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ALBITE.

ANORTHITE.

Fig. 1.

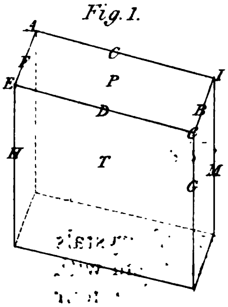


Fig. 2.

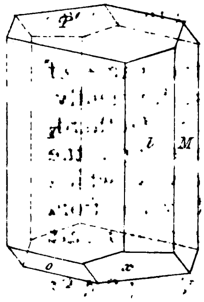


Fig. 3.

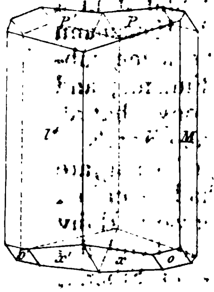


Fig. 4.

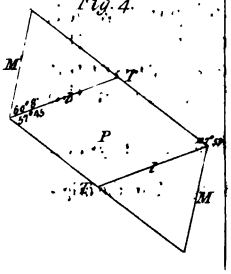


Fig. 8.

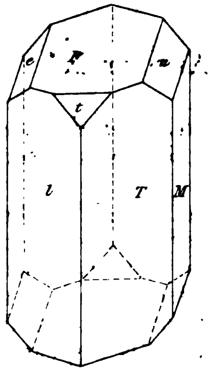


Fig. 6.

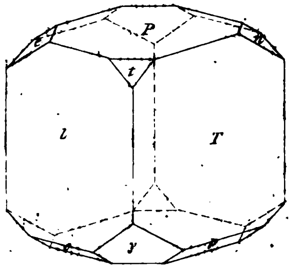


Fig. 7.

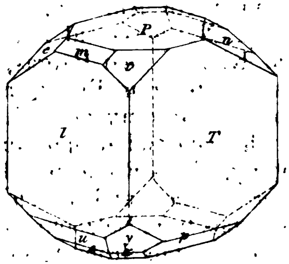


Fig. 5.

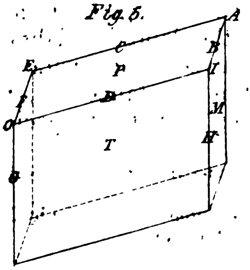
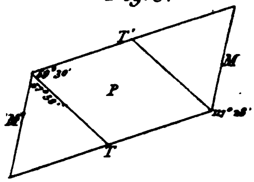
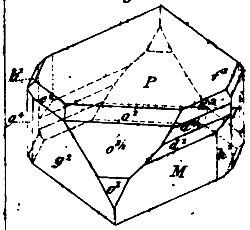


Fig. 9.



CLEAVELANDITE.

Fig 10.



FORSTERITE.

Fig. 11.

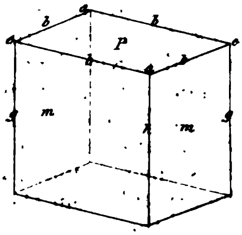
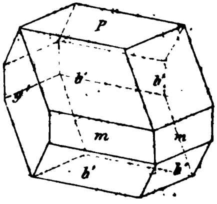


Fig. 12.



Engraved for the Annals of Philosophy, for Baldwin, Cradock & Joy, Jan 1824

ARTICLE XI.

On Felspar, Albite, Labrador, and Anorthite.
By M. Gustavus Rose.*

SOME differences I had found in the angles of crystals described hitherto as felspar, induced me to examine them with greater accuracy. From my observations, it results that four different species, which differ as much in their form as in their chemical composition, had been united under the common name of felspar; it is true that there is a great analogy in their crystalline forms.

Among these species, that which will retain the name of felspar, $K S^3 + 3 A S^3$, is the one met with most frequently. Under that name must be classed the adularia from St. Gothard, vitreous felspar from Vesuvius and from Siebengebirge, the amazon-stone, the felspar from Friedrichwarn, in Norway, which had been taken for labrador, the felspar from Baveno, from Carlsbad, from Fichtelgebirge, and in general the greater part of what Werner has called common felspar.

