lieve it, this fact corroborates the idea that the nervous system characterizes only the primary divisions. And our position would turn out to be the right one.

If instead of a single series, or several series with a starting point and an end, we construct a circle or an ellipse, and place the Gasteropods on its circumference, then the arrangement of each group would meet with less difficulty and perhaps satisfy completely the mind.

Cambridge, Mass., October, 1850.

ART. V.—*Memoir on Emery;* by J. LAWRENCE SMITH, M.D.—Second part.—*On the Minerals associated with Emery: Corundum, Hydrargillite, Diaspore, Zinc spinel, Pholerite, Ephesite* (a new species), *Emerylite* (a new species), *Muscovite, Chloritoid* (a new variety), *Black Tourmaline, Chlorite, Magnetic Oxyd of Iron, Oligiste Iron, Hydrated Oxyd of Iron, Iron Pyrites, Rutile, Ilmenite and Titaniferous Iron.*

Read before the Academy of Sciences of the French Institute, July 15th, 1850, and communicated by the author for this Journal.

Now that it has been shown that emery is found in considerable abundance in certain parts of the world,* occupying almost the position of a rock; it is useful to mention the different accidental minerals or *minerals of elimination*, that are found with emery, and what new facts have been observed with relation to them. Corundum may be first mentioned.

Corundum.—Although emery is constituted principally of corundum, the examination of this substance in its pure state, or rather in the form of those prismatic crystals which I have sometimes found in contact with emery, has brought to light several new and well established facts that could not have been satisfactorily ascertained from a mixed mineral like emery.

At *Gumuch-dagh*,† it is not difficult to find large pieces of this mineral, pure or mixed with a little diaspore and emerylite; sometimes the crystals are very distinct, under the form of six-sided prisms. The small crystals found in the cavities are sometimes terminated by a summit of six faces. The color of the corundum found in the different places alluded to in this memoir, is blue, except that of Kulah and of Adula, which is of a greenish grey. All that I have to add to what is already known of this mineral,

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* For the *First Part* of this memoir, see the last volume of this Journal, pages 354–369.

† See the *first part* of this memoir for a description of the localities, this Journal, x, 354.

relates to its *composition* and *effective hardness;* the latter was ascertained in the way already described in speaking of the emery, and it has been found to vary with the composition of the mineral. The analyses were made in the same manner as those of the emery, and the results which I have obtained are as follows:—

	CORUNDUM.		COMPOSITION.					
Localities.	Effective hardness. Sapphire 100.	Sp. grav.	Water.	Alumina.	Magnetic ox. iron.	Lime.	Silica.	Manganese.
Sapphire of India, ...	100	4·06	——	97·51	1·89	——	0·80	——
Ruby of India, ...	90	——	——	97·32	1·09	——	1·21	——
Corundum of Asia Minor,	77	3·88	1·60	92·39	1·67	1·12	2·05	trace.
Corundum of the island of Nicaria, ...	65	3·92	0·68	87·52	7·50	0·82	2·01	——
Corundum of Asia,....	60	3·60	1·66	86·62	8·21	0·70	3·85	——
Corundum of India,....	58	3·89	2·86	93·12	0·91	1·02	0·96	——
Corundum of Asia,....	57	3·80	3·74	87·32	3·12	1·00	2·61	——
Corundum of India,....	55	3·91	3·10	84·56	7·06	1·20	4·00	0·25

The most remarkable fact ascertained by these analyses, is the presence of water in variable quantity in all varieties of the corundum except the sapphire and ruby. To me this fact has a certain value in proving that the corundum and the sapphire are formed under different circumstances and do not belong to the same geological formation. The different structure of these two species of corundum might make one suspect a difference in the condition of their formation; and this is somewhat confirmed by the results of the beautiful experiments of M. Ebelmen in making artificial corundum by subjecting alumina and borax to the heat of a porcelain furnace for many hours; circumstances under which he always obtained crystals under some of the modifications of hyaline corundum, and never as prismatic corundum. In addition to this, I remark that in my most thorough examination of the localities of emery, not the slightest trace of sapphire or ruby was found.

The quantity of water found to exist in corundum, coming from different localities, is variable, and it would appear that all other things equal, those containing the least water are the hardest. I will not insist on the slight difference between the hardness of the sapphire and ruby, having made only one experiment upon each of these minerals.

