MINERALOGICAL CHEMISTRY.

IN preparing this report the writer has followed on the whole the method of treatment adopted in that of last year, for as the material under discussion consists in the main of a number of entirely disconnected facts, the construction of a continuous narrative appeared neither easy nor indeed advisable, and has accordingly not been attempted. The object in view has been rather to present in some detail points of general interest, and to touch lightly, or not at all, on matters of little moment, or likely to appeal to none save specialists ; it is hoped, however, that nothing of great importance has been overlooked or omitted.

General and Physical Chemistry of Minerals.

Salt Deposits.—During the year, J. H. van't Hoff¹ and his pupils have added seven more to the long series of papers on the "Formation of Oceanic Salt Deposits." In number xxxix, the transformation of Glauber's salt, $\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$, into thenardite, Na_2SO_4 , which takes place normally at 32.4° , is shown to occur at lower temperatures if other salts are present. The limits of the existence of tachhydrite, $\text{CaCl}_2 \cdot 2\text{MgCl}_2 \cdot 12\text{H}_2\text{O}$, are set forth in number xl. The temperature of formation of potassium pentacalcium sulphate, $\text{K}_2\text{Ca}_5(\text{SO}_4)_6 \cdot \text{H}_2\text{O}$, is the subject of number xli, that of glauberite, $\text{Na}_2\text{SO}_4 \cdot \text{CaSO}_4$, of number xlii. The investigation, so far as calcium compounds at 25° are concerned, is brought to a conclusion in number xliii, and the composition of all constant solutions when saturated with the particular calcium salt with which the solutions are in equilibrium is tabulated.

The investigation of boron compounds and of the part played by calcium salts at higher temperatures is now being begun. Number xliv deals with the limit of existence of tachhydrite at 83° , and number xlv with the occurrence of tinkal, $\text{Na}_2\text{B}_4\text{O}_7 \cdot 10\text{H}_2\text{O}$, and of octahedral borax.

The study of this important work has been greatly facilitated by

¹ *Sitzungsber. K. Akad. Wiss. Berlin*, 1904, 1418 ; 1905, 232, 305, 478, 712, 913, 1086.

the publication by van't Hoff¹ of the first part of a connected account in book form of his researches, in which salt deposits consisting of the chlorides and sulphates of sodium, potassium, and magnesium are fully dealt with. This account has been supplemented by a long paper recently published in the *Zeitschrift für anorganische Chemie*, in which calcium compounds are considered.² It is therefore now possible to obtain readily a complete conception of the progress so far made towards the solution of the complex problems of salt deposits.

Constitution of the Felspars.—One of the most important contributions which has yet been made to our knowledge of the mutual relations of molten silicates is contained in a paper by A. L. Day and E. T. Allen³ on the "Isomorphism and Thermal Properties of the Felspars." Employing refined modern methods of high temperature thermometry, the authors have traced the cooling and heating curves of albite and anorthite, and of mixtures of these substances corresponding to certain of the plagioclases. Microcline and borax have also been included in the field of observation. The melting points were determined by the changes in the cooling or heating curves caused by evolution or absorption of heat. In the case of the plagioclases, the various members studied were prepared artificially. After a preliminary examination of albite, microcline, and borax, which brought to light the important part played by viscosity in retarding crystallisation and in obscuring the phenomena, it was found that artificial anorthite melted sharply at 1532° and crystallised readily. Pure albite, on the other hand, could not be persuaded to crystallise at all, and had no definite melting point. The intermediate members of the plagioclase series gave intermediate results. Thus, the mixture Ab_1An_9 crystallised tolerably readily, and had a fairly sharp melting point at 1500°, while Ab_4An_1 was almost as intractable as pure albite. The specific gravities of these crystalline artificial felspars were also determined. The most important conclusions arrived at are as follows: (1) if the melting points of the plagioclases are plotted as ordinates and the compositions as abscissæ, a nearly linear relation is obtained. These felspars are solid solutions and form an isomorphous series belonging to type I of Bakhuis Roozeboom's classification. (2) The isomorphism is confirmed by a study of the specific gravities. (3) In the case of albite and microcline there is no definite melting point, the amorphous melted mass remaining of the same order of

¹ *Zur Bildung der ozeanischen Salzablagerungen*. Braunschweig: Vieweg u. Sohn. 1905. Pp. 85. Price 4 marks.

² *Zeit. anorg. Chem.*, 1905, **47**, 244—280.

³ *Amer. J. Sci.*, 1905, [iv], **19**, 93. See also Pub. 31 of the Carnegie Institute, Washington.

viscosity as the rigidity of the crystals through a considerable range of temperature. The absorbed heat of fusion was distributed over this interval. (4) Viscous, poorly-conducting melts do not give constant solidifying points.

Mutual Relations of Fused Silicates.—The important work of J. H. L. Vogt was referred to in the report for 1904, and towards the close of that year the second half of his book entitled “Die Silikatschmelzlosungen” appeared. In it are given the data on which were based many of the conclusions he had already announced, as well as a full discussion of many points, either new or but lightly touched on in the first portion. The subjects dealt with include: the melting points of minerals; the cooling curves of the silicates, their total and latent heats of fusion, specific heats, and radiation exponents; energy isobars; points of transformation below the melting points; experimental proof of the depression of the melting point in silicate melts containing several components; types of mixed crystals in the meta-silicate series; the composition of certain eutectic mixtures; determination of molecular weights; supersaturation and resorption; relations between viscosity, time of crystallisation, and size of crystals; glass as a solid solution; feldspar and quartz; theory of silicate melts and technical applications. The general position adopted may be summed up in the statement that van’t Hoff’s law of molecular melting point depression, Ostwald’s law relative to the formation of labile compounds, Nernst’s laws of the diminution of solubility by a common ion and of the heterogeneous equilibrium of two liquid phases possessing limited solubility, Bakhuis Roozeboom’s laws concerning the solidifying points of mixed crystals of two substances, and the law of electrolytic dissociation, due to Arrhenius, all hold for these silicate melts.

Further, he believes that silicate melts at the ordinary pressure are crystalloidal mutual solutions of tolerably simple compounds which crystallise out on cooling. As a rule, the compounds do not polymerise. All molten silicates are mutually soluble to any extent, but between silicates and sulphides limited solubility prevails.

Vogt’s views are only partially shared by C. Doelter, who thinks that the former is inclined to press the theories of physical chemistry in this new sphere further than is warranted in the present state of knowledge. This difference of opinion has led to a good deal of discussion,¹ but whatever view may be taken as to the arguments employed, there can be no doubt as to the interest aroused in the subject. Doelter’s present position is set forth in a long paper communicated to the Viennese academy,² partly experimental and partly theoretical in char-

¹ See *Centr. Min.*, 1905, 144, 148, 361.

² *Sitzungsber. K. Akad. Wiss. Wien*, 1905, **114**, 529.

acter. On the experimental side, the paper deals with the viscosity of minerals in the neighbourhood of their melting points, which he has measured by observing the depths to which a platinum rod will penetrate the substance previously heated to a definite temperature. His results for the feldspars confirm in the main the observations of Day and Allen, and he has also examined elæolite, leucite, diopside, augite, hedenbergite, and acmite. The melting point of a silicate is, he thinks, best defined as the point of transition from the crystalline to the amorphous condition, and he calls attention to the fact that this point is not necessarily identical with the point of liquefaction, which may be 100° or more above the transition point. The uncertainty as to what various authors have meant by the melting point when dealing with these substances is probably the cause of many of the discrepancies in the published values. Doelter further points out the necessity of distinguishing between the power of crystallisation possessed by a substance and the velocity with which it crystallises, and shows how the crystallising power may influence the order of separation of compounds from complex mixtures such as igneous rocks.

Constitution of the Zeolites.—The work of F. W. Clarke and of G. Steiger has shown that the bases in many zeolites can be replaced by ammonium when the minerals are heated with ammonium chloride in sealed tubes, and the latter¹ has lately found that on fusion with the nitrates of silver or thallium these elements can also be introduced into the silicate molecules. Thus, from analcite, $\text{NaAlSi}_2\text{O}_6 \cdot \text{H}_2\text{O}$, the compounds $\text{AgAlSi}_2\text{O}_6 \cdot \text{H}_2\text{O}$ and $\text{TlAlSi}_2\text{O}_6$ were prepared. In the case of chabazite and stilbite, the ratios of the substitution compounds were found to agree closely with the ratios 1 : 2 : 2 for the monoxide base, alumina, and silicic acid respectively, and, although in thomsonite incomplete substitution occurs, the ratios are nevertheless fairly well preserved. The experiments on chabazite proved of special interest, for the preparations were found to contain notable quantities of nitrate which could not be removed by washing. The compounds obtained from natrolite, scolecite, and mesolite indicate that all three minerals are derived from the trisilicic acid, $\text{H}_8\text{Si}_3\text{O}_{10}$.

A paper on the same subject has recently been published by F. W. Clarke.² It contains an account of some experiments on substitution by barium and strontium in the zeolites made by H. C. McNeil, as well as a theoretical discussion of the work of both McNeil and of Steiger. Analcite is shown to yield the compounds $\text{BaAl}_2\text{Si}_4\text{O}_{12}$ and $\text{SrAl}_2\text{Si}_4\text{O}_{12}$ as well as those mentioned above, and a sodium stilbite has also been prepared. In the case of chabazite, the action of barium chloride is to produce complete substitution, but it

¹ *Bull. U.S. Geol. Surv.*, 1905, **262**, 75.