The second species called albite (cleavelandite†) $N S^3 + 3 A S^3$ is not so common as felspar. We are indebted to M. Eggerts for the first notice of this substance; he examined a radiated variety of it from Finbo and from Broddbo, near Fahlun. Since, MM. Hausmann and Stromeyer have also found it in a rock from Chesterfield in North America, and M. Hausmann named it Kieselspath. M. Nordenskiold found the same substance in a granite from Kimito, near Pargas, in Finland; and lastly, M. Ficinus in a granite from Penig, in Saxony; but all these varieties were not regularly crystallized. The crystals of the same substance which I have had an opportunity of seeing, are the crystals from Dauphiny, which Romé de L'Isle had described under the name of *schorls blancs,* and which afterwards Haüy took for felspar; the crystals from Salzbourg and the Tyrol, described as adularia; the crystals from Kerabinsk in Siberia, from Arendal in Norway, from Prudelberg near Stirschberg in Silesia; as well as many other crystals from different localities.

The third species is the labrador (labrador-felspar) which Klaproth had already analyzed and separated from felspar; the external characters of this substance had, however, prevented mineralogists from making a distinct species of it. From the

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* Translated (with some omissions) from the Annales de Chimie et de Physique, tome xxiv. p. 5.

† This name (cleavelandite) was proposed for albite by Mr. Brooke, but the original term has been preserved in this translation.

analysis of Klaproth, M. Berzelius has found that the formula was $NS^3 + 3CS^3 + 12AS$.

The fourth species is the scarcest of all; I have only met with it in small groups of crystals in blocks of carbonate of lime, which are found near Vesuvius. I have found that their chemical formula was $MS + 2CS + 8AS$, and I have given them the name of *anorthite*.

I shall now describe the principal properties of these four species. In the description of the crystals I have only given the primitive form, the signs of the secondary planes, and the principal angles. I have thought it useless to describe more minutely the secondary crystals.* The figures I have given, especially when compared with their signs, are perfectly sufficient to form an exact idea of the relative situation of these planes, and of the parallelism of the edges. The signs of the secondary planes are given according to the method of Haüy, and I have calculated them from the angles of the primitive form, which I have measured with as much exactness as possible, by means of spherical trigonometry, and by the parallelisms of the edges. But the primitive forms of these species being doubly oblique prisms, the theory of which is not yet perfectly known, their determination depends on five measurements, while the determination of oblique rhombic prisms depends only on two: it is for that reason that I can only consider the angles I have given as approximations not very far from the truth.

The specific gravity has been determined with care. When I had only small crystals to examine, I weighed some of them in a small flask of glass, the weight of which both in water and in air was subtracted from the weight of the flask containing the small crystals, and weighed under the same circumstances. I have given the temperature of the water I used in my experiments. I have not reduced my results to the same temperature, because they would be but very little altered by that reduction.

The hardness of all the species described is less than that of quartz, and differs but little from that of felspar. Albite has in general appeared to me to be the hardest, and labrador the softest.

First Species.—Felspar.

The system of crystallization is, according to M. Weiss, *bino-singulaire*. The primitive form is an oblique rhombic prism, in which the ratio of the three dimensions which are perpendicular to each other, and equal to the diagonals of the section perpendicular to the lateral edges, and to the length of one of these edges is $= \sqrt{13} : \sqrt{3 \cdot 13} : \sqrt{3}$.

The chemical formula is, according to Berzelius, $KS^3 +$

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* The figures of crystals are not all given in the translation.—Edit.

$3 A S^3$. If we calculate from this formula the proportion of the constituent parts, we find that 100 parts of felspar contain

Silex	65·94
Alumina	17·75
Potash	16·31

Observations.—Although felspar is common, yet it is rarely met with in such perfectly brilliant crystals as are necessary for measurement by the reflecting goniometer. The collection of minerals in the University of Berlin, which is extremely rich in crystals of felspar, does not contain a specimen the crystals of which could have been measured by that instrument. The best for that purpose with which I am acquainted are the crystals of glassy felspar from Vesuvius, and I have measured the angles of some which differ a little from those given by M. Weiss. I have found for instance the obtuse incidence of the lateral planes of the primitive to be 119° 18′, and that of the base of the primitive upon one of the lateral planes 112° 14½′*. These measurements, however, I did not consider as sufficiently exact to ground my calculations upon.

I was rather surprised by what I found to be the specific gravity of the felspar of Baveno. I had weighed it several times, and I had chosen not only the hemitrope crystals which are so frequently met there, but also simple crystals which are perfectly pure, and did not appear to contain any foreign substance. The results I obtained were always the same, and I was induced to think that the composition of the crystals of Baveno differed from that of felspar, and that since the crystallisation was perfectly the same in both, some isomorphous principle was replaced by another. I, therefore, analyzed a crystal from Baveno. In fusing it with carbonate of potash, and in treating it in the usual manner, I found the proportion between the silex and the alumina exactly the same as that which exists in common felspar; so that though I had not separated the potash, I thought I had no reason to suppose the composition different from other felspars.