The two varieties of corundum are so evidently united by their system of crystallization, that I would not undertake to separate them on account of the presence of water in one of them, and that in variable quantity; nevertheless, the fact is important as it explains to a certain extent their differences in structure and hardness. I would remark that great pains was used to ascertain whether the water might not be due to the presence of diaspore or some other hydrate of alumina; but after the most careful and repeated examinations, this has been decided in the negative.

Hydrargillite.—Hydrargillite is rarely met with. I have one specimen with this mineral forming the external coating of a crystal of corundum, and also a hexagonal prism of the same mineral. It was not analyzed, but its physical properties and its reactions under the blowpipe served to prove its identity with this mineral. The specimen in my possession comes from *Gumuch-dagh.*

Diaspore.—This mineral up to the present time has not occupied a very important position in mineralogy, and has been found only in two or three localities. In the course of this article, I hope to show that it plays a somewhat important part in the emery and corundum formations. Before my attention was drawn to the minerals, first discovered by M. Lelievre, it was studied by M. Dufrenoy, on that coming from Siberia, and by M. Haidinger on the diaspore of Schemnitz. Before going farther I would remark, that the gangue of the latter which has been described as analogous to steatite, was found by me not to be such, but a hydrated silicate of alumina, similar to one found with the emery of Naxos.*

To the localities of diaspore already known, I have to add those of *Gumuch-dagh* and *Manser* in Asia Minor, and the islands of *Naxos*, *Samos*, and *Nicaria*, in the Grecian Archipelago; and there is reason to suppose that this mineral will be found in almost every corundum locality. I have already found it on crystals of corundum from China.†

In examining the emery formations, one of the first things that struck my attention was the existence of diaspore and corundum together, then observed for the first time. The same year, M. Marignac discovered it in the limestone of St. Gothard, along with the well known crystals of corundum that exist there. Having found the diaspore under these new circumstances it has been examined with much attention.

At Gumuch-dagh the diaspore is found in flattened and rounded prisms with the surface streaked with lines that afford by reflected light an iridescence. Crystals with perfect summits are rarely found, and during two or three days examination on the place I found only five small crystals with one of the summits perfect, they were however, very beautiful and finer probably

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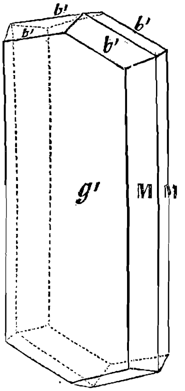
* The gangue of the Schemnitz diaspore has been examined by Hutzelmann, see this Journal, [2], x, 247, and Pogg. Ann., lxxviii, 575, who makes it to contain three distinct hydrates of alumina; but this fact cannot be considered as sufficiently established. One of these hydrates is named *Dillnite*, and another is near Agalmatolite.

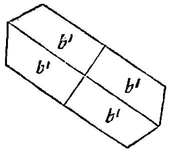
† Prof. C. U. Shepard has found diaspore with topaz at Trumbull, Conn.

than any yet known. Not wishing to lose so favorable an occasion to verify the crystallography of diaspore, I requested M. Dufrenoy to undertake the measurement of the angles, and it is to this able professor that we are indebted for the crystallographic results here given.*

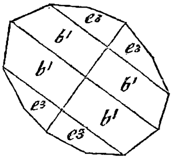
1.



1 *a.*



2 *a.*



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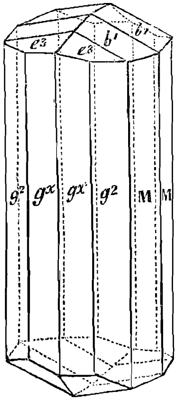

The crystals are elongated needles crossing each other in all directions like an acicular variety of arragonite from the Vosges. They resemble small crystals of topaz in lustre and in the disposition of the vertical striæ on the faces g. Their color is yellowish white. They are strongly dichroitic, the summits under certain inclinations appear black as if the light was completely polarized. The cleavage is very easy parallel to the face g^1, and it is this cleavage that gives a lamellar structure to that diaspore which is not in the form of needles. This cleavage notwithstanding its facility does not expose surfaces that reflect with great accuracy; it is the only angle which offers the difference of a half degree; repeated measurements of the other angles never varied more than four minutes. The pearly lustre of the cleavage in connection with its striated character are the causes of this difficulty which at first sight would not appear to exist, only becoming evident when the angle is examined.

The crystals, very much flattened parallel to the face g^1, are represented by figures 2 and 3; the face g^1 does not exist, being replaced by three series of faces g, the angles of which could not be measured, but the almost absolute identity of these crystals with those of St. Gothard, which M. Marignac first described,

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* Three of the crystals measured are in the Cabinet of the School of Mines and Garden of Plants at Paris.