² *Proc. Washington Acad. Sci.*, 1905, **7**, 257.

seems probable that a series of reactions takes place, the barium chabazite first formed being afterwards decomposed. Although the presence of chlorine and of NO_3 in substituted stilbite and chabazite can be explained on the assumption that chlorides or nitrates are occluded as such by the preparations, Clarke points out that it is possible that new compounds have been formed, analogous to sodalite or marialite, into which chlorine and NO_3 have entered as integral parts of the molecule. It may be mentioned here that experiments of a somewhat similar character on the action on kaolin of the chlorides of barium, strontium, sodium, and lithium have been made by Z. Weyberg.¹

Water in Zeolites.—Very various opinions have been held as to the part played by water in zeolites. Some workers have regarded it as present partly as water of constitution, partly as water of crystallisation, and have constructed elaborate formulæ on the basis of this assumption. Others, basing their conclusions in the main on the continuous and reversible changes in the optical characters which take place when zeolites are heated, have held that water is in no way essential to the existence of these substances in the crystalline state, but that its part in the crystalline network is very much that of water held in the pores of a sponge. Others, again, have been inclined to regard zeolites as solid solutions. An important contribution to this subject, both from the experimental and from the theoretical side, has been made recently by F. Zambonini.² Using as material specimens of heulandite and of thomsonite of known composition, he has set himself to determine the phenomena of dehydration and reabsorption presented by these minerals under various conditions, and to trace the resulting changes in the optical properties. To this end he has determined at short intervals of time the loss of weight when the finely-powdered zeolites were dried: (1) over sulphuric acid in a vacuum at the ordinary temperature, (2) in a current of dry air at various temperatures, (3) in a current of moist air at various temperatures. He finds that over sulphuric acid a certain definite maximum loss is slowly attained. The process can be represented by a continuous curve, and in the case of a heulandite containing 16.6 per cent. of water the maximum loss amounted to 6.06 per cent. From a study of the dehydration curves obtained when currents of dry and moist air are respectively employed, he finds that moist air removes water more slowly than dry air. The difference in effect is apparently due to the tension of aqueous vapour present, and varies with the temperature. As regards reabsorption, he finds that the water given off over sulphuric acid or on exposure to a moderate degree of heat is rapidly

¹ *Centr. Min.*, 1905, 138, 646, 717.

² *Mem. R. Accad. Lincei*, 1905, 5, 344.

taken up again when the zeolite is placed in moist air. If, however, the substance has been heated above a certain temperature, about 300° in the case of heulandite, the rate of reabsorption is much diminished and may be reduced to zero, even if the point of complete dehydration has not been attained. Further, he finds that above a certain temperature the duration of heating has a great retarding influence on the velocity of reabsorption when the substance is afterwards exposed to moisture. A similar effect is produced by a series of successive dehydrations if carried out at temperatures near that at which the diminution in the velocity of reabsorption begins. On the other hand, a series of successive dehydrations (followed by exposure to moisture) at moderate temperatures does not appear to influence the absorption or emission of water. A study of the optical characters of heulandite has shown that the mode of dehydration has an influence on the result. Cleavage flakes dehydrated by exposure to a temperature of 100° for from three to eight hours not only presented appearances different to those exhibited by flakes kept in a vacuum over sulphuric acid for twenty-four hours at the ordinary temperature, but always regained their original optical characters when exposed to moist air, which the latter failed to do. As the result of these experiments, Zambonini concludes that the view is untenable which regards the zeolites as hydrated salts, although they doubtless present many points of resemblance to such substances. Moreover, he believes that although the view that zeolites are solid solutions receives some support from their dehydration curves and from their optical behaviour, yet it fails to explain all the facts. He therefore prefers to regard them as analogous to the hydrogels studied by van Bemmelen, for, like the zeolites, the state of hydration of these substances depends on the temperature and on the concentration of the gaseous phase. Moreover, above a certain temperature the phenomena of dehydration are not reversible, and prolonged heating renders them incapable of reabsorbing water.

The dehydration of heulandite has also been studied by A. A. Ferro,¹ who used a specimen from Montecchio Maggiore. He determined the loss of weight experienced by the mineral when kept in a desiccator over calcium chloride and also when heated to various temperatures in air. Like Zambonini, he finds that the loss attains a maximum in both cases if sufficient time is allowed. When the mineral is kept in the desiccator, the maximum loss amounts to from 6.9 to 7.1 per cent., and can be quickly made good by exposure to moisture. Further, he points out that heulandite which has been kept in air absorbs water when exposed to a saturated atmosphere at a slightly elevated temperature, and loses it again when once more placed in air. Since

¹ *Atti R. Accad. Lincei*, 1905, **14**, ii, 140.

the water retained when equilibrium is reached, either over calcium chloride or on heating to 100—104°, amounts to approximately 3 mols., Ferro concludes that heulandite contains 3 molecules of water more intimately connected with the molecule than the rest, which may be termed hygroscopic water.

The Silicic Acids.—The importance of the preparation and study of the various silicic acids as an aid to our knowledge of the constitution of the naturally occurring silicates has lately been insisted on by E. Jordis¹ and by G. Tschermak.² While the former has occupied himself chiefly with the investigation of the conditions necessary for the preparation of pure silicic acid, the latter has attacked the problem from the mineralogical side. He points out that the silicates are probably salts of various acids derived from orthosilicic acid by removing from $n - 1$ to $2n - 1$ molecules of water from n molecules of H_4SiO_4 . We thus obtain a series of acids such as H_4SiO_4 , $\text{H}_6\text{Si}_2\text{O}_7$, $\text{H}_8\text{Si}_3\text{O}_{10}$, H_2SiO_3 , $\text{H}_4\text{Si}_2\text{O}_6$, and so on. Some of these are polymerides, for example, $\text{H}_4\text{Si}_2\text{O}_6$ and H_2SiO_3 ; of others, isomerides can exist. If the natural silicates are salts of these acids, then on decomposing them with hydrochloric acid the corresponding silicic acid should be set free. To determine whether this is so or not, he proceeds as follows. A small quantity of the silicate is digested with hydrochloric acid at a temperature not exceeding 60° until decomposition is complete. This may take many days or even weeks. The silica obtained is washed by decantation until free from chlorine and then allowed to dry in the air in a weighed dish. The weight of the dish and contents is determined at intervals of twenty-four hours until it becomes constant, when the amount of silica present is found by igniting the residue. The results when plotted give the dehydration curve. On inspection, this is seen to consist of two parts, one portion corresponding to the drying process, the other to the decomposition of the silicic acid. The change in the course of the curve marks the point when dehydration is complete and decomposition is just beginning. It is difficult to determine the position of this point by direct observation or inspection of the curve, but it may be calculated with a fair degree of accuracy by means of observations taken on each side of it. Finally, as an aid to the better definition of the acids, their specific gravities were in some cases determined. The main results of the work are as follows. The acid obtained on decomposing silicon chloride by water is orthosilicic acid, H_4SiO_4 (sp. gr. 1.576). The same acid is obtained from natrolite, $\text{Na}_2\text{H}_4\text{Al}_2\text{Si}_3\text{O}_{12}$, and from diopside, H_2CuSiO_4 , which are accordingly acid salts of orthosilicic acid. Hemimorphite,

¹ *Zeit. anorg. Chem.*, 1905, **44**, 200.

² *Zeit. physikal. Chem.*, 1905, **53**, 349. See also an earlier paper on the same subject, *Sitzungsber. K. Akad. Wiss. Wien.*, 1903, **112**, i, 355.

$\text{H}_2\text{Zn}_2\text{SiO}_6$, behaves similarly, and is therefore also derived from orthosilicic acid. The application of the method to olivine yielded no certain result. From anorthite, $\text{CaAl}_2\text{Si}_2\text{O}_8$, metasilicic acid, H_2SiO_3 (sp. gr. 1.813), was obtained. Leucite, KAlSi_2O_6 , yields a polymeride of metasilicic acid, $\text{H}_4\text{Si}_2\text{O}_6$, which differs from metasilicic acid in its appearance and also in its behaviour towards methylene-blue. A similar result was obtained with serpentine, which is therefore to be regarded as $\text{H}(\text{Mg},\text{OH})_3\text{Si}_2\text{O}_6$. From garnet, epidote, zoisite, and prehnite, the acid $\text{H}_4\text{Si}_3\text{O}_8$ (sp. gr. 1.910) was obtained. These minerals must therefore be regarded as silicoaluminates. Prehnite is the acid salt $\text{Si}_3\text{O}_8\text{Ca}_2\text{Al}_2\text{O}_4\text{H}_2$. In garnet, all the hydrogen is replaced by calcium, in epidote and zoisite its place is taken by the group AlOH . Albite, $\text{NaAlSi}_3\text{O}_8$, yields an acid, $\text{H}_2\text{Si}_3\text{O}_7$, which is stable when exposed to air.

In concluding this section, attention may be called to the "Treatise on Metamorphism," by C. R. van Hise, published as Memoir 47 of the United States Geological Survey towards the close of last year, which will be found to be a rich storehouse of information on many important branches of mineral chemistry. C. Doelter's work entitled "Physikalisch-chemische Mineralogie" (Leipzig: J. A. Barth, 1905) will also be found of value.

Artificial Formation of Minerals.

Diamond.—The study of the mode of occurrence of the diamonds found in the Cañon Diablo meteorite has led H. Moissan¹ to repeat some of his early experiments on the artificial formation of this substance, and to perform some new ones. Noticing that the diamonds were found in fissures which appeared to be connected with the presence of nodules containing sulphur, silicon, and phosphorus, he tried the effect of adding these elements to the molten iron from which carbon was to separate on cooling. The results showed that the presence of sulphur improved the yield. In the case of silicon, the yield also appeared to be improved, but the quality of the diamonds was poorer. The influence of phosphorus was unfavourable. His final conclusions may be summed up as follows: diamond is the variety of carbon which has been liquefied under high pressures; carbon heated to a high temperature under atmospheric pressure vaporises without becoming liquid and solidifies as graphite.