Second Species.—Albite.

The primitive form of albite is a doubly oblique prism (Plate XXV), figs. 1, 2. The planes M and T of which are inclined at an angle of 117° 53′; the planes M P form angles of 93° 36′ and 86° 24′; the planes T and P angles of 115° 5′ and 64° 55′. The section perpendicular to the planes M and T is an oblique-angled parallelogram, fig. 2, the obtuse angle of which is divided by a plane *l* produced by a decrement of two rows along the

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* Mr. W. Phillips gives for the same angles [illegible] and [illegible]

edge G, into two angles of 60° 8′ and 57° 46′, the first of which has one of its sides situated in the plane M, and the second one of its sides in the plane T. The section perpendicular to the planes M and P is an oblique-angle parallelogram, the obtuse angle of which is divided by the plane *n*, produced by a decrement by one row on the edge B, into two angles of 46° 5′ and 47° 31′; the first of which corresponds to the edge of the parallelogram situated in the plane P; the other to the edge of the parallelogram situated in the plane M.

The planes I have observed are

$$P\ M\ T\ \underset{l}{G_2}\ \underset{z}{G_4}\ \underset{f}{{}_2H}\ \underset{y}{\overset{1}{A}}\ \underset{x}{\overset{2}{A}}\ \underset{n}{\overset{\frac{1}{2}}{B}}\ \underset{o}{\overset{2}{C}}\ \underset{g}{\overset{4}{C}}\ \text{(see figs. 3, 4).}$$

*Incidences.**

T on M′	117°	53′
T on *l*	122	15*
M on *l*	119	52*
M on *z*	149	12
l on *z*	150	40
M′ on *f*	148	30
T on *f*	149	23
P on T	115	5*
P on *l*	110	51*
P on *o*′	122	23*
M on *o*′	112	11
P on *g*	150	5
M on *g*	100	52
P on M	86	24
P on *n*	133	55
P on *y*′	97	37
T on *y*′	134	32
T on *x*′	110	29
P on *x*′	127	23

Plane Angles of the Primitive Form.

Those of plane	P	119°	12′ and	60°	8′
	M	116	35	63	25
	T	99	45	80	15

The crystals of albite are frequently or almost always met under the form of hemitropes.† These hemitropes are formed

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* I have marked * the angles from which the others are calculated.

† I found, however, afterwards, that the crystals of St. Gothard, the prisms of which are so short that the planes of one of the summits meet those of the other, are very likely albite: they are met commonly in simple crystals, and seldom in hemitropes. Their planes were not sufficiently brilliant to be measured; but it is likely that they were albite, since, when digested in hydrochloric acid, they were not decomposed.

when two crystals are so joined to each other that the upper plane of the one is applied upon the inferior plane P' of the other, in the manner exhibited by fig. 3. The two crystals have generally the same size; however all the differences which are known to occur in the hemitropes are also met with in this substance; frequently one of the crystals is only visible by a narrow line on the plane P of the other. A third crystal is often applied on the second; and a fourth upon the third, &c. The hemitropes attached to the matrix present always the same end upwards, and that corresponds to the upper part of fig. 3.

This substance can be cleaved parallel to every plane of the primitive; the cleavage parallel to P is the most brilliant. The colour of the crystals is white or reddish-white; the crystals are translucent or transparent, either wholly or in part as in those of Kerabinsk.

The specific gravity will be found in the following table:

	Locality.	Weight gram.	Sp. gr.	Tem. water.
Hemitrope crystals	Kerabinsk	4·808	2·608	20° R.
Hemitrope crystals	Kerabinsk	12·711	2·6175	21½
Id. reddish-white	Arendal	3·692	2·619	17
			2·614	17½

The specific gravity has been found before by

Eggertz, that of Finbo	2·612
Eggertz, that of Broddbo	2·619
Nordenskiold, that of the red albite from Kimito	2·609
Ficinus, that of the albite of Penig	2·50

The result of an analysis of crystallized albite from Arendal, decomposed by means of carbonate of potash, is

Silica	68·46	which contains oxygen	34·43	12
Alumina	19·30		9·01	3
Lime	0·68			
Oxide of iron	0·28			
Magnesia				
Loss	11·27	taken as soda	2·88	1