The second crystal above is nearly as thin as the first, although represented thicker in order to show well all the planes.

authorizes one to suppose that they are represented by the crystallographic signs g^2 and $g^{\frac{5}{3}}$. The faces M and those of the summit have a very bright lustre. The primitive form of the diaspore is undoubtedly a right rhombic prism of 130° 2′; the fact that the base is horizontal, is shown by the identity of the angles of the faces b^1 on the anterior faces M, and the faces b^1 on the posterior faces of the same. This position is verified in seeking for the angle of the edge b^1 on M, which ought to be a right angle; in fact the calculation of a spherical triangle composed of the faces M, b^1 and g^1, of which all the angles of incidence were measured, gave for this edge 90° 2′ 30″, which differs from a right angle by only two minutes and a half.

The following table is made up of the measurements of the angles of the diaspore of Gumuch-dagh (near Ephesus) by M. Dufrenoy, of that of St. Gothard by M. Marignac, and of that of Schemnitz by M. Haidinger, also the measurement of some angles of the hydrated peroxyd of iron of Cornwall, by M. Dufrenoy, which are here given to show an interesting connection, first pointed out by M. de Senarmont, and which consists in the isomorphism of diaspore and the hydrated oxyd of iron. Thus while the peroxyd of iron or oligiste iron is isomorphous with alumina or the corundum, the hydrates of the same oxyds are isomorphous.

	Diaspore of St. Gothard, *Marignac.*	Diaspore of Schemnitz, *Haidinger.*	Diaspore of Gumuch-dagh near Ephesus, *Dufrenoy.**	Hydrated Oxyd of Iron, of Cornwall, *Dufrenoy.*
$M : M$	130°	129° 54′	130° 2′	130° 57′
$M : b^1$	....	....	125° 17′	
$M : b^1$ (posterior faces),	....	....	125° 18′	
$M : g^1$	115°	....	114° 58′	
$b^1 : g^1$	104° 12′	....	104°	
$b^1 : b^1$	151° 36′	151° 36′	151° 35′	
$b^1 : b^1$ (posterior faces),	....	....	151° 33′	151° 34′
$b^1 : b^1$ (opposite faces),	116° 38′	....	116° 18′	
$b^1 : c^3$	....	....	167° 6′	
$g^1 : g^2$	144° 40′	....		
$g^2 : g^2$	145° 40′	....		
$i : i$	126° 12′	....	....	126° 20′
$g^1 : i$	116° 56′	....	....	116° 55′
$e^{\frac{1}{2}} : e^{\frac{1}{2}}$	117° 46′	....	....	117° 10′

I have found crystals of diaspore in hydrated oxyd of iron, the needles traversing the oxyd in all directions. There is a specimen in my possession composed of a small crystal of diaspore, surrounded by a kind of scabbard of crystallized göthite; one of the summits of the crystal is exposed. In breaking the oxyd of iron which contains these crystals, they become detached, leaving on the oxyd an impression with a very brilliant surface.

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* The values of these angles are just as given by the goniometer without any correction by calculation.

The diaspore of Gumuch-dagh is also found, of a lamellar structure, but very rarely; that of Naxos, Nicaria and Samos are all lamellar. Yet of all the specimens that I have collected none offer so much interest as those composed of diaspore imbedded in corundum; here we see the two minerals passing one into the other, without being able, in many places, to distinguish the line of separation, so imperceptible is the gradation. After what has been said in respect to corundum, it is not astonishing to see this connection of alumina more or less hydrated with a hydrate of alumina of definite composition.

After a knowledge of this fact one might seek to explain the existence of water in corundum, by the intimate mixture of diaspore with this mineral; if this be the case, the crystal of corundum from the Carnatic, which gave me three per cent. of water, must contain twenty-three per cent. of diaspore, although neither the eye nor microscope could detect its presence.

As to the properties of diaspore, I have nothing to add to what has already been published on the subject, except that the specimens I examined do not decrepitate to the same extent as that of Siberia. Its specific gravity is 3·45 and hardness above 7. The following analyses were made, the mineral being attacked with the bisulphate of soda. They afford the formula, $\dddot{\bar{\mathrm{A}}}\mathrm{l}\,\dot{\bar{\mathrm{H}}}$.

