the two chromates, except as regards the optical deportment, for that of the chromate of soda is not known. Nothwithstanding this dissimilarity, the two sulphates or the chromates unite in indefinite proportions. It might be said—in accordance with a phenomenon of dimorphism—that sulphate of soda has two forms, one known, the other unknown, and resembling sulphate of potash, as happens with the nitrates of potash and soda. But this hypothesis is based on analogy, not on facts directly observed, dimorphism not having been hitherto observed in sulphate of soda. Moreover a series of facts seem to contradict such a view, for in a mixture of two bodies, of which one is dimorphous, the one form being stable and the other unstable, it is found that one of these forms, generally the more stable, has a great morphogenic power. This happens with the sulphates of iron and of zinc, 20 per cent. of the former being sufficient to give the clinorhombic form to the mixture. The sulphates of iron and of zinc, the sulphates of iron and of magnesia, the nitrates of potash and of soda, are all thus identical. Sulphate of iron which has 70 per cent. of sulphate of zinc is optically, pure sulphate of iron, not only by the position of the plane of its axes, but also by their angle, while sulphate of zinc with 10 per cent. of sulphate of iron is optically pure sulphate of zinc.

Such is not the case with the two sulphates of potash and soda. Intermediate forms exist, but, since rhombohedral crystals have very nearly the same angles as rhombic crystals, there is very little geometrical difference. The double sulphate is however very difficult to study optically; well formed crystals are easily obtained, but they are either too small to be cut into slices, or else are composed of a number variously aggregated. On the other hand fine crystals of the double chromate are readily formed.

R. C. B.

Contributions to the Study of Chemical, Geometrical, and Optical Isomorphism. (M. G. WYROUBOFF, *ibid.* No. 6)—A continuation of the essay on this subject in the April number. The definition of isomorphism arrived at is that bodies are isomorphous when they have similar forms and unite in proportions which are not those of their atomic weights. The author

has endeavoured to prepare mixtures of the chromates of potash and ammonia, by adding chloride of ammonium to potassic chromate, and also by neutralising bichromate of potash. But crystallisation proceeded with difficulty; with 11 to 13 per cent. of chromate of ammonia, the form of the crystals of chromate of potash did not change, but the optic axes diverged. With more ammonia, decided crystals are not obtained; with a still greater quantity—approaching the formula $CrO_4\,K\,(NH_4)$—the crystals are clear and have quite a different appearance, but they are so macled as to be optically useless. From these facts it would appear that the combination belongs to two bodies exhibiting different geometrical forms, like the sulphates of potash and soda; and this is the case, for the chromate of ammonia is geometrically isomorphous with the sulphate of soda, not with the sulphate of ammonia. The chromate of ammonia is easily obtained, in crystals large enough to be cut into plates, by adding excess of ammonia to a hot concentrated solution of the bichromate of ammonia, and then cooling slowly. It is an unstable salt, quickly losing a molecule of ammonia, and becoming a bichromate. The crystals are in long needles, usually terminated at one end only by an obtuse pyramid, and exhibit a form identical with that of the anhydrous sulphate of soda. The combination of the chromate and the sulphate of ammonia takes place with difficulty; small macles are obtained, as in the case of the mixture with chromate of potash. From the geometrical isomorphism of the chromate of ammonia with the sulphate of soda, a combination of the chromates of soda and ammonia was tried, when a double salt with two molecules of water was obtained. The angle of the prism exhibits a striking analogy with that of the anhydrous sulphate of soda, and therefore with that of ammonic chromate. The four salts, the two anhydrous and the two hydrous, are perfectly isomorphous.