Similar ideas have guided W. Crookes² in some recent work on the same subject. He has pointed out that there is reason to believe that the physical constants of carbon are approximately as follows:

¹ *Ann. Chim. Phys.*, 1905, [viii], 5, 174.

² *Proc. Roy. Soc.*, 1905, A 76, 458.

boiling point, 3870° abs. ; melting point, 4400° ; critical temperature, 5800° ; critical pressure, 2320 atmospheres. From these values the melting point pressure of 16.6 atmospheres can be calculated. If the diamond is the result of the crystallisation of liquid carbon, it is clear that pressure is an all important factor in its formation. Now as the experimental conditions for the simultaneous production of high temperatures and high pressures were realised in A. Noble's work on the explosion of cordite in closed cylinders, W. Crookes has examined the residues in the cylinders for diamonds, and his search has been rewarded by success.

C. V. Burton,¹ on the other hand, has suggested that carbon may crystallise as diamond under atmospheric pressure at temperatures lying between 550° and 700° . He has found that an alloy of lead with about 1 per cent. of calcium holds some carbon in solution. On passing steam over the alloy at a low red heat, no graphite was produced, but microscopic crystals were found in the residues, which from their shape, high refractive index, and chemical behaviour seemed to be diamonds. On performing the experiment at a full red heat, no such crystals could be detected, but graphite was obtained.

Ferron trite.—In the course of his work on the constitution and genesis of the native sulphates of iron, R. Scharizer² points out that ferronatrite, $\text{Na}_6\text{Fe}_2\text{S}_6\text{O}_{24}, 6\text{H}_2\text{O}$, and sideronatrite, $\text{Na}_4\text{Fe}_2\text{S}_4\text{O}_{17}, 7\text{H}_2\text{O}$, are probably both derived from $[(\text{HO})\text{Fe}]_2[\text{HSO}_4]_4, 6\text{H}_2\text{O}$, the acid ferric sulphate ; thus sideronatrite is $[(\text{HO})\text{Fe}]_2[\text{NaSO}_4]_4, 6\text{H}_2\text{O}$ and ferronatrite is $[(\text{NaSO}_4)\text{Fe}]_2[\text{NaSO}_4]_4, 6\text{H}_2\text{O}$. This view is confirmed by the fact that a substance having the composition of ferronatrite was obtained by mixing acid ferric sulphate and sodium hydrogen sulphate and allowing them to act on one another in the presence of moist air. Experiments on the production and transformation of sideronatrite support the constitution given above rather than that represented by the formula $2\text{Na}_2\text{SO}_4, \text{Fe}_2\text{S}_2\text{O}_9, 7\text{H}_2\text{O}$.

Radioactive Minerals.

Several papers dealing with radioactivity and containing matter of mineralogical interest have appeared during the year. In the first place, R. J. Strutt³ has described experiments made to determine the amounts of uranium, radium, thorium, and helium present in monazite, pitchblende, æschynite, gadolinite, and a number of other minerals. Uranium was estimated by the ordinary chemical methods, radium and thorium by means of their emanations, whilst helium was determined directly. The conclusions he arrives at are as follows : (1) the amount

¹ *Nature*, 1905, **72**, 397.

² *Zeit. Kryst. Min.*, 1905, **41**, 209.

³ *Proc. Roy. Soc.*, 1905, *A* **76**, 88.

of radium in a mineral is proportional to the uranium present. Incidentally he has shown that uranium occurs in some minerals, for example, monazite, not previously known to contain it. (2) Thorium is always accompanied by the uranium-radium combination, a fact which leads to the suggestion that thorium is producing uranium. (3) Helium only occurs in quantity if thorium is present, and is therefore probably produced more by thorium than by radium. (4) Thorium minerals vary much in emanating power. The conclusion that the amount of radium contained in a mineral is proportional to the uranium present has also been reached by B. B. Boltwood¹ after an examination of 22 samples belonging to 12 species of minerals containing from 0.3 to 74 per cent. of uranium. He believes that uranium is the parent of radium and that thorium has no part in its production; he has not, however, been able to obtain direct evidence of the change of uranium into radium. Like Strutt, he has detected uranium in monazite and, noticing the persistent occurrence of lead in these minerals, suggests that this element may result from the breaking up of uranium. He has followed up this idea in an important paper² on the ultimate disintegration product of the radioactive elements, in which he insists on the necessity of distinguishing between the primary minerals, which occur embedded in pegmatites and other rocks, and those of secondary origin, produced by the alteration of primary compounds or found in many mineral veins. To the first class belong the pitchblendes of Norway, North Carolina, Texas, and Connecticut, as well as æschynite, euxenite, fergusonite, samarskite, thorite, and thorianite. In the second class must be placed the pitchblendes of Cornwall, Saxony, and Bohemia, as well as gummite, autunite, and others. It is to the study of the composition of the primary minerals that we must look for evidence as to the existence of possible disintegration products. The secondary minerals may be too recent for the products to have accumulated in sufficient quantity for us to detect them. Studying the matter from this point of view, Boltwood finds that lead is present in all primary minerals which contain more than 2 per cent. of uranium. Further, since Hillebrand has found lead in all the uranium minerals he has analysed, Boltwood is confirmed in the view that lead is one of the final inactive disintegration products of uranium. The common association of uranium and thorium he interprets as supporting the idea that thorium is also a result of the disintegration of uranium: the opposite position to that adopted by Strutt. The small quantities of barium and of bismuth present in radioactive minerals are, he thinks, also to be attributed to disintegration, the former being possibly derived from actinium, the latter from thorium. The presence of hydrogen and of water in some of these

¹ *Phil. Mag.*, 1905, [vi], 9, 599.

² *Amer. J. Sci.*, 1905, [iv], 20, 253.

minerals has long been a puzzle to mineralogists. It seems impossible to believe that water can have penetrated them from without, for many of them are compact enough to retain helium, and they are, moreover, often associated with anhydrous minerals such as apatite and magnetite. Boltwood points out that this difficulty vanishes if we admit that the hydrogen is also due to disintegration. The presence of argon is accounted for in the same way. Further, he shows that a comparison of a number of analyses of pitchblende made by Hillebrand reveals a rough proportionality between the amount of uranium and the amounts of lead, rare earths, and helium for specimens from the same general locality, and a closer relation between the quantities of UO_2 and of helium. For specimens from the same actual locality, the content of rare earths increases with the amount of lead present, and the proportion of helium, as compared with lead, is greatest in those which have the highest specific gravity. It should, however, be noted that the proportions of helium and of rare earths and lead are not the same in the pitchblendes of Connecticut and of Norway, the relative quantity of helium being smaller in the latter than in the former. This discrepancy may perhaps be explained by the greater geological age of the Norwegian pitchblendes. That helium and rare earths are absent from the secondary pitchblendes of Saxony and Bohemia is quite in accordance with theory. From a study of other minerals, Boltwood finds that the proportion of helium with respect to lead and uranium is high in dense compact substances of low emanating power, such as monazite and samarskite, and also in minerals such as thorianite found in the oldest geological formations, and that the minerals with the greatest proportion of thorium are in general the most hydrated. That monazite contains uranium has also been confirmed by F. Zerban,¹ who detected the element in all the monazite sands he examined, and also to the extent of 0.02 per cent. of U_3O_8 in a good crystal from Norway. In conclusion, we may mention that E. Rutherford and B. B. Boltwood² have found that the quantity of radium associated with 1 gram of uranium in a radioactive mineral is equal to 7.4×10^{-7} grams approximately. This result was arrived at by comparing the effect on an electroscope of the emanation from a radium bromide solution of known strength and from a specimen of pitchblende from Spruce Pine, North Carolina, containing 74.65 per cent. of uranium.

New Minerals.

Beckelite.—This mineral is a calcium cero-lanthano-didymo-silicate. It is found in brown grains, or in little isotropic octahedra or dodecahedra embedded in the albite of a dyke rock, consisting of

¹ *Ber.*, 1905, **38**, 557.

² *Amer. J. Sci.*, 1905, [iv], **20**, 55.

albite and nepheline with magnetite and ægirine, which occurs in the elæolite syenite (mariupolite) of the Mariupol district on the sea of Azov. The cleavage is cubic, and the specific gravity 4·15 approximately. It is soluble in hot hydrochloric acid, and yields the following results on analysis :

SiO ₂ .	ZrO ₂ .	Al ₂ O ₃ .	Mn ₂ O ₃ .	Yt ₂ O ₃ + Er ₂ O ₃ .	Ce ₂ O ₃ .	La ₂ O ₃ .
17·13	2·50	0·30	0·07	2·80	28·10	13·60
Di ₂ O ₃ .	CaO.	K ₂ O.	Na ₂ O.	Ignition loss.	Total.	
18·00	15·46	0·39	0·78	0·99	100·12	

Traces of iron and magnesium were also detected. These numbers give the formula $\text{Ca}_3(\text{Yt,Ce,La,Di})_4(\text{Si,Zr})_3\text{O}_{15}$. J. Morozewicz,¹ the discoverer of the mineral, points out that by writing this in the form $\text{Ca}_3(\text{Ce,La,Di})_2\text{Si}_3\text{O}_{12}(\text{Ce,La,Di})_2\text{O}_3$ the analogy with the garnets is exhibited. It can also be written as follows: $\text{CaR}_2\text{Si}_2\text{O}_8, \text{Ca}_2\text{SiO}_4, \text{R}_2\text{O}_3$, where R = Ce, La, Di. The mineral may be distinguished from pyrochlore by its cleavage, lustre, and index of refraction, and also by the fact that it remains soluble in hydrochloric acid after ignition. It has been named in honour of Professor F. Becke.