Another analysis in which I had precipitated the alumina with carbonate of potash, gave the following result:

Silex	68·60
Alumina, with a little oxide of iron	19·25

An analysis with carbonate of barytes, gave

Silex	68·84
Alumina, with a little oxide of iron and lime.	20·53
Soda	9·12
	98·49

If the composition of albite is calculated from the formula $N\,S^3 + 3\,A\,S^3$, the following proportion of the constituent parts is found

Silex	69·78
Alumina.	18·79
Soda	11·43

Crystallized albite is found at Arendal in Norway, where it is almost always accompanied with epidote, according to what I have seen at the place itself, as well as in private collections. It is found also in the Schmirnerthal, in the Tyrol, with carbonate of lime in veins of carbonate of lime; at Rohrberg, near Zell, in veins with quartz, or in gneiss very rich in quartz, accompanied by rock crystal and carbonate of iron: it is found in the same circumstances at Gastein, in the country of Salzbourg; at Bareges in the Pyrenees, and at Auris in Dauphiny, in veins with axinite, anatase, adularia, epidote, asbestus, with which the albite is sometimes perfectly mixed. As to the albite of Kerabinsk, in Siberia, the collection of minerals in the University of Berlin, contains only isolated hemitrope crystals, which are of a much larger size than the others. Sometimes the plane M is one inch long, while the other hemitrope crystals are never more than a few lines. At Prudelberg, at Stonsdorf, near Hirschberg, in Silesia, albite is found with felspar in veins of granite; the crystals of felspar are flesh-coloured, and sometimes covered with crystals perfectly white, or of the same colour as those of albite. The crystals of felspar of Baveno are also frequently accompanied by some small whitish crystals, which commonly are not felspar, but albite.*

Observations.—The crystals of albite are easily distinguished by their hemitropes, and the re-entering angles formed by the planes P. If the crystals of felspar were grouped in the same way, the similar planes of the two crystals would be parallel, since in felspar the planes M and P are at right angle to each other, and could never form re-entering angles; the analogous hemitrope crystals of felspar, such as those of Carlsbad, can only be formed as it has been demonstrated by M. Weiss, when two crystals are grouped, either with their right planes M, or with their left planes M. So that the faces P of cleavage are situated on opposite sides in the two crystals, while in albite the planes P of the two crystals are situated on the same side.

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* If the above-mentioned crystals of St. Gothard are albite.

Albite offers, however, sometimes crystals which are grouped in a manner analogous to the hemitrope crystals of felspar. They are joined to each other by their planes M, and consequently have their planes P on different sides; but in this case the two crystals are attached by their other faces to other crystals in the common way; so that the whole is only an hemitrope formed by two different hemitropes which are grouped in the same manner as the two simple crystals which form the hemitrope crystals of felspar of Carlsbad.

Although albite is found massive, it is always radiated, never in laminæ, and that distinguishes it essentially from felspar. It may always be admitted, therefore, that the felspar which is met in this state is not felspar, but albite. The palmed felspar of Johann Georgenstadt in Saxony, distinguished by Werner, is among those of this kind the most known in Germany: however, some doubts may be entertained concerning several specimens of various localities contained in the collection of minerals at Berlin.

Besides the albite of Arendal, I have analyzed that of Salzbourg. Some circumstances have prevented me terminating the analysis of it; however, I have obtained soda, and the same quantity of silex, as in the analysis of the albite of Arendal.

The sulphate I had obtained, and which I had crystallized with a great deal of care, gave me crystals perfectly similar to those of sulphate of soda. When exposed to the atmosphere, they fall to powder, and treated by the solution of platina, by tartaric acid, and by sulphate of alumina, they exhibited the same properties as sulphate of soda. Having mixed a solution of these crystals with a solution of chloride of platinum in alcohol, it remained perfectly limpid, and evaporated to dryness, and left a mass perfectly soluble in alcohol. A solution of these crystals into which I had put tartaric acid, retained its limpidity. In mixing this with sulphate of alumina and alcohol, I obtained regular octohedrons perfectly well crystallized, which I consider as sulphate of alumina and soda; because when opposed to the atmosphere, they were reduced to a fine powder, and are thus sufficiently distinguished of sulphate of alumina and potash, which mixed with alcohol was immediately precipitated in a state of powder.