R. C. B.

On the Artificial Production of Minerals by Heat. (M. M. FOUQUE and MICHEL-LEVY, *ibid.*)—Experiments based on the consideration of eruptive volcanic matter, were made on the common silicates of volcanic rocks, by first melting the constituents of the silicate, and then lowering the temperature slightly below the fusing point. In this way the following were obtained: albite, oligoclase, labradorite, anorthite, nepheline, leucite, melanite, pleonast, magnetite, pyroxene, melilite. The Leucite exhibited roundish crystals resulting from the combination of the octahedron faces b' (112) with the dioctahedron a_3 (211) of the quadratic system; they had no action on polarised light. Attempts to produce orthose in a similar manner were unsuccessful. By operating with several grammes of material, the authors obtained the following associations, identical with

those ejected by volcanoes:—labradorite with pyroxene and magnetite, and these last two with leucite (leucitite); and nepheline with pleonast and melanite. Many inclusions of gas-bubbles were obtained, especially in the crystals of labradorite, leucite, anorthite, and nepheline, similar in appearance, composition, and form, to those found in eruptive rocks. Negative crystals were abundant; those of anorthite exhibited the faces p (001), g' (010), m (110), t (110), and giving in section regular hexagons or parallelograms.

Some silicates were very refractory: thus black mica, Wernerite, and amphibole could not be obtained. On fusing the constituents of black mica, two substances were obtained, the one orthorhombic, brown, and somewhat dichroic; the other formed very long colourless microliths, strongly birefractive. The constituents of Wernerite (dipyre. 1, 2, 6), mixed with a trace of fluoride of sodium and fused, produced fine crystals of labradorite. Wernerite and amphibole from Odegaard near Bamle (Norway), similarly treated, produced an association of labradorite and pyroxene. A mixture possessing the composition of oligoclase with an excess of one-tenth of alumina gave rise to an association of many crystals of oligoclase, with a few of labradorite.

R. C. B.

An Artificial Crystallised Quartz. (M. M. FRIEDEL and SARASIN, *ibid.*)—Crystals of quartz have already been obtained by de Senarmont, who heated gelatinous silica in hydrochloric acid; by Daubrée, by the action of superheated water on glass; and by Hautefeuille, by heating silica to about 800° with tungstate of soda. The method adopted by the authors is to heat, to a temperature below dull red, a mixture of potash, precipitated alumina, and an excess of gelatinous silica in presence of water. At the expiration of 14 hours in one experiment, and 38 hours in another, nearly the whole of the silica was crystallised. In the first case a number of very small regular crystals were obtained, exhibiting only the hexagonal prism e^2 (10$\bar{1}$0) terminated by the double pyramid p $e^{\frac{1}{2}}$=(10$\bar{1}$1), (01$\bar{1}$1), and acting strongly on polarised light; the second time the crystals were much larger, and accompanied by small crystals connected together in masses and diverging from a central mass whose exterior was covered with hexagonal pyramids. They show all the characters of natural crystals, such as the striæ parallel to the intersections of p and $e^{\frac{1}{2}}$ with e^2, and the unequal development of the faces p and $e^{\frac{1}{2}}$. In an experiment in which somewhat less silica was present, some crystals were of the deformed variety termed *sphalloid* by Haüy. A description of the apparatus employed is appended to the paper.

R. C. B.

On Mallardite. (M. A. CARNOT, *ibid.*)—In the Ecole des Mines are several minerals from Utah, and in one specimen were many fragments of an undescribed species,—a hydrated sulphate of manganese, analogous to that obtained in the laboratory by crystallisation at a low temperature. They were fibrous in structure; hyaline, and colourless, readily soluble in water, and very efflorescent. On heating, much water was given off, and then fumes of sulphuric acid, leaving a reddish-brown residue. Fused with carbonate of soda and nitre, a green mass was obtained, exhibiting the characters of a manganate. An aqueous solution of the mineral gives with basic salts the reaction of a sulphate; with sulphhydrate of ammonia a precipitate is thrown down, rosy, or grey to blackish, according to the greater or less absence of sulphate of iron. The results of two analyses are as follows:—

	I	II	OXYGEN.	
Sulphuric acid	26·0	29·0	17·40	=5·80×3
Protoxide of manganese ..	20·9	23·6	5·31	
Do. iron	0·3	—	—	
Magnesia	1·2	0·6	0·24	=5·75×1
Lime	0·8	0·7	0·20	
Water	36·8	44·5	39·55	=5.65×7
Insoluble residue	14·0	1·6		
	100·0	100·0		

The first was made by M. Rioult, of the Bureau d'essai, the second by the author on a carefully cleaned specimen. Formula=$Mn\,SO_4+7\,H_2O$.