Bowmanite is one of the many new minerals recently discovered by R. H. Solly² in the dolomite of the Binnenthal. Up to the present, only a few small, honey-yellow crystals have been found. They crystallise in the rhombohedral system, and have a perfect basal cleavage. Optical examination has shown that the mineral is pseudo-symmetric. It appears to be essentially a phosphate of lime and alumina with small amounts of iron and water.

Doughtyite.—This name has been tentatively proposed by W. P. Headden³ for a hydrated basic aluminium sulphate of the formula $\text{Al}_2(\text{SO}_4)_3, 5\text{Al}_2(\text{OH})_6, 21\text{H}_2\text{O}$, found at Doughty Springs, Delta Co., Colorado.

Giorgiosite.—This name has been given by A. Lacroix⁴ to a basic magnesium carbonate found as a fine powder composed of minute spherules on saline crusts obtained by Fouqué in 1866 from a fissure in the lava of Aphroëssa, Santorin. With it is associated a white, flocculent, isotropic material. The amount of these substances available was too small to admit of analyses being made, but as the properties of the latter are comparable with those of the freshly precipitated white magnesia of pharmacy, its composition is probably similar to that of hydromagnesite, $3\text{MgCO}_3, \text{Mg}(\text{OH})_2, 3\text{H}_2\text{O}$. The spherules appear to be identical with the product obtained when the precipitate

¹ *Bull. Acad. Sci. Cracovie*, 1905, année 1904, 485.

² *Min. Mag.*, 1905, 14, 80.

³ *Proc. Colorado Sci. Soc.*, 1905, 8, 55.

⁴ *Bull. Soc. franç. Min.*, 1905, 28, 198. See also *Compt. rend.*, 1905, 140, 1308.

of white magnesite is boiled for some time with its mother liquor. This product has been shown to be $4\text{MgCO}_3, \text{Mg}(\text{OH})_2, 4\text{H}_2\text{O}$, and this is accordingly the probable formula of the new mineral.

Hibschite occurs incrusting a green titaniferous melanite found in calcareous inclusions in the phonolite of the Marienberg near Aussig; it crystallises in isotropic octahedra. From two analyses, one of the melanite alone, the other of melanite mixed with hibschite, a formula has been arrived at by F. Cornu¹ identical with that of lawsonite, $\text{H}_4\text{CaAl}_2\text{Si}_2\text{O}_{10}$.

Hutchinsonite.—A few small crystals of this orthorhombic mineral, showing numerous faces and a good cleavage, have been obtained by R. H. Solly² from the dolomite of the Binnenthal. An analysis by G. T. Prior revealed the interesting fact that the substance is a thioarsenite of thallium, lead, silver, and copper containing nearly 20 per cent. of thallium.

Janosite.—A greenish-yellow efflorescence found on graphitic schist at the iron mine of Vashegy, Komitat Gömör, Hungary, has been analysed by H. Böckh and K. Emszt.³ The substance, which is probably the result of the decomposition of pyrites, crystallises in minute, orthorhombic plates with good basal cleavage (sp. gr. = 2.51 to 2.548). The formula is $\text{Fe}_2(\text{SO}_4)_3, 9\text{H}_2\text{O}$ and the mineral is therefore dimorphous with coquimbite (rhombohedral, sp. gr. 2.105) and closely allied to quenstedtite, $\text{Fe}_2(\text{SO}_4)_3, 10\text{H}_2\text{O}$.

Kleinite.—A. Sachs⁴ finds that small, yellow, hexagonal crystals from Terlingua, Texas, have the composition $3\text{HgO}, \text{HgCl}_2$. The mineral has a perfect basal cleavage. Its sp. gr. is 7.441.

Lengenbachite is a thioarsenite of lead with small amounts of silver, copper, and antimony, found by R. H. Solly⁵ in thin, blade-shaped crystals in the dolomite quarry through which flows the Lengenbach, a tributary stream of the Binnenthal.

Marrite is another of the new minerals described by R. H. Solly⁶ from the Binnenthal dolomite. Only a few small crystals have so far been found, and these belong to the oblique system and are very rich in faces. The chemical composition has not yet been determined.

Moissanite.—H. Moissan⁷ found green, hexagonal crystals of carbon silicide together with the various forms of carbon in those residues from the solution of 53 kilograms of Cañon Diablo iron in hydrochloric acid which resisted the attack of hydrofluoric and sulphuric acids. A further study of these crystals⁸ leaves no doubt as to their identity

¹ *Tsch. Min. Mitth.*, 1905, **24**, 327.

² *Min. Mag.*, 1905, **14**, 72.

³ *Föld. Közlöny*, 1905, **35**, 139.

⁴ *Sitzungsber. K. Akad. Wiss. Berlin*, 1905, 1091.

⁵ *Min. Mag.*, 1905, **14**, 78.

⁶ *Ibid.*, 76.

⁷ *Compt. rend.*, 1904, **139**, 773.

⁸ *Compt. rend.*, 1905, **140**, 405. See also *Ann. Chim. Phys.*, 1905, [viii], **5**, 174

with carborundum, and G. F. Kunz, therefore, proposes that the naturally occurring compound should be called moissanite.

Paracelsian.—In the crystalline schists of Candoglia, Val del Toce, veins and nodules rich in quartz, diopside, calcite, pyrite, and other minerals are found together with calcareous fragments consisting almost entirely of calcite and pyroxene. Intimately associated with these veins and fragments occur pale yellow granules of a barium aluminium silicate. The optical properties and chemical composition of this mineral have been carefully studied by E. Tacconi,¹ whose analyses lead him to assign to it the formula $\text{Ba}_3\text{Al}_8\text{Si}_8\text{O}_{31}$. This suggests comparisons with barylite, $\text{Ba}_4\text{Al}_4\text{Si}_7\text{O}_{24}$, and celsian, $\text{BaAl}_2\text{Si}_2\text{O}_8$. From the former, it is clearly distinguished by its lower specific gravity, 3.325, that of barylite being 4.03, and from the latter by its very poor cleavage (celsian has two perfect cleavages and a sp. gr. 3.37). As, however, the optical characters of the mineral closely resemble those of celsian, Tacconi is doubtful whether it should be considered an entirely new species, and, therefore, following the suggestion of L. Brugnatelli, has named it paracelsian.

Purpurite occurs in small, irregular masses in the tin-bearing pegmatite and in the neighbouring schist at the Faires tin mine, King's Mountain, Gaston Co., North Carolina. It has also been observed on specimens from the lithium-bearing pegmatite dykes of Hiriart Hill, Pala, San Diego Co., California. The mineral has probably resulted from the oxidation of lithiophilite, the lithium being almost entirely removed and the iron and manganese oxidised and recrystallised with phosphoric acid and water. The mineral is of a rich deep red or reddish-purple colour, and appears to crystallise in the orthorhombic system. It is soluble in hydrochloric acid with evolution of chlorine, the iron and the manganese being present as ferric and manganic salts respectively. The following results were obtained on analysis:

Fe_2O_3 .	Mn_2O_3 .	P_2O_5 .	H_2O .	CaO .	Na_2O .	Insol.	Total.
15.89	29.25	47.30	5.26	1.48	0.84	0.52	100.54

A trace of lithium was detected, and on heating to 105° the loss of water amounted to 3.31 per cent. Assuming the isomorphism of ferric and manganic oxides, L. C. Graton and W. T. Schaller² have deduced the formula $2(\text{Mn}, \text{Fe})\text{PO}_4 \cdot \text{H}_2\text{O}$.

Smithite.—An analysis by G. T. Prior has shown that this mineral has the simple formula AgAsS_2 . It was found by R. H. Solly³ associated with other rare thioarsenites in the dolomite of the Binnenthal. The small red crystals exhibit numerous faces and belong to the oblique system.

¹ *Rend. Reale Istit. Lombardo*, 1905, [ii], 38, 636.

² *Amer. J. Sci.*, 1905, [iv], 20, 146.

³ *Min. Mag.*, 1905, 14, 74.

Trechmannite also occurs in the Binnenthal dolomite.¹ Like hutchinsonite and smithite it is a red mineral, but from these the minute crystals may be distinguished by their symmetry, as they crystallise in the rhombohedral system. The composition of the mineral has not as yet been ascertained.

Stilpnochloran.—This substance has been discovered by F. Kretschmer² in the iron mines of Gobitschau, near Sternberg, Moravia. It is a product of the metamorphism of thuringite and occurs in shining yellow scales, thus suggesting the name, which is derived from *στιλπνός*, glittering, and *χλωρός*, yellow. It is decomposed by hydrochloric acid, and was found to have the following composition :

SiO ₂ .	Al ₂ O ₃ .	Fe ₂ O ₃ .	MnO.	CaO.	MgO.	P ₂ O ₅ .	H ₂ O.	Total.
33·30	4·37	44·33	0·34	1·22	1·73	0·37	14·10	99·76

These numbers lead to the formula $H_{24}(Al,Fe)_{10}(Ca,Mg)Si_9O_{46}$.