Localities.	Silica.	Alumina.	Lime.	Oxyd of Iron.	Magnesia.	Water.
Gumuch-dagh, ...	0·67	82·20	0·41	1·20	*trace.*	14·52
Gumuch-dagh, ...	0·82	83·12	*trace.*	0·66	*trace.*	14·28
Naxos, ...	0·26	82·94	0·35	1·06		14·81

Zinc Spinel.—I possess a single specimen of this spinel in chloritoid on a piece of emery from Gumuch-dagh; it is in octahedral crystals agglomerated, of a dark emerald green color; the quantity being small I have been prevented from making an exact analysis. The quantity of oxyd of zinc appears to be from thirty to forty per cent.

Pholerite.—A mineral, resembling pholerite in composition, has been found with the emery of Naxos associated with emerylite. It is white, lamellar, and somewhat crystalline, sometimes grey. It is soft to the touch like steatite, infusible before the blowpipe, and when heated with nitrate of cobalt becomes strongly colored blue. It is scratched with the nail, and has a specific gravity of 2·564. Its composition is identical with the pholerite of Guillemin, also with the mineral forming the gangue of the diaspore of Schemnitz. For analysis it was decomposed with carbonate of soda. It afforded:—

		Pholerite of Guillemin.	Gangue of diaspore of Schemnitz—Smith.
Silica,	44·41	42·93	42·45
Alumina,	41·20	42·07	42·81
Lime,	1·21		*trace* and mag. *trace.*
Water,	13·14	15·00	12·92

This corresponds to the following formula, $\dddot{\mathrm{Si}}\,\dddot{\overline{\mathrm{Al}}}+2\dot{\mathrm{H}}$, but it is a question whether or not we should consider the water as existing in any definite proportion, and whether or not they did not all contain more water when first taken from their localities. These hydrated silicates of alumina are numerous, and bear various names, but it is doubtful if many of them are entitled to much consideration as distinct species.

Ephesite, (a new species.)—This silicate is found with the emery of Gumuch-dagh and occurs on specimens of magnetic oxyd of iron. It is of a pearly white color, and lamellar in structure; cleavage difficult. It scratches glass easily, and has a sp. grav. of from 3·15 to 3·20. Heated before the blowpipe it becomes milk-white, but does not fuse. At first sight it might be taken for white disthene. It is decomposed with great difficulty by carbonate of soda even with the addition of a little caustic soda. I used also very successfully in the analysis the bisulphate of soda either in attacking the mineral from the commencement, or in operating first with carbonate of soda, and then acting on the part not decomposed with bisulphate of soda. The alkalies were separated by means of hydrofluoric acid.

Silica,	31·54	30·04
Alumina,	57·89	56·45
Lime,	1·89	2·11
Protoxyd of iron,	1·34	1·00
Soda with a little potash,		4·41
Water,	3·12	3·06

This corresponds very nearly to the formula

$$\dot{\mathrm{R}}^2\,\dddot{\mathrm{Si}}+5\dddot{\overline{\mathrm{Al}}}{}^2\,\dddot{\mathrm{Si}}+4\,\dot{\mathrm{H}}.$$

	Atoms.	At. weight.	Pr. ct.	Oxygen ratio.
Soda,	2	781·6	7·08	1
Silica,	6	3400·2	30·77	9
Alumina,	10	6416·2	58·08	15
Water,	4	450	4·07	2

This mineral has been designated *Ephesite* because of its occurrence at the emery locality near the ancient city of Ephesus.

Emerylite, (a new species.)—This mineral which I have designated by the name of Emerylite is a new species belonging to the family of micas. I have already published a note indicating its existence,* but have reserved for the present time a complete description of it.

I first discovered this mineral with the emery of Gumuch-dagh in Asia Minor, and subsequently in that of Manser, the islands of Naxos and Nicaria, and also with the emery of Siberia.

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* See this Journal, 2nd ser., vii, 285, 1849.

Its connection with all the emerys that have come under my observation except that of Kulah, induced me to call it *Emerylite.* When I announced this discovery to Prof. Silliman, Jr., he hastened to examine the minerals coming from the corundum localities of the United States, and has succeeded in finding the emerylite with the corundum of several localities.* The specimen from Siberia on which I found this mineral is in the collection at the Garden of Plants at Paris, and I have also reason to think that I have found it with the corundum of China.