Some minerals are known to contain sulphate of manganese, especially Apjohnite and Dietrichite, which are double sulphates of alumina and manganese, Fauserite (double sulphate of manganese and magnesia), and Szmikite, a sulphate of manganese with one equivalent of water. The mineral in question is a distinct and well-defined species, and the name Mallardite is proposed for it, after M. Mallard, the president of the French Mineralogical Society, by whom it is added that the mineral appears in the form of very transparent parallel fibres; those which could be isolated exhibit the prism *m* (110) with four faces modified by the faces *g'* (010); its crystallisation being probably oblique.

R. C. B.

An Artificial Dioxide of Manganese. (M. A. GORGEN, *ibid.* No. 5, May, 1879.)—On heating crystallised nitrate of manganese, it first melts, and then boils; decomposes at about 135°, and gives off nitrous fumes, leaving the pure dioxide. To obtain it in crystals the author decomposes the salt very slowly at a temperature of 155° to 162°, for 24 hours, in an oil or

paraffin bath. The binoxide thus produced has the same properties as polianite, as to density, hardness, colour and crystallisation.

R. C. B.

On the Production of Caystallized Chromates. (M. L. BOURGEOIS, *ibid.*) —By a procedure similar to that adopted in his preparation of chromate of barium, the author has obtained the chromates of strontian and lime. The former presented fine yellow rhomboidal plates, with an angle of 101° 40′; cleavage parallel to the prism $m=(110)$; decomposed by a continued red heat and somewhat soluble in water. The chromate of lime formed fine yellow needles of a brilliant silky lustre, apparently right-angled. Slightly soluble in water, and more easily decomposed by heat than the preceding. By operating on equal portions of barium and strontium, or of barium and lime, the author has obtained double chromates in long prisms; with strontium and lime large tabular crystals were obtained, like those of the chromate of strontium. Hence the chromates of the alkaline earths are isomorphous one with another, and also with the corresponding sulphates, both as to form and composition.

R. C. B.

New Researches on Hopeite. (M. DAMOUR, *ibid.*)—This mineral, named after the Scotch chemist, Hope, was first described by Brewster, in the *Trans. Roy. Soc., Edin.*, 1824, but owing to its rarity, it has not hitherto been thoroughly analysed. The author, having had 2 mgrms. of it placed at his disposal, found that it is soluble in nitric acid without effervescence. On evaporating to dryness, it entirely dissolved in weak nitric acid. The liquid was then divided into two portions; the first, treated with ammonic molybdate, gave the greenish-yellow precipitate characteristic of phosphoric acid. Excess of ammonia, added to the second part of the solution, produced no precipitate, but ammonic hydrosulphide threw down sulphide of zinc of a blackish colour, owing to presence of iron. A long series of angular measurements is annexed.

R. C. B.

On the probable Identity of Microcline and Orthose. (M. A. MICHEL-LEVY, *ibid.*)—The association of these two minerals is remarkably intimate; they have the same chemical composition, and their crystals are very nearly alike. It has also been observed that the extinction produced by microcline between two crossed Nicols, in parallel rays, agrees with that of orthose. A demonstration, accompanied with a diagram, here follows, whence the author concludes that as all the other felspars extinguish the light in circumstances differing from those described, this agreement can hardly be regarded as accidental.