Tychite.—This exceedingly rare mineral occurs associated with northupite, $MgCO_3$, Na_2CO_3 , $NaCl$, which it closely resembles in form and appearance, at the Borax Lake, San Bernardino Co., California. It was discovered by the chance that a small octahedron selected for examination from a parcel of northupites failed to react for chlorine, but was found to contain sulphate. Following up this observation, S. L. Penfield and G. S. Jamieson³ tested some thousands of northupites, but were only able to detect three more crystals of the new mineral. Its accidental discovery finds expression in the name *tychite*, from *τύχη*, luck. Thinking that the composition of the mineral might resemble that of northupite, Penfield and Jamieson attempted to prepare it artificially. In this they were successful, for on adding magnesium sulphate to a solution of the carbonate and sulphate of sodium, and heating the mixture for five days on a steam-bath, a crystalline precipitate was obtained. The physical characters of the precipitate agreed with those of the natural crystals, and as its composition was found to be $2MgCO_3, 2Na_2CO_3, Na_2SO_4$, this is probably the formula to be assigned to *tychite*. Penfield and Jamieson further point out that northupite and *tychite* both take some time to form when their constituents are brought together in solution, and that whereas the former is readily decomposed by boiling water, the latter is almost insoluble. This behaviour suggests that these substances probably possess a complex molecular structure which may perhaps find expression in a constitutional formula in which four carbon atoms are joined with four oxygen atoms to form a ring. The isomorphism of the two compounds can only be accounted for by the mass effect of the large number of sodium, oxygen, carbon, and magnesium atoms, which overpowers the morpho-

¹ *Min. Mag.*, 1905, **14**, 75.

² *Centr. Min.*, 1905, 203.

³ *Amer. J. Sci.*, 1905, [iv], **20**, 217.

tropic influence of either the two chlorine atoms or the sulphate group.

A New Zeolite.—In the pegmatite veins of the granite of San Piero in Campo, Elba, small, eight-sided crystals occur which G. D'Achiardi¹ thinks may perhaps be a new species of zeolite. He finds that the crystals are complex twins and that they have the following composition :

SiO ₂ .	Al ₂ O ₃ .	CaO.	SrO.	MgO.	K ₂ O.	Na ₂ O.	H ₂ O.	Total.
61·41	11·15	5·52	1·14	trace	3·31	2·06	13·51	98·10

These percentages do not quite accord with those given by any known zeolite, although they resemble to some extent those of some heulandites in spite of a considerable difference in the amounts of alumina and alkaline oxides. The two minerals, however, differ widely in habit. D'Achiardi deduces the following formula from his results : $(\text{Na}_2, \text{K}_2, \text{Ca})_3 \text{Al}_4 \text{Si}_{18} \text{O}_{45}, 14 \text{H}_2\text{O}$.

Mineral Analyses.

Many mineral analyses have been published during the year. Of these, some have thrown light on the composition of rare and imperfectly described species and varieties, others, although referring to well-known minerals, are interesting because the determination of the chemical composition has been accompanied by a careful study of the crystallography and optical characters of the material analysed. The most important of these investigations will be given below under the name of each species arranged alphabetically.

Amphibole Group.—An analysis of the *amphibole* from the syenite of Biella has already been published by Cossa. It is remarkable as showing a high percentage of ferric oxide and alumina and little magnesia, resembling in this respect the analysis made by Flink of so-called diastatite from Nordmarken. F. Zambonini,² who has lately made an elaborate study of the minerals of the Biella syenite, has re-examined the amphibole, and his numbers, which differ a good deal from those obtained by Cossa, are given below :

SiO ₂ .	TiO ₂ .	Al ₂ O ₃ .	Fe ₂ O ₃ .	FeO.	MnO.	CaO.	MgO.	K ₂ O.	Na ₂ O.	H ₂ O.	Total.
51·32	0·84	6·11	3·28	7·39	trace	13·59	16·17	0·36	0·91	0·30	100·27

Zambonini represents the substance as composed of the following molecules : $5\text{Mg}_2\text{Al}_4\text{Si}_2\text{O}_{12}$; $3\text{FeFe}_2\text{Si}_4\text{O}_{12}$; $2(\text{Na}_2, \text{K}_2, \text{H}_2)_4\text{Si}_4\text{O}_{12}$; $32(\text{Mg}, \text{Ca})_4\text{Si}_4\text{O}_{12}$; $5\text{Fe}_4\text{Si}_4\text{O}_{12}$, and points out that the composition cannot be satisfactorily explained on Scharizer's view that amphibole is $x\text{Ca}(\text{Mg}, \text{Fe})_3\text{Si}_4\text{O}_{12}, y(\text{R}'\text{R}'')_3\text{R}'''\text{Si}_3\text{O}_{12}$, because it contains too much silica. The geometrical constants also differ considerably from

¹ *Proc. Verb. Soc. Toscana Sci. Nat.*, 1905, Jan. 15.

² *Zeit. Kryst. Min.*, 1905, **40**, 231.

those of other amphiboles and fail to support the view expressed by Brögger that the angle β increases with the amount of iron and manganese present. A specimen of the rather rare variety of hornblende called *edenite*, which contains much alumina, but little or no ferric oxide, has been analysed by A. Roccati¹ with the following results:

SiO ₂ .	Al ₂ O ₃ .	Fe ₂ O ₃ .	MgO.	CaO.	Na ₂ O + K ₂ O.	Ignition.	Total.
49·25	13·82	trace	20·95	11·91	2·80	0·91	99·64

The composition may be expressed by the formula

The mineral is found as grains and crystals embedded in limestones associated with the gneissic rocks of Piano dei Chiotas, in the Maritime Alps.

A well developed crystal of *black hornblende* from Lukow, Bohemia, shown by microscopic examination to be free from inclusions, has been analysed by F. Hanusch at the request of J. E. Hibschi.² The results are as follows:

SiO ₂ .	TiO ₂ .	F.	Al ₂ O ₃ .	Fe ₂ O ₃ .	FeO.	MnO.	CaO.
39·60	2·50	0·10	18·51	5·50	2·26	0·74	12·57
		MgO.	K ₂ O.	Na ₂ O.	H ₂ O.	CO ₂ .	Total.
		14·11	1·87	2·58	0·26	0·07	100·67

Aragotite.—H. G. Hanks³ has examined a specimen of this rare hydrocarbon from the Aetna quicksilver mine, Napa Co., California. On analysis, E. Huetlin found 88·10 per cent. of carbon and 9·17 per cent. of hydrogen.

Ardennite.—This silicate is interesting because it contains arsenic and vanadium. As the formula hitherto assigned to it is very complicated, and as the state of oxidation of the vanadium has never been satisfactorily made out, W. Prandtl⁴ has investigated the substance afresh. He concludes that arsenic and vanadium are both present in the quinquevalent state, and writes the formula

basing it on the following analytical data:

SiO ₂ .	As ₂ O ₅ .	V ₂ O ₅ .	Al ₂ O ₃ .	Fe ₂ O ₃ .	MnO.	MgO.	CaO.	FeO.	H ₂ O.	Total.
27·77	9·91	0·81	25·25	0·53	22·70	5·20	1·44	0·65	5·24	99·50

Atopite has been found in small, yellow octahedra on manganese ores from the mines of Miguel Burnier, Minas Geraes, Brazil. It has been examined by E. Hussak,⁵ who finds that its formula is $(Ca, Mn, Na)_2Sb_2O_7$, like that of the specimens from Långban, in Sweden.

Awaruite.—The naturally occurring alloys of iron and nickel have

¹ *Revista Min.*, 1905, **32**, 12.

² *Tsch. Min. Mitth.*, 1905, **24**, 271.

³ *J. Roy. Micros. Soc.*, 1905, 673.

⁴ *Zeit. Kryst. Min.*, 1905, **40**, 392.

⁵ *Centr. Min.*, 1905, 240.

been the subject of investigations by G. C. Hoffmann¹ and by G. S. Jamieson.² The former has given the name souesite to a specimen found in the auriferous gravels of the Fraser River, British Columbia. The latter has examined material from Josephine County, Oregon, and from the Smith River, California. On comparing his results with those of Hoffmann, as well as with the published data for similar material from Awarua Bay, New Zealand, from the Elvo River, Piedmont, and from Josephine County (so-called josephinite), Jamieson finds that this alloy has not a definite composition, the amount of nickel varying from 67.63 per cent. up to 77.17 per cent. He therefore rightly deprecates the use of the names josephinite and souesite, and urges that the name awaruite should be alone retained.

Blende.—C. Rimatori³ has continued his quantitative and spectroscopic investigation of Sardinian blendes. Fifteen specimens were examined, and cadmium found in all up to a maximum of 1.23 per cent. Copper was present in several, bismuth in two. Seven belonged to the variety called marmatite, and one of these contained 5.81 per cent. of manganese, the largest quantity hitherto reported. Two contained both gallium and indium and six others indium alone; in one of these, 0.0243 per cent. of indium was found.

Californite.—This name was given by G. F. Kunz to a remarkable compact variety of vesuvianite found in Siskiyou Co., California. Similar material was subsequently obtained from Fresno Co., California.