The emerylite is lamellar like mica, the plates are easily separated, and possess a little elasticity. Sometimes it is in the form of a mass composed of very small pearly scales, which are very friable, resembling some species of talc. The plates are commonly convex and concave, grouped in such a manner as to form a triangular prism. I have also found it massive with a micaceous structure, but with an irregular fracture; the aspect of this variety is waxy: it comes from Gumuch-dagh. The crystalline form of this mineral is difficult to determine, but if we are permitted to judge from the streaks on the surface, and the imperfect cleavage in two directions, it would appear to belong to an oblique rhombic prism.

Its color is white and lustre silvery; the hardness taken on a specimen from the island of Nicaria is from 4 to 4·5. The sp. grav. taken on ten specimens varies from 2·80 to 3·09; this difference is not remarkable in a lamellated mineral. That which gave me the greatest specific gravity contained some small specks of titaniferous iron visible to the eye. Its optical properties have not been examined, for the want of a transparent piece of sufficient size and thickness. This mineral is not attacked by the acids; heated before the blowpipe it emits a bright light and melts with great difficulty on the edges, which assume a blue color if touched with the nitrate of cobalt and reheated. Heated in a tube it furnishes water frequently having an acid reaction due to fluoric acid.

The composition of several specimens subjected to analysis is as follows:—

Localities.	Silica.	Alumina.	Lime.	Oxyd iron.	Magnesia.	Potash & soda.	Water.	Manganese.
Gumuch-dagh, ...	29·66	50·88	13·56	1·78	0·50	1·50	3·41	——
Island of Nicaria, ...	30·22	49·67	11·57	1·33	*trace.*	2·31	5·12	——
" "	29·87	48·68	10·84	1·63	*trace.*	2·86	4·32	——
Island of Naxos, ...	30·02	49·52	10·82	1·65	0·48	1·25	5·55	——
" "	28·90	48·53	11·92	0·87	not estimat'd	not estimat'd	5·08	——
" "	30·10	50·08	10·80	not estimat'd	"	"	4·52	——
Gumuch-dagh, ...	30·90	48·21	9·53	2·81	"	"	4·61	——
"	31·93	48·80	9·41	1·50	"	2·31	3·62	*trace.*
Siberia, ...	28·50	51·02	12·05	1·78	"	not estimat'd	5·04	——

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* See this Journal, viii, 379, and Dana's Mineralogy, pp. 362 and 689.

The oxyd of iron may be regarded as an impurity which exists between the plates of the mineral. The composition of the emerylite is represented by

	Atoms.	At. Weight.	Pr. ct.	Oxygen ratio.
Lime,	2	700·	13·48	2
Silica,	3	1700·1	32·74	9
Alumina,	4	2566·5	49·44	12
Water,	2	225·	4·34	2
		5191·6		

Formula, $\dot{\mathrm{R}}^2\,\dddot{\mathrm{Si}}+2\overline{\dddot{\mathrm{Al}}}{}^2\,\dddot{\mathrm{Si}}+2\dot{\mathrm{H}}$,

As is seen, the specimens examined came from four distinct localities, and were all taken under different circumstances; yet their analyses accord perfectly, and also agree with those of the United States coming from Village Green and Unionville of Pennsylvania, and Buncombe County, North Carolina.*

Localities.	Silica.	Alumina.	Lime.	Magnesia.	Potash & soda.	Water.		
Village Green,	32·31	49·24	10·66	0·30	2·21	5·27	=100	*Craw.*
"	31·06	51·20	9·24	0·28	2·97	5·27	=100	*Craw.*
"	31·26	51·60	10·15	0·50	1·22	4·27	=100	*Craw.*
"	30·18	51·40	10·87	0·92	2·77	4·52	=100·46	*Craw.*
Unionville,...	29·99	50·57	11·31	0·72	2·47	5·14	=100·10	
"	32·15	54·28	11·36	0·05	not estimat'd	0·50	$\overline{\dddot{\mathrm{Fe}}}$ *trace,*	*Hartshorne.*
Buncombe Co.,	29·17	48·40	9·87	1·24	6·15	3·99	HF 2·03 =100·80	*Silliman, Jr.*

My analyses were made in the ordinary way, only with more carbonate of soda than is usually employed. The alkalies were separated either by means of hydrofluoric acid or by carbonate of lime, which is preferable to the carbonate of baryta for the decomposition of the silicates.

It is seen that potash and soda are present in small quantities in all the specimens. The composition of this mineral is remarkable for the large proportion of alumina present; but when we look at its origin it is not astonishing to find a silicate of alumina with a small amount of silex.

