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Art. XXXVII.—*Orientite, a new hydrous Silicate of Manganese and Calcium from Cuba;*[1] by D. F. Hewett[2] and Earl V. Shannon.[3]

Contents.

Introduction.

Introduction.—In the course of the examination of some manganese deposits in Oriente Province, Cuba, during March and April, 1920, a crystallized silicate of manganese and calcium was discovered by D. F. Hewett. After preliminary tests, specimens were sent to E. V. Shannon, who determined that the mineral was a hydrous silicate of manganese and calcium and represented a new species. In the following statement, the crystallographic, optical and chemical studies have been made by Shannon and those with reference to mode of occurrence and genesis by Hewett.

As the mineral is known to occur in two localities in Oriente Province, where many manganese deposits are found,[4] and it may be widespread in the region, it is appropriate that the geographic relation be perpetuated in the name *orientite.*

Part I.

Mode of Occurrence.—The province of Oriente roughly coincides with a broad structural trough in the rocks,

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[1] Published by permission of the Director of the U. S. Geological Survey and the Secretary of the Smithsonian Institution.

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[3] Assistant Curator, Department of Geology, U. S. National Museum.

[4] Hayes, C. W., Vaughan, T. W., Spencer, A. C., Report on a geological reconnaissance of Cuba made under direction of Gen. Leonard Wood, 1901.
Burchard, E. F., Manganese-