The analytical data have been interpreted by F. W. Clarke and G. Steiger⁴ as leading to the approximate empirical formula $2\text{H}_2\text{O}, 2\text{Al}_2\text{O}_3, 7\text{CaO}, 6\text{SiO}_2$ or $\text{Al}_2\text{Ca}_7(\text{SiO}_4)_6(\text{AlOH})(\text{AlO}_2\text{H}_2)\text{H}$. If part of the water is extraneous, the following much simpler formula may hold: $\text{Al}_2\text{Ca}_7(\text{SiO}_4)_6(\text{AlOH})_2$, and this fairly represents a good many other analyses of vesuvianite. Clarke and Steiger further point out that while $\text{Al}_2\text{Ca}_6(\text{SiO}_4)_5(\text{AlOH})$ is a good expression for the average composition of the species it does not fit the extremes, and from a study of more than forty analyses they suspect that vesuvianite is a mixture of the four following molecules: $\text{Al}_2\text{Ca}_7(\text{SiO}_4)_6(\text{AlOH})_2$; $\text{Al}_2\text{Ca}_7(\text{SiO}_4)_6(\text{AlO}_2\text{H}_2)_4$; $\text{Al}_2\text{Ca}_7(\text{SiO}_4)_6\text{H}_4$; $\text{Al}_2\text{Ca}_7(\text{SiO}_4)_6\text{Ca}_2$, the first and third usually predominating. About one-seventh of the calcium is replaced by magnesium, and in wiluite the group BOH probably occurs.

Carnotite.—This radioactive uranium mineral has been tested for helium by E. P. Adams.⁵ As he failed to find any, he concluded that

¹ *Amer. J. Sci.*, 1905, [iv], **19**, 319.

² *Ibid.*, 1905, [iv], **19**, 413.

³ *Atti R. Accad. Lincei*, 1905, **14**, i, 688.

⁴ *Bull U.S. Geol. Surv.*, 1905, **262**, 72.

⁵ *Amer. J. Sci.*, 1905, [iv], **19**, 321.

helium, if ever present, had escaped owing to the permeable character of the mineral.

Chrysoberyl.—A crystal from Maskinonge Co., Quebec, has been analysed by N. N. Evans¹ with the following results :

BeO.	Al ₂ O ₃ .	Fe ₂ O ₃ .	Total.	Sp. gr.
17.78	76.76	6.07	100.61	3.52

Some if not all the iron was probably present as FeO ; no calcium or magnesium were found.

Columbite.—W. P. Headden² has analysed specimens of this mineral (I) from Cañon City, Colorado, and (II) from Black Hills, South Dakota, with the following results :

	Cb ₂ O ₅ .	Ta ₂ O ₅ .	WO ₃ .	SnO ₂ .	FeO.	MnO.	Ignition.	Total.
I.	56.48	22.12	0.45	0.11	8.07	12.45	0.15	99.83.
II.	54.64	25.62	—	0.15	6.80	12.61	—	99.82.

Copper-pitch Ore.—A dark brown, pitch-like mineral from Amzalar, Roumania, has been analysed by Th. Nicolau.³ The theory that copper-pitch ore is a mixture of chrysocolla and limonite is not supported by the results, and although no simple formula can be calculated the mineral must be regarded as homogeneous, a conclusion already reached by Lindgren and Hillebrand.

Dognacskaite.—The composition of this bismuth copper sulphide has hitherto rested on an analysis by Maderspach. At the request of A. Otto, an analysis has been published by Koechlin⁴ showing a much smaller quantity of bismuth, corresponding to the formula of wittichenite, Bi₂S₃.3Cu₂S. As, however, the specific gravity of dognacskaite is 6.79 to 6.72 and that of wittichenite is 5, and as, moreover, the former mineral has a good cleavage and the latter none, F. Neugebauer⁵ has made a fresh analysis of carefully selected material. From his results, he deduces the formula Bi₄Cu₂S₇ or 2Bi₂S₃.Cu₂S, and thinks that the individuality of dognacskaite as a species may be considered to be established.

Dumortierite has been the subject of an elaborate investigation by W. T. Schaller,⁶ who has not only collected the results of other workers, but has determined the crystallographic and optical properties of the mineral, and made three very careful analyses. The results of these are given below ; I and II refer to a specimen from near Dehesa, San Diego Co., California, III to material from Skamania Co., Washington.

¹ *Amer. J. Sci.*, 1905, [iv], **19**, 316.

² *Proc. Colorado Sci. Soc.*, 1905, **8**, 55.

³ *Ann. Sci. Univ. Jassy*, 1905, **3**, 103.

⁴ *Tsch. Min. Mitth.*, 1905, **24**, 117.

⁵ *Tsch. Min. Mitth.*, 1905, **24**, 323.

⁶ *Amer. J. Sci.*, 1905, [iv], **19**, 211 ; see also *Bull. U.S. Geol. Surv.*, 1905, **262**, 91.

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	SiO ₂ .	Al ₂ O ₃ .	Ti ₂ O ₃ .	Fe ₂ O ₃ .	H ₂ O.	B ₂ O ₃ .	Total.
I.	28·58	63·31	1·49	0·21	1·53	5·21	100·33
II.	28·78	63·30	1·40	0·25	1·51	5·53	100·77
III.	28·51	59·75	0·95*	2·48	2·12	5·54	100·03

* Titanium calculated as TiO₂ ; 0·68 CaO also present.

The first two analyses agree exceedingly well with the formula $8\text{Al}_2\text{O}_3, \text{B}_2\text{O}_3, \text{H}_2\text{O}, 6\text{SiO}_2$. In the case of the third, the agreement is not quite so close, but this analysis is of less value than the other two as the material was known to be contaminated with andalusite and titanite (leucoxene) as well as with traces of pyrite. Schaller points out that an analysis by Ford of a specimen from Arizona is completely in accord with his formula, although Ford's results for the Californian and New York minerals are less perfectly in harmony with it: the same is true for the analyses made by Whitfield and Riggs. By writing the formula thus, $(\text{SiO}_4)_3\text{Al}(\text{AlO})_7(\text{BO})\text{H}$, its analogy with andalusite is exhibited, and its alteration into muscovite explained.

Enargite.—The following is an analysis by W. P. Headden¹ of crystalline enargite from the Powers Mine, Willis Gulch, Gilpin Co., Colorado :

S.	As.	Sb.	Cu.	Pb.	Fe.	Zn.	Total.
29·35	16·17	3·77	48·40	1·83	0·30	0·19	100·01

Epidote.—The crystallographic, optical, and chemical properties of good crystals of epidote from Inverness-shire have been carefully studied by H. H. Thomas and W. Pollard.² The mineral is an interesting member of the epidotes with a low percentage of ferric iron, and falls naturally into the series. In composition, it is very similar to the epidotes from Huntington, Mass., the Zillerthal, and Val Maigels. Its formula is $\text{Ca}_4\text{Al}_4(\text{AlOH})_2(\text{SiO}_4)_6$.

Felspar Group.—In addition to the important investigation of Day and Allen referred to above, we may note the following points. G. Melczer³ has determined with great care the crystallographic constants of an *albite* from Nadabula, shown by qualitative examination to be pure. He finds $a : b : c = 0·6350 : 1 : 0·5578$; $\alpha = 94^\circ 6'$, $\beta = 116^\circ 36\frac{1}{2}'$, $\gamma = 87^\circ 52'$. The extinction on 010 is $20^\circ 30'$, on the base $3^\circ 5'$ to $4^\circ 30'$.

An *albite* from Nurra, Sardinia, has been examined by C. Viola,⁴ and an analysis made by H. Steinmetz (I, below). Viola thinks that the lime is due to impurities and regards the mineral as a mixture of 10 molecules of albite with 1·3 molecules of orthoclase. He has determined the

¹ *Proc. Colorado Sci. Soc.*, 1905, **8**, 55.

² *Min. Mag.*, 1905, **14**, 109.

³ *Zeit. Kryst. Min.*, 1905, **40**, 571.

⁴ *Boll. R. Com. Geol. d'Italia*, 1905, [iv], **6**, 106.

indices of refraction and the extinctions and finds that, whilst the former indicate a nearly pure albite, the latter belong rather to an oligoclase-albite. An *orthoclase* from Biella, geometrically and optically normal, has been analysed by F. Zambonini.¹ Some very pure white crystals gave the results quoted under II below. At the same locality occur crystals of *oligoclase*. Zambonini has also measured these, and finds that their constants are the same as those of the Vesuvian oligoclase determined by vom Rath; he quotes an analysis by C. Montemartini (III, below), and points out that on Tschermak's theory the mineral consists of 7Ab + 3An.

	SiO ₂ .	P ₂ O ₅ .	Al ₂ O ₃ .	Fe ₂ O ₃ .	CaO.	MgO.	K ₂ O.	Na ₂ O.	Ignition.	Total.
I.	67·16	—	17·57	—	4·52	—	1·07	9·51·	—	99·83
II.	64·61	trace	18·75	trace	0·83	trace	14·46	0·81	—	99·46
III.	63·51	—	22·40	—	3·38	0·08	1·24	8·66	0·48	99·75

Fibroferrite.—W. P. Headden² has found that aggregates of greenish-white, acicular crystals from Green River, Utah, have the formula $\text{Fe}_2\text{O}_3, 2\text{SO}_3, 10\text{H}_2\text{O}$.

Fiedlerite is an oxychloride of lead found in ancient slags at Laurion. A. de Schulten³ has recently determined its composition to be $\text{PbO}, 2\text{PbCl}_2, \text{H}_2\text{O}$. It is therefore related to penfieldite, $\text{PbO}, 2\text{PbCl}_2$, and to laurionite, $\text{PbO}, \text{PbCl}_2, \text{H}_2\text{O}$, which both occur at the same locality.

Glaucodote is found in imperfect crystals at the Standard Consolidated gold mine, Sumpter, Oregon. A crystal has been measured, and the material analysed by W. T. Schaller.⁴ As the ratio of cobalt to iron is approximately 3 to 2, the formula may be written $\text{Co}_3\text{Fe}_2\text{As}_5\text{S}_5$.

Gyrolite occurs with pectolite and datolite at Fort Point, San Francisco. W. T. Schaller⁵ has analysed the material and deduces the formula $5\text{H}_2\text{O}, 4\text{CaO}, 6\text{SiO}_2$, thus confirming the view taken by F. W. Clarke. The mineral is probably oblique and related to heulandite.