I regard emerylite as a mineral of elimination from emery, the result of an effort by which the corundum in its formation purifies itself. It is not remarkable that from the mass in which the corundum crystallizes, the silica finding itself in presence with an excess of bases, combines with as large a quantity as its affinity will admit of. In speaking of the formation of emery, I have already alluded to a nodule in my possession that exemplifies this in a very exact manner.

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* See Dana's Mineralogy, 3d edition, p. 362.

Notwithstanding the recent discovery of emerylite there is no other species of mica that can be considered so well established as this mineral, or so constant in its composition. Up to the present time this mineral has not been found except with emery or corundum, which frequently contain it in the interior of the mass as well as on the surface. Some emerys contain it in such quantity that it has the aspect of gneiss, as I have already said with reference to certain specimens from Nicaria.

The most beautiful specimens of emerylite come from Naxos; and as the blocks of emery from this island frequently contain it, there will be no difficulty in procuring specimens for cabinets. It is often mixed with diaspore.

Mica, (Muscovite?)—This mica is found on all the emerys which I have examined, but especially on that coming from Kulah. It is always in small plates on the surface of the emery. The analyses of four specimens are as follows:—

Localities.	Silica.	Alumina.	Lime.	Oxyd of iron.	Magnesia.	Pot'h with little soda.	Water.	Manganese.
Gumuch-dagh, ...	42·80	40·61	3·01	1·30	*trace.*	not estimated.	5·62	*trace.*
Kulah, ...	43·62	38·10	0·52	3·50	0·25	7·83	5·51	*trace.*
Kulah, ...	42·71	37·52	1·41	2·32	*trace.*	not estimated.	5·95	*trace.*
Island of Nicaria, .	42·60	37·45	0·68	1·70	*trace.*	9·76	5·20	*trace.*

The composition is very nearly that of the muscovite or Muscovy glass, and until farther examination, I shall retain it under that species, as particular care should be exercised in making new species among the micas.

Chloritoid, (a new variety of this mineral.)—It is found with the emery of Gumuch-dagh in considerable abundance. Its structure is lamellar, cleaving without much difficulty, and the surfaces exposed are always very brilliant. In thin fragments it transmits the light and appears of a dark green color. The powder is greenish grey. Its hardness is 6, and specific gravity 3·52. Heated in the flame of the blowpipe it loses water, and becomes brown from the absorption of oxygen but does not melt. When heated without being in contact with the air it loses its brilliancy, and acquires the aspect of scales from the blacksmith's forge.

This mineral is attacked by the strong acids but is only completely decomposed by sulphuric acid. Melted with four or five times its weight of carbonate of soda it is rendered easily soluble in hydrochloric acid. Great precaution was taken to see that nothing but perfectly pure chloritoid was submitted to analysis, and the possession of well crystallized specimens enabled me to do this without much difficulty.

The method of analysis, was to break the mineral in small fragments, to place it in a small platinum crucible, which was introduced into an earthen crucible and surrounded by pulverized quartz: in one word, I pursued the same method as that for estimating the water in emery. For the other ingredients, a new portion was taken, pulverized finely, and attacked either by concentrated sulphuric acid or melted with carbonate of soda, and afterwards dissolved in hydrochloric acid with the addition of a little nitric acid evaporated to dryness, and treated with dilute hydrochloric acid. The liquid separated from the silica is treated with an excess of caustic soda, and the filtered liquid is neutralized by hydrochloric acid and the alumina precipitated by carbonate of ammonia.

The contents of the filter which are essentially peroxyd of iron, are placed in a capsule, dissolved by hydrochloric acid, heated and precipitated by ammonia and thrown on a filter. From the filtered solution the lime and magnesia are separated in the ordinary way. The peroxyd of iron remaining on the filter after being well washed and dried, is weighed and decomposed in a current of hydrogen gas. To the oxyd thus reduced, nitric acid diluted with thirty times its weight of water is added, and digested at 100° to 120° C. for about an hour, stirring frequently, when if the iron has been thoroughly reduced it will be taken up by the acid, and a little alumina left which is weighed and added to the first portion. Ordinarily I never have found more than from one to two per cent. of alumina with the oxyd of iron. Care must be taken to decompose the iron completely, as otherwise the iron will not be entirely taken up by the acid. The mineral thus analyzed afforded as follows:—

	Silica.	Alumina.	Protox. of iron.	Water.	Lime.	Magnesia.	Titanic acid.	Manganese.	Potash & soda
Decomposed by sulphuric acid,	24·10	39·8	27·55	6·5	not estimat'd	not estimat'd	not estimat'd	not estimat'd	0·30
Decomposed by carb. soda, . . .	23·94	39·52	28·05	7·08	0·45	0·80	*trace.*	0·52	——
Decomposed by carb. soda, . . .	23·20	40·21	27·25	6·97	0·83	0·95	*trace.*	not estimat'd	——

These analyses correspond to the following composition.