R. C. B.

On the Optical Properties of Isomorphous Mixtures. (M. H. DUFET, *ibid.*)—The author states that in mixtures of isomorphous salts, the differences between the principal indices of the mixture and those of the component salts are in the inverse ratio of the number of equivalents of the two salts forming the mixture. If the equivalent of the compound salt be calculated, a straight line is formed by taking the equivalents for abscissæ and the indices for ordinates. By taking lengths proportional to the corresponding indices of the two salts on the lines perpendicular to the axis of x, and then joining the points representing the corresponding indices, straight lines are obtained which do not intersect; the plane of the axes does not alter, a condition which obtains in the mixture of the sulphates of zinc and magnesia studied by the author, and in the mixture of the chromate and sulphate of potash studed by M. Wyrouboff. Two of the lines can intersect, and then a uniaxal salt is obtained with a given composition, as is the case in the potash and ammonia salts of Seignette. One of the lines can intersect the two others, as happens in the mixture of the sulphates of potash and ammonia, and there are then two uniaxal salts.

R. C. B.

On some Crystallised Tungstates. (M. L. MICHEL, *ibid.*)—To obtain these the method of Geuther, Schultze, Forsberg, etc., was adopted, which consists of melting at a high temperature an alkaline tungstate (e.g. sodic tungstate), with a mixture of sodium and metallic chlorides. The fusion is conducted in a porcelain, contained in a Hessian crucible, the space between being packed with calcined magnesia. The mass is slowly cooled and then treated with water to extract the soluble chlorides. Crystals 1 cm. long and 1½ mm. wide were thus obtained. The proportions employed were:—1 part of tungstate of soda, 1½ of the metallic chloride, and two parts of sodium chloride,—the excess of this last giving larger and more regular crystals. By this procedure the author has obtained the tungstates of barium, strontium, calcium (Scheelite), magnesium, manganese (Hubnerite), iron, iron and manganese (Wolfram), cobalt, nickel, zinc, cadmium, copper, and lead (Stolzite); also the tungstate of bismuth (not hitherto obtained), in greenish-white nacreous plates.

R. C. B.

Boracite. (*Ibid.* No. 6, June.)—In an abstract from a late number of the *Zeitschrift für Krystallographie* (Vol. III, No.4), it is stated that M. Baumhauer has studied the crystallisation of this substance, as developed by corrosion-figures, whence he has deduced that it is orthorhombic, and that the cubic form is due to an assemblage of six orthorhombic crystals, constituting as many pyramids, and having the cubic faces as their bases.

R. C. B.

Minerals occurring at Sarrabus (Sardinia), ibid.—In a communication from M. Traverso, it is stated that veins of silver and lead ores are being worked at this place; they occur in granitoid porphyries, amphibole-quartzite, with pyrrhotine, and black schists with pyrite and calcareous veins. The gangue consists of calcite, fluor, baryte, quartz, and steatite. Associated minerals are: native silver, argentite, *argent fragile* or psaturose, red silver (argyrithrose), galena, blende, copper pyrites, grey copper (tetrahedrite), molybdate of lead (wulfenite), carbonate of lead, Breithauptite, harmotome, gypsum, dolomite, and Aragonite.

R. C. B.

On Breislakite. (The same, *ibid.*)—This was observed as brownish filaments on a druse of tridymite, amongst crystals of hypersthene, from the sanidine-trachyte of the Roc du Capucin, Mont Dore. They had an appearance identical with those of the trachyte of Monte Olibano.

R.C.B.

On the Composition of Hopeite. (M. M. FRIEDEL and SARASIN, *ibid.*) —The authors have succeeded in producing a substance with the crystalline and optical properties of this mineral. Oxide of zinc was mixed in various proportions with a dilute solution of phosphoric acid, and the whole heated in closed tubes at from 150° to 180° for about 16 hours. The contents became crystalline, and under the microscope exhibited crystals apparently orthorhombic, together with others in triangular plates. As these last became more numerous with a greater amount of phosphoric acid, it was increased till its weight equalled that of the oxide of zinc, when the product became free from orthorhombic prisms. Tabular crystals were thus obtained, rectangular or six-sided, and symmetrical, the smaller sides of the rectangle disappearing through the replacement of the angles with obtuse slopes. These sloping sides contain an angle of about 150°; the angle of the faces a^3 a^3 of Hopeite is 149° 16′ (Levy.) Measured with the goniometer, it was found that the angle of the faces $m\ m = 120°$, $m\ g' = 120°$; those of Hopeite are 120° 26′ and 119° 47′. The optical properties are also similar. In parallel polarised light, the planes of extinction are parallel to the sides of the rectangles. With converging light, there is a disposition of symmetrical colours, and with plates sufficiently thick, there is an appearance of the neutral lines indicating that the plane of the axes is parallel to the base of the prism. On analysis, these artificial crystals gave:—

Phosphoric acid	31·12	31·07	Theory.
Oxide of zinc..	53·52	53·18	
Water	14·45	15·75	
	99.09		

Formula = P_2O_5, 3Zn O, 4 H_2O. Only two molecules of water are given off at 100°. Hopeite is therefore very probably a tribasic phosphate of zinc.

R. C. R.

On Artificial Libethenite. (The same, *ibid*)—It has been shown by Debray that this substance is obtained, as a crystalline powder, when the tribasic phosphate of copper, P_2O_5, 3 CuO, 3 H_2O, is heated with water in sealed tubes. The boiling temperature is sufficient to change the tribasic phosphate into greenish-white crystalline Libethenite. To obtain fine crystals, it is necessary to employ a closed vessel at about 180°, with an excess of phosphoric acid. Olive-green crystals were thus obtained, exhibiting the faces *m* and *a'*; the angles found were, $m\ m = 87°\ 30'$, $a'\ a' = 70°—71°$; in Libethenite, $m\ m = 87°\ 40'$, $a'\ a' = 70°\ 8'$. When either the natural or the artificial mineral is reduced to powder, and ignited at a red heat in a test-tube, or on platinum in the Bunsen flame, water is given off, and a substance results which is brown while hot, and of a fine green when cold.

Olivenite, which much resembles Libethenite, gives merely a brown powder on calcination.

R. C. B.

On the Preparation of a Felspar. (The same, *ibid.*)—By using the apparatus employed in their production of artificial quartz, and a mixture composed of the silicates of alumina and potash, together with a small quantity of caustic potash, the authors obtained a crystalline powder after heating the mixture to a dull red for 36 hours. This powder behaves under the blowpipe like felspar, and fuses with difficulty to a white glass. Its density is the same as that of orthose. Analysis showed that a felspathic matter was obtained, viz.:—

		ORTHOSE	POTASSIC PETALITE.	
Silica	72·0	64·63	calculated	70·90
Alumina	14·9	18·49		15·21
Potash	12·2	16·87		13·83

The result agrees with a mixture of orthose and quartz, or a felspar rich in silica, analogous to petalite, and mixed with a small quantity of quartz.

R. C. B.

Epistilbite. (M. DES CLOISEAUX, *ibid.*)—From an examination, with the micro-polariscope, of more than two dozen cleavage-plates of specimens from Berufjord and Ofjord, the author finds that there exists in them a

twin-plane tangent to the obtuse edge $\frac{m}{m}$. He concludes that it should be considered as belonging to the clinorhombic system, and remarks on the necessity of new and exact measurements.

R. C. B.

On a Chromiferous Garnet from the Pyrenees. (M. A DAMOUR, *ibid.*)—This mineral forms an essential part of a crystalline rock of a pale-green colour, containing calcite, quartz, and a white mineral, very fusible under the blowpipe, and exhibiting a relation to Wernerite or Zoizite. By acting on this rock with dilute nitric acid, the calcareous part is dissolved and small druses are set free, in which the green garnet appears crystallised as rhomboidal dodecahedra. This mineral, being variously fissured, is easily broken, retaining the hardness of the garnets = 6 to 7; spec. grav. = 3·43. Melts with difficulty before the blowpipe to a black glass, not magnetic; with borax or microcosmic salt it gives an emerald-green glass. The analysis was as follows:—

			OXYGEN	RATIO.
Silica	36·20		19·30	2
Alumina..	10·20	4·75		
Chromic oxide	6·50	2·04	9·67	1
Ferric ,, ...	9·60	2·88		
Ferrous ,, ...	8·16	1·81		
Manganous oxide	0·50	0·13	9·79	1
Lime	27·50	7·85		
	98·66			

whence the formula = 3 (CaO, FeO, MnO) + (Al_2O_3, Fe_2O_3, Cr_2O_3) + 3 SiO_2. This analysis agrees with that of a chromiferous garnet from Orford (Canada), as found by Mr. Sterry Hunt. There is not enough oxide of chromium to connect it with Uwarowite, but it seems rather to be a variety between Uwarowite, almandine, and melanite. The mineral described was found near Venasque, on the Pic Posets, near Maladetta.

R. C. B.

On Venasquite. (By the same, *ibid.*)—This mineral, so called from being found near Venasque, was first described by M. N. Boubée in 1857, and referred by him to Ottrellite. It occurs in crystalline masses, lamellar and radiated; in colour it is greyish-black, powder grey. H = 5·5. G = 3·26. Heated in a tube, a little water is given off. Under the blowpipe, the thin edges melt with difficulty on platinum; on charcoal, a black scoria is formed, slightly magnetic; microcosmic salt gives the reaction of

iron, with a silica skeleton. Not attacked by acids. Analysis gave the following result:—

		OXYGEN.	RATIO.
Silica	44·72	23·89	6
Alumina..	29·71	13·84	3
Ferrous oxide.. ..	20·75	4·61	
Magnesia	0·62	0·24	4·85 1
Water	4·93	4·38	1
	100·80		

giving a formula=(FeO, MgO) Al_2O_3, 3 SiO_2+H_2O; while that of Ottrelite from Luxemburg is=3 (FeO, MnO) 2 Al_2O_3 6 SiO_2+3 H_2O, the manganese being sufficient to form a distinctive character.

R. C. B.

On Luckite. (M. A. CARNOT, *ibid.*)—In some specimens of the Mallardite from the "Lucky-Boy" silver mine, Utah, occur many crystals of hydrated sulphate of iron containing manganese; they are clear and of a bluish tinge, and form furrowed prisms, irregular and somewhat twisted. Both in the dry and wet way, they give all the reactions of hydrated sulphate of iron, or melanterite, but manganese is also present. The result of analysis was:—

		OXYGEN.	
Sulphuric acid	26·3	15·78	=5·26×3
Ferrous oxide	21·7	4·80	
Manganous oxide ..	1·9	0·43	=5·45×1
Magnesia	0·2	0·08	
Lime	0·5	0·14	
Insoluble residue.. ..	7·2		
Water (by diff.)	42·2	37·55	=5·36×7
	100·0		

when the formula is SO_3, FeO, MnO+7 H_2O, in which the proportion of manganese is about one-tenth that of iron. The mineral would seem to occupy a position between melanterite and Mallardite; but on exposure to the air it does not effloresce, like the latter, nor exhibit an ochreous colour like the former. It constitutes a manganiferous variety of melanterite, and the name Luckite, from the place of its occurrence, is proposed for it.

R. C. B.

Szaboite. (A. VON LASAULX and A. KOCH, *Zeit. für Kryst. und Min. III*, 3, pp. 288 and 307.)—This mineral is known to occur in four localities; Aranyer Berg, Transylvania (Koch); Monte Calvario at the

foot of Etna (von Lasaulx); in a trachyte of the Riveau Grand, Mont Dore (Gonnard); and lastly on lava at Monte Corvo, uear Biancavilla. The specimens from the last two places are chocolate-brown; those from Mont Dore (Puy de Dome) have the yellow colour of certain sphenes, while those from Monte Corvo are of a greyish colour.

The crystals hitherto met with are figured in Pl. XIII, figs. 3 to 5. See also *Min. Mag.*, Vol. II, p. 248.

R. C. B.

Correspondence.

Montreux, March 6th, 1880.

To the Editor of the Mineralogical Magazine.

Sir,—I propound the following as a problem, as specially suitable for the attention of Cornishmen, since they live near the sea, and can no doubt obtain the use of suitable instruments.

Measure the angles of crystals, fixed on the axis of the moveable limb of

I.—A Bordas circle.

II.—A Theodolite.

Very truly yours,

MARSHALL HALL.