Huebnerite.—W. H. Hobbs⁶ has published the following analysis by S. V. Peppel of a nearly pure huebnerite, MnWO_4 , found in large brown crystals at Dragoon Summit, Arizona.

SiO ₂ .	WO ₃ .	MnO.	FeO.	Total.
1·10	75·10	22·87	0·81	99·88

Kentrolite.—Specimens of this rare mineral have recently been discovered by D. Lovisato,⁷ near Ozieri, Sardinia, where it occurs in

¹ *Zeit. Kryst. Min.*, 1905, **40**, 251.

² *Proc. Colorado Sci. Soc.*, 1905, **8**, 55.

³ *Compt. rend.*, 1905, **140**, 315.

⁴ *Bull. U.S. Geol. Surv.*, 1905, **262**, 132.

⁵ *Ibid.*, 124.

⁶ *Amer. Geol.*, 1905, **36**, 179.

⁷ *Atti R. Accad. Lincei*, 1905, **14**, i, 696.

little brownish-red spherules and aggregates. An analysis by C. Rimatori gave the following results:

SiO ₂ .	PbO.	CuO.	Fe ₂ O ₃ .	MnO ₂ .	CaO.	MgO.	H ₂ O.	Total.
17.71	60.02	trace	1.55	18.87	0.33	trace	1.79	100.27

In composition, the Sardinian mineral somewhat resembles that from Långban, but in its appearance and mode of occurrence it is more like the specimens from Chili.

Melilite.—The study of a slag has led F. Zambonini¹ to analyse melilite from Capo di Bove, and to criticise the formulæ proposed for this mineral. His results agree closely with those already published by Damour. Very various views as to the nature of melilite have been maintained, thus Des Cloizeaux has calculated the formula $12R''O, 2R'''_2O_3, 9SiO_2$, and Groth has arrived at a somewhat similar expression, $(Ca, Mg)_6(Al, Fe)_2Si_5O_{19}$. Vogt, on the other hand, regards melilite as an isomorphous mixture of gehlenite, $R''_3R'''_2Si_2O_{10}$, with åkermanite, an artificial substance of the formula $R''_4Si_3O_{10}$. Bodländer, however, has pointed out as a necessary consequence of Vogt's view that the ratio of the oxygen in the silica to that present as $R''O$ must vary between the limits 1.33 and 1.5. Discussing his own analyses and those of others in the light of Bodländer's criticism, Zambonini finds that this ratio is always much smaller than that required by Vogt's hypothesis. If, however, it is assumed that the alumina and ferric oxide are present as gehlenite and the corresponding quantity of this mineral is subtracted, Zambonini finds that silica and oxides of the type $R''O$ are always present in the exact proportions required to form a metasilicate. Melilite may accordingly be regarded as a mixture of gehlenite, $R''_3R'''_2Si_2O_{10}$, with n molecules of a metasilicate, $R''SiO_3$. It may also be represented as an isomorphous mixture of $R''SiO_3$ with an aluminate of the type $R''R'''O_4$; this is the view held by Bodländer and preferred by Zambonini. A third possibility is to write it $R''R'''_2Si_2O_8, nR''_2SiO_4$. If this last expression is adopted, Des Cloizeaux's formula becomes

Olivine.—The investigation of a gabbro containing both olivine and a rhombic pyroxene suggested that it would be interesting to determine the relative proportions of the iron and magnesium compounds present in these two minerals when they occur together. J. Schiller² has therefore analysed the olivine and the bronzite from bombs found at Kapfenstein, near Gleichenberg.

The olivine consists of 90.2 per cent. of Mg_2SiO_4 and 9.8 per cent. of Fe_2SiO_4 . If, in working out the results for the bronzite, the water, lime, and titanium oxide present are omitted, and ferrous oxide and

¹ *Zeit. Kryst. Min.*, 1905, **41**, 226.

² *Tsch. Min. Mitth.*, 1905, **24**, 309.

magnesia considered as equivalent, we arrive at the following composition: 86 per cent. of $\text{Mg}_2\text{Si}_2\text{O}_6$, 3.9 per cent. of $\text{MgAl}_2\text{SiO}_6$, 3.2 per cent. of $\text{MgFe}_2\text{SiO}_6$, and 6.9 per cent. of $\text{Fe}_2\text{Si}_2\text{O}_6$. Here also the ferrous silicate and the magnesium silicate are in the ratio 1:9. There is, therefore, no essential difference between the proportions in which the ferrous compounds and the magnesium compounds occur in the two minerals. A consideration of the work of others leads Schiller to conclude that when olivine and rhombic pyroxene occur together in rocks free from felspar, the ferrous and magnesium compounds exist in about the same molecular ratio in each. When, on the other hand, they occur in rocks which contain felspar, the olivine is always the richer in the magnesium compound.

Prehnite.—Specimens from Lower California and from Biella have been analysed by W. T. Schaller¹ and by F. Zambonini² respectively. In both cases, the composition is well expressed by the formula $\text{H}_2\text{Ca}_2\text{Al}_2\text{Si}_3\text{O}_{12}$.

Pyroxene Group.—The optical characters of good crystals of *diopside* from the eozone limestone of Côte St. Pierre, Canada, have been described by H. Preiswerk.³ The mineral has been analysed by F. Hinden, and may be regarded as a compound of 96.25 per cent. of $\text{CaMgSi}_2\text{O}_6$, 1.92 per cent. of $\text{FeMgSi}_2\text{O}_6$, 1.51 per cent. of $\text{MgAl}_2\text{SiO}_6$, and 0.32 per cent. of $\text{MgFe}_2\text{SiO}_6$, although the actual numbers obtained show an excess of basic oxides as compared with silica (I below).

Crystals of *black augite* from Canale Monterano, near Rome, have been measured and analysed by F. Zambonini;⁴ his results are given under II below.

	SiO_2 .	TiO_2 .	Al_2O_3 .	Fe_2O_3 .	FeO .	MnO .	CaO .	MgO .	Na_2O .	H_2O .	Total.
I.	53.70	—	0.95	0.32	0.65	—	25.45	19.04	—	0.47*	100.58
II.	50.88	1.02	5.36	1.21	4.67	trace	22.96	13.78	0.50	0.34	100.72

* Ignition loss.

Tengerite.—In an account of the locality at Barringer Hill, Llano Co., Texas, from which have come fine specimens of many rare radioactive minerals, W. E. Hidden⁵ has described the occurrence in gadolinite of white, semi-globular concretions which may perhaps be tengerite. As the composition of this species had not previously been determined, the following analysis was made by W. F. Hillebrand:

Yt group.	Ce group.	Fe_2O_3 .	BeO .	CO_2 .	$\text{H}_2\text{O} > 105^\circ$.	$\text{H}_2\text{O} < 105^\circ$.	SiO_2 .	MgO
40.8	7.0	4.0	9.7	19.6	14.1	3.2	0.4	1.2*

* Includes alkalis and loss.

No definite formula can be calculated, but the presence of glucinum

¹ *Bull. U.S. Geol. Surv.*, 1905, **262**, 128.

² *Zeit. Kryst. Min.*, 1905, **40**, 262.

³ *Ibid.*, 498.

⁴ *Ibid.*, 52.

⁵ *Amer. J. Sci.*, 1905, [iv], **19**, 429.

in the form of carbonate is remarkable, and may perhaps indicate the existence of a new glucinum mineral mechanically mixed with a basic hydrous carbonate of the rare earths of the yttrium group.

Tetradymite.—The composition of cleavage masses of this mineral from Whitehorn, Fremont Co., Colorado, has been found by W. F. Hillebrand¹ to agree well with the formula Bi_2Te_3 . In this connection, we may notice that K. Mönkemeyer² has made a careful study of the cooling curves of mixtures of bismuth and tellurium taken in various proportions. These experiments lead to the conclusion that Bi_2Te_3 is the only compound of the two elements which can exist, and this view was confirmed by a study of the sections cut from the solidified masses.

Thorianite.—The leading characteristics of this interesting mineral were given last year; a more detailed description has recently been published by W. R. Dunstan and G. S. Blake,³ who give the following analysis :

ThO_2	UO_2	UO_3	CeO_2	PbO	Fe_2O_3	CaO	He.	Insol.	Total.
78·86	6·03	9·07	1·02	2·59	0·46	1·13	0·39	0·20	99·75

The number quoted for helium was calculated on the assumption that the whole of the gas evolved from the mineral consisted of that element. Lanthanum and didymium are included under cerium. A trace of phosphate was detected. This analysis differs somewhat from those previously published. Taken together, they show that the mineral consists essentially of thoria, oxide of uranium, and varying quantities of ceria. The exact part played by the uranium cannot be said to be as yet precisely made out. Possibly it was originally all present as UO_2 , in isomorphous admixture with the thoria. Thorianite is slightly less radioactive than pitchblende, a mineral with which it is evidently closely related. From the residues left after fusing about 250 kilograms of thorianite with potassium hydrogen sulphate, O. Hahn⁴ has isolated a highly radioactive product differing markedly from radium. The rate of decay of the emanation from this substance was found to be identical with that of the thorium emanation. Further work⁵ has led Hahn to the conclusion that a new element, "radiothorium," is contained in these residues.

Thuringite.—In last year's report, reference was made to Zaluski's work on thuringite. Attention may now be called to F. Kretschmer's⁶ observations on specimens from the iron mines of Gobitschau, where it occurs associated with its decomposition products limonite and the new mineral stilpnokloran. An analysis by S. Vogl shows that it is very similar to the thuringite from Zirmsee,

¹ *Bull. U.S. Geol. Surv.*, 1905, **262**, 57.