	Atoms.	At. weight.	Pr. ct.
Silica,	2	1133·40	23·87
Alumina,	3	1925·88	40·57
Protoxyd of iron,	3	1350·00	28·44
Water,	3	337·50	7·12

The most probable formula is

$$\overset{\cdots}{\bar{\mathrm{Al}}}{}^{3}\,\overset{\cdots}{\mathrm{Si}}+\dot{\mathrm{Fe}}{}^{3}\,\overset{\cdots}{\mathrm{Si}}+3\dot{\bar{\mathrm{H}}}.$$

The minerals which are brought under this species are the chloritspath or chloritoid of the Ural, the Sismondine of St. Marcel and the Masonite of Rhode Island; their analyses and formmulæ are as follows:—

	I.	Oxygen.	II.	Oxygen	III.	Oxygen.	IV.	Oxygen.	V.	Oxygen.	VI.	Oxygen.
Silica,.....	27·48	6	24·40	2	24·1	9	28·27	6	25·18	5	23·91	2
Alumina, ..	35·37	6	45·17	3	44·2	15	32·16	6	33·61	6	39·52	3
Protox. of iron, ...	27·05	3	30·29	1	23·8	4	33·72	3	35·31	3	28·05	1
Magnesia,..	4·29											
Water, ...	6·95	3	....	..	7·6	5	5·00	2	5·88	2	7·08	1

I. Chlorite spar or Chloritoid of the Ural by Bonsdorff. $(\dot{\mathrm{Fe}},\dot{\mathrm{Mg}})^3\dddot{\mathrm{Si}}+\ddot{\overline{\mathrm{Al}}}^2\,\dddot{\mathrm{Si}}+3\dot{\overline{\mathrm{H}}}$.

II. Chlorite spar of the Ural, Erdmann. $\dot{\mathrm{Fe}}^3\,\ddot{\overline{\mathrm{Al}}}+2\ddot{\overline{\mathrm{Al}}}\,\dddot{\mathrm{Si}}$.

III. Sismondine of St. Marcel, Delesse. $\dot{\mathrm{Fe}}^4\,\dddot{\mathrm{Si}}^3+5\ddot{\overline{\mathrm{Al}}}\,\dot{\overline{\mathrm{H}}}$.

IV. Masonite of Rhode Island, Whitney. $\dot{\mathrm{Fe}}^3\,\dddot{\mathrm{Si}}+\ddot{\overline{\mathrm{Al}}}^2\,\dddot{\mathrm{Si}}+2\dot{\overline{\mathrm{H}}}$.

V. Chlorite spar according to Rammelsberg requires, $3\dot{\mathrm{R}}^3\,\dddot{\mathrm{Si}}+2\ddot{\overline{\mathrm{Al}}}^3\,\dddot{\mathrm{Si}}+6\dot{\overline{\mathrm{H}}}$.

VI. Chloritoid of Asia Minor, J. L. Smith. $\ddot{\overline{\mathrm{Al}}}^3\,\dddot{\mathrm{Si}}+\dot{\mathrm{Fe}}^3\,\dddot{\mathrm{Si}}+3\dot{\overline{\mathrm{H}}}$.

This mineral is found very abundantly with the emery of Gumuch-dagh; it covers the surface of the blocks, and sometimes enters largely into the substance of the emery. It is easy to see from the composition of this mineral, that it is formed by elimination from the mass of emery at the time of its consolidation, which by this means tends to purify itself. The nodule of which I have already spoken under the head of emery and of emerylite goes to sustain this view of the question.

On the emery of the other localities, I have not found this chloritoid. Its composition is not in perfect accordance with the known varieties of chloritoid, and differs from Sismondine (which it approaches most in composition) by its imperfect solubility in hydrochloric acid.

Black Tourmaline.—This mineral is found abundantly with the emery of Naxos, and also in small quantities with that of other localities. It appears to have replaced the chloritoid that is found so abundantly with the emery of Gumuch-dagh.