In analyzing albite with carbonate of barytes, I have found a loss of 2½ per cent. It is undoubtedly soda which suffers this loss; this appears to me so much the more likely, for I obtained silex and alumina in the same proportions as in analyzing albite with carbonate of potash, and the result was the same in calculating the proportion of these two bodies from the same chemical formula. I could not repeat the analysis, because I had used all I had of the substance to determine the nature of the alkali contained in albite, and for the analysis with the carbonate of potash.

Third Species.—Labrador.

This substance is very seldom met in regular crystals. There is only one specimen in the collection of minerals at the University of Berlin; and although it is possible to determine the form of it, which shows great analogy with felspar, the angles cannot be measured. The modifications appear to be the same as those of felspar. It cleaves easily in two directions, in one of which the face obtained by cleavage is perfectly brilliant; the difference between the degree of brilliancy of these two cleavages denotes a difference between labrador and felspar. Moreover those two cleavages are not obviously at right angles to each other. I have found their inclination to be 93½° and 86½°. I could not measure more exactly the incidence of these two cleavages on account of the dulness of one of them. There is a third cleavage still more imperfect, and which corresponds with one of anorthite, but not with any of albite.

Thin laminæ of labrador are of a whitish-grey; the fine reflection of light which distinguishes this substance is given by one of the cleavages.

The specific gravity of a fragment of labrador (from Labrador, in America) weighing 10·576 grs. was found, using water at the temperature of 18° R. = 2·7025.

The specific gravity of a fragment weighing 12·068 gr. from the same locality, using water at the temperature of 17½° R. = 2·695.

According to Brisson, = 2·692.

According to Klaproth, = 2·690.

Specific gravity of the labrador from Ingremanie, according to Klaproth, = 2·750.

One hundred parts of labrador from Labrador, and an equal quantity of labrador from Ingremanie, contain, according to Klaproth,

	Labrador from Labrador.	Labrador from Ingremanie.
Silex	55·75	55·00
Alumina	26·50	24·00
Lime	11·00	10·25
Oxide of iron.	1·25	5·25
Soda	4·00	3·50
Water	0·50	0·50
	99·00	98·50

Berzelius has calculated from these analyses the mineralogical formula

$$N S^3 + 3 C S^3 + 12 A S.$$

Observations.—Labrador and felspar present similar characters with the blowpipe; and for this reason Berzelius was induced to suppose that the mineral analyzed by Klaproth, under the name of labrador, was iridescent parenthine, with which it has great analogy of composition. However, an analysis undertaken by my brother, gave, excepting a greater quantity of alumina, almost the same results as that of Klaproth. This chemist has already demonstrated that the iridescent felspar from Friedrichwarn, in Norway, cannot be ranked in this class; it is also distinguished from it by the incidence of the two faces of cleavage which is equal to 90°. The acids act upon this mineral in a different manner than upon felspar and albite; for concentrated hydrochloric acid, according to Fuchs, entirely decomposes labrador, and has no action upon felspar or albite.

Fourth Species.—Anorthite.

The primitive form of anorthite is a doubly oblique prism, fig. 5, 6, in which the planes M and T are inclined at an angle of 117° 28′; the planes M and P at an angle of 94° 12′, and the planes T and P at an angle of 111° 57′. The section perpendicular to the planes M and T is an oblique angled parallelogram, the obtuse angle of which of 117° 28′ is divided by the plane produced by two rows in breadth on the edge G into two angles, the one of 59° 30′ and the other of 57° 58′; the first of which has one of its sides in the plane T, and the other one of its sides in the plane M. The section perpendicular to the planes M and P is an oblique angled parallelogram, the obtuse angle of which equal to 94° 12′ is divided by a plane produced by a decrement by one row on the edge B of the primitive into two angles, the one of 46° 47′, and the other of 47° 25′; the first of which has one of its sides in the plane P, and the other one of its sides in the plane M. The planes I have observed are:

$$P\ M\ T\ \underset{l}{{}_2G}\ \underset{f}{{}_4G}\ \underset{z}{H^3}\ \underset{e}{\overset{1}{T}}\ \underset{n}{\overset{1}{B}}\ \underset{p}{\overset{2}{C}}\ \underset{y}{\overset{1}{A}}\ \underset{x}{\overset{2}{A}}\ \underset{q}{\overset{3}{A}}\ \underset{t}{\overset{1}{O}}\ \underset{o}{A^{\frac{1}{2}}}\ \underset{u}{\overset{2}{A}}\ \underset{m}{{}_2\overset{1}{O}}\ \underset{v}{{}_4A}\ \underset{w}{E^2}$$ (figs. 7, 8, 9).