³ *Proc. Roy. Soc.*, 1905, series A, **76**, 253.

⁶ *Ber.*, 1905, **38**, 3371.

² *Zeit. anorg. Chem.*, 1905, **46**, 415.

⁴ *Ibid.*, 115.

⁶ *Centr. Min.*, 1905, 195.

and if Tschermak's theory of the composition of the mineral is accepted it may be expressed as consisting of 4 molecules of amesite with 3 molecules of strigovite.

Titanite.—In spite of much analytical work, the composition of this mineral still offers difficulties. Attention has been called to some of these by F. Zambonini¹ in the course of his work on the minerals of Biella. At this locality, titanite occurs in good crystals which were measured and in grains which were found to resemble in composition the variety described by Groth from the Plauen Grund. No satisfactory formula could, however, be deduced from the following analytical data :

SiO ₂ .	TiO ₂ .	Fe ₂ O ₃ .	FeO.	Al ₂ O ₃ .	(Yt,Ce) ₂ O ₃ .	MnO.	CaO.	MgO.	H ₂ O.	Total.
30·89	30·58	5·77	trace	2·81	3·07	0·40	26·09	0·25	0·86	100·72

The ordinarily accepted formula, CaTiSiO₅, also fails to represent the composition of the dark brown crystals from Urotva, Transylvania, described by Th. Nicholau,² who has published the two following analyses :

TiO ₂ .	SiO ₂ .	CaO.	MnO.	Al ₂ O ₃ .	Na ₂ O.	Total.
42·24	31·10	24·30	2·09	0·64	0·06	100·43
42·65	31·03	24·19	2·34	0·55	trace	100·76

Zeolite Group.—A specimen of *heulandite* from the Biella syenite has been found by Zambonini³ to contain considerably less silica and more alumina than is usual in this mineral. Its formula is Ca₂Al₄Si₉O₂₆·10H₂O. Zambonini⁴ has also examined the *chabazite* from the same locality, and points out that it too has an abnormal composition, being exceptionally rich in lime and poor in alkalis. The analytical numbers do not support Ströng's hypothesis that the chabazites are mixtures of CaAl₂Si₆O₁₆·8H₂O with CaAl₂Si₂O₈·4H₂O. Chabazite has also been analysed by A. Bygdén.⁵ The two specimens examined came from Gellivare, Malmberg. The first may be approximately represented by the formula RO,Al₂O₃,4SiO₂,6H₂O, the second by 2RO,2Al₂O₃,9SiO₂,13H₂O. To *stilbite* from the same locality, Bygdén assigns the formula 2RO,2Al₂O₃,13SiO₂,14H₂O.

In concluding this section, we may notice that J. Schilling⁶ has compiled a useful table showing the specific gravities, percentages of tantalum and of niobium and the localities of all the minerals containing tantalum of which analyses have as yet been published.

¹ *Zeit. Kryst. Min.*, 1905, **40**, 239.

² *Ann. Sci. Univ. Jassy*, 1905, **3**, 169.

³ *Zeit. Kryst. Min.*, 1905, **40**, 266.

⁴ *Loc. cit.*, 263.

⁵ *Bull. Geol. Instit. Univ. Upsala*, 1905 (for 1902—1903), **6**, 92.

⁶ *Zeit. angew. Chem.*, 1905, **18**, 883.

Meteorites.

The death of Professor E. Cohen in the early part of the year has removed from this field of inquiry one of its most active cultivators. Among the latest of his publications¹ may be noticed a catalogue of the meteorites in the collection at Greifswald. A catalogue by G. Dewalque² of the meteorites preserved at Ghent, Gembloux, Liège, Louvain, and Maredsous is also worthy of mention.

The work on meteorites of most general interest which has recently appeared is contained in a paper by F. Rinne,³ in which the composition and structure of meteoric iron are compared with those of iron and steel, the subject being treated from the point of view of physical chemistry and the phase rule. The paper opens with a very lucid description of the phenomena of solidification presented by cast iron and steel, and of the composition and mutual relations of ferrite, martensite, cementite, and pearlite. The changes which may occur after the metal has solidified are set forth with equal clearness. Having called attention to the fact that the meteoric irons contain compounds similar to those found in technical iron, Rinne points out that far-reaching transformations may take place in meteorites long after the alloy composing them has become solid. Thus, nickel-iron is the equivalent of ferrite, cohenite $(\text{Fe}, \text{Ni}, \text{Co})_3\text{C}$ of cementite Fe_3C , schreibersite (rhabdite) of Fe_3P , troilite of FeS , and just as martensite may break up on cooling into ferrite and the mixture of ferrite and cementite known as pearlite, so also in nickel-iron similar changes may occur. Now, iron and nickel being closely related elements, they may be expected to form mixed crystals, and there is reason to believe that their behaviour on solidification can be represented by a curve of the second type of Bakhuis Roozeboom's classification. The study⁴ of the magnetic and other physical properties of the alloy leads to the conclusion that on further cooling differentiation of the solid takes place into crystals rich in iron and crystals rich in nickel, the series being interrupted by a gap or lacuna, the differentiation following a course which can be represented by a curve of Bakhuis Roozeboom's fifth type. A chemical compound of iron and nickel may also possibly exist. A study of this curve leads to the following classification of the alloys of nickel and iron: (1) group below the lacuna. This includes alloys containing up to 7 per cent. of nickel, and to these the name kamacite has been given. (2) Group of the lacuna. In this group

¹ *Mith. naturwiss. Ver. Neu-Vorpommern und Rügen*, 1905, **36**, (1904), 1.

² *Ann. Soc. Géol. Belg.*, 1905, **32**, M 15.

³ *Neues Jahrb. Min.*, 1905, i, 122.

⁴ Compare F. Osmond and G. Cartaud, *Compt. rend.*, 1903, **137**, 1057.

three sub-classes may be distinguished: (a) kamacite is crystallised with the eutropic mixture of kamacite and taenite (nickel-iron rich in nickel) known as plessite, (b) plessite is found alone, (c) plessite and taenite both occur. (3) Group above the lacuna. This contains the alloys rich in nickel, so-called taenite. Assuming the existence of a compound containing 68 per cent. of nickel, this group may be further subdivided according as the alloy contains more or less nickel than is required to form the compound. (4) Dystektite group. This consists of a definite chemical compound, assumed to be Ni_2Fe , and is held by Rinne to be represented by awaruite. It should be noted, however, that the work on this substance referred to above renders the existence of a definite compound somewhat doubtful. In concluding his paper, Rinne calls attention to the wide field of research presented by meteorites when studied from this point of view, and expresses his belief that the knowledge we already possess as to the influence of carbon, phosphorus, and sulphur in modifying the structure and properties of iron will afford the clue to the part played by cohenite, schreibersite, and troilite in the constitution of meteorites. Evidence that differentiation has really taken place after solidification is found in the fact that in some meteoric irons the relation of the kamacite to the troilite is such as to leave no doubt that the former crystallised after the latter had become solid. As troilite melts at 900° , this observation shows that the crystallisation of kamacite can take place at a temperature far below the melting point of the alloy.

Among the individual meteorites examined, the following may be noticed:

The Billings Meteorite.—This iron was found in southern Missouri and has been described by H. A. Ward,¹ and analysed by H. W. Nichols.

Cañon Diablo.—The investigation by Moissan² of the residue obtained on dissolving 53 kilograms of this iron in hydrochloric acid has already been referred to. It is interesting to notice that the crater of Coon Mountain, Arizona, twelve miles south-east of Canon Diablo station, is believed by D. M. Barringer and B. C. Tilghman to have been produced by the impact of an immense meteorite of which the specimens of Cañon Diablo iron once formed a part.

Barraba, Cowra, and Mount Dyrning.—Careful analyses of these Australian meteorites have been published in full detail by J. C. H. Mingaye.³ The first contains 93.50 per cent. of iron and 5.54 per cent. of nickel. The second consists mainly of 85.26 per cent. of

¹ *Amer. J. Sci.*, 1905, [iv], **19**, 240.

² *Ann. Chim. Phys.*, 1905, [viii], **5**, 174.

³ *Rec. Geol. Surv., N.S. Wales*, 1904, **7**, 305.

iron and 13.23 per cent. of nickel. That of Mount Dyrning is of pallasite type, but much rusted.

Hvittis.—A. Lacroix¹ has called attention to the similarity in composition of this meteorite with that of Pillistfer. Both contain enstatite but no olivine.

Rodeo.—This iron has been shown by O. C. Farrington² to be an octahedrite of medium coarseness. It contains large inclusions of schreibersite and some graphite, but no troilite.

Shelburne.—This meteorite, which fell near the village of Shelburne, Grey Co., Ontario, in 1904, has been examined by L. H. Borgström,³ who finds it to be a chondritic stone consisting mainly of olivine and enstatite.

Mount Vernon.—W. Tassin⁴ has determined this to be a pallasite of the Krasnojarsk type. It consists essentially of nickel-iron containing olivine and varying amounts of troilite. The nickel-iron alloy, the taenite, schreibersite, troilite, chromite, and olivine were separated and their composition ascertained.

A. HUTCHINSON.

¹ *Bull. Soc. franç. Min.*, 1905, **28**, 70.

² *Field Columb. Mus.*, Pub. 101, 1905, **3**, 1.

³ *Trans. R. Astronom. Soc. Canada*, 1905 (for 1904), 69.

⁴ *Proc. United States Nat. Mus.*, 1905, **28**, 213.