The crystals are found agglomerated on the surface, and also disseminated in the interior of the emery. This mineral like the last is strongly basic, containing a little more than thirty per cent. of silica.

Chlorite.—With the emery of Gumuch-dagh we find a chlorite. It is in compact masses composed of an agglomeration of small crystalline plates, and contains octahedral crystals of magnetic oxyd of iron. Analysis gives as its composition,

Silica,	27·20
Alumina,	18·62
Protoxyd of iron,	23·21
Magnesia,	17·64
Water,	10·61

It is identical with the chlorite of *Mont des sept-Lacs* which gave M. Marignac,

Silica,	27·14
Alumina,	19·19
Protoxyd of iron,	24·76
Magnesia,	16·78
Water,	11·50

It is the same as the chlorite of *St. Christophe* and the ripidolite of *Rauris* and of *St. Gothard.* The formula given by von Kobell is,

$$2\dot{\mathrm{M}}\mathrm{g}\,\dddot{\bar{\mathrm{A}}}\mathrm{l}+3(\dot{\mathrm{M}}\mathrm{g}\,\dot{\mathrm{F}}\mathrm{e})^2\,\dddot{\mathrm{S}}\mathrm{i}+6\dot{\bar{\mathrm{H}}}.$$

Magnetic Oxyd of Iron.—This is found with the emery of every locality. It enters into the composition of the emery itself and is also found on the surface in regular octahedral crystals. We find it frequently massive and of strong polarity. That of Gumuch-dagh contains a trace of titanic acid.

Oligiste Iron.—It is associated with all the emerys, and sometimes enters into their composition. It is also found in detached masses, either amorphous or as crystallized specular iron.

Hydrated Oxyd of Iron.—This oxyd of iron is not unfrequently found with emery, covering the surface. It is found with pyrites having resulted from the decomposition of this mineral.

Iron Pyrites.—Pyrites is found principally with the emery of Gumuch and Nicaria. At the latter locality it is in small crystals in the interior of the mass. At Gumuch it is principally on the surface but much less abundant than at Nicaria.

Rutile.—This oxyd of titanium is found with the emery of Gumuch-dagh and of Kulah, where I obtained some large detached crystals. I have also a specimen, with it in small crystals on diaspore attached to emery from Gumuch-dagh.

Ilmenite.—It has been found on the gangue of the emery of Kulah in minute crystals, of the usual form of this mineral.

Titaniferous iron.—Titaniferous iron is found with almost all the varieties of emery that I have examined, but I have analyzed none but that associated with the emery of Nicaria. Care being first taken to see that it was anhydrous, one gramme of it was calcined in a current of oxygen and it augmented ·019, which indicated the presence of ·171 gramme of protoxyd of iron, and corresponds to ·190 gramme of peroxyd of iron; the same portion then decomposed by a current of hydrogen gas and the loss sustained was equal to ·222 gramme of oxygen, which corresponds to ·740 gramme of peroxyd of iron; deducting from this the quantity of peroxyd equal to the protoxyd (·171) contained in the mineral, we have ·550 gramme for the quantity of peroxyd present. The mass reduced by hydrogen was treated with hydrochloric acid, and the part not dissolved (·230 gramme) was titanic acid with a little alumina. The acid solution contained ·010 lime, and a trace of alumina. The titanic acid was examined as to its purity and was found to contain no silica, and only a trace of alumina. The result of the analysis is,

Protoxyd of iron, ...	17·10
Peroxyd of iron, ...	55·00
Titanic acid, ...	23·01
Lime, ...	1·00
Alumina, ...	a little, not estimated.

This titaniferous iron corresponds in composition to the Washingtonite of Prof. Shepard as analyzed by M. Marignac, and to the titaniferous iron of Arendal analyzed by M. Mosander. Its sp. grav. is 4·78.

There are still two or three minerals that I have found associated with emery, but their specific characters have not been well established, on account of the difficulty of obtaining enough in a state of sufficient purity for analysis.

The study of these accidental minerals in contact with emery has led to several general conclusions which have been mentioned under the description of the different species; and now I do not risk much in saying, that the hydrates of alumina, as diaspore,—as well as the silicates, as emerylite, chloritoid and tourmaline,—and the minerals of iron, as magnetic, titaniferous iron, &c,—will be found almost everywhere with the emery and corundum.

My labors on this subject are thus terminated, and it is to be hoped that the examination of the emery of Asia Minor has served to elucidate the geology and mineralogy of this substance, until now but little known except in its uses.