Incidences.

T on M	117°	28′
T on *l*	120	30
M′ on *l*	122	2
M on *z*	149	1
T on *z*	14	7
M′ on *f*	15	[illegible]
P on *y′*	98	29
P on *x′*	128	27
P on *q′*	145	12
P on *t*	138	46
P on *o′*	121	50
P on *u′*	94	53
P on *m*	134	46
l on *f*	151	28
P on M	85	48*
P on *n*	133	18*

P on l	137°	22′
P on T	110	57
P on p′	125	38
M on o′	115	20
M on u′	122	45
M′ on m	116	12
P on v′	91	56
M on v′	141	54
P on u′	98	37
M′ on w′	141	22

Plane Angles of the Primitive Form.

Those of plane P	121°	33′ and	58°	27′
M	116	15	63	45
T	106	42	73	18

Anorthite, as well as albite, although not quite so frequently, presents also hemitrope crystals, I have not given drawings of them, because they are formed exactly according to the same laws. This substance can be cleaved parallel to the planes P and M with equal facility. I have not been able to obtain a cleavage parallel to the plane T, and I have chosen it for one of the primitive planes in preference to the plane *l*, because it is generally much more brilliant. The fracture in other directions is conchoidal. The lustre of the cleavages is pearly, and that of the conchoidal fracture vitreous.

Anorthite is found sometimes crystallized in small masses. The crystals are perfectly clear and transparent, but very small.

The specific gravity of several fragments weighing 1·463 gr. by using water at the temperature of 14° R. has been found equal to 2·763.

That of small crystals weighing 0·316 gr. mixed with a small quantity of pyroxene, by using water at 17° R. was found equal to 2·656.

Concentrated hydrochloric acid entirely decomposes anorthite. I have found 100 parts of anorthite, the specimens of which, as well as those of albite, I had obtained through the kindness of Mr. Weiss, from the collection of minerals in the University of Berlin, composed of

Silex	44·49	which contains oxygen	22·38	11
Alumina	34·46	16·096	16·326	8
Oxide of iron	0·74	0·23		
Lime	15·68		4·40	2
Magnesia	5·26		2·04	1

Another analysis in which I had only 0·6 gr. to examine gave, however, similar results, and consequently the mineralogical formula is

$$M S + 2 C S + 8 A S$$

when one part of 8 A S is replaced by F S. Anorthite has only been found hitherto in masses of carbonate of lime at Mount Somma, near Vesuvius, where it is accompanied only by green translucent pyroxene.

Observations.—The mineralogical formula indicated above, appears to be the result of the analyses: I cannot, however, warrant its exactness, because I could only operate upon very small quantities; the first time with 0·628 gr.; the second time with 1·482 gr.: it is the result of this last analysis I have given. The formula would be analogous to other formulæ already known, if there was 9 A S, instead of 8 A S. Then it would be the same as that of meionite and paranthine, the formula of which is C S + 3 A S, with this difference, however, that one-third of C S in anorthite would be replaced by M S. Anorthite would then be referred to meionite, in the same manner as idocrase is to garnet, or, according to my brother's analysis, pyroxene to wollastonite.

I have provisionally given the name of anorthite to this mineral, derived from *ανορδὸς*, which signifies without right angles; because its crystalline form is principally distinguished from felspar, in not being at right angles to each other. Haüy, to whom the name of felspar did not seem proper, had suggested for this mineral the name of *orthose*, from two of its cleavages being at right angles to each other.

ARTICLE XII.

Observations on the preceding Paper, with an Account of a new Mineral. By M. Levy, MA. of the Academy of Paris.

(To the Editor of the *Annals of Philosophy*.)

SIR, *Dec.* 20, 1823.

SINCE the notice you inserted in one of the preceding numbers of the *Annals of Philosophy* of the division I had made of the specimens commonly ranked under the name of felspar, into two distinct species, viz. felspar and cleavelandite, I have seen in the last number of the Annales de Chimie a paper by M. Rose, of Berlin, upon the same subject. An abstract of this paper is inserted in the present number of the *Annals*, and contains, in addition to the essential part of what I intended to publish, not only new analyses of both felspar and cleavelandite, and their specific gravities, but also the complete determination of two new species, viz. labrador and anorthite. In consequence of this, I shall limit what I proposed to send you, to a very few observations, which M. Rose's paper does not render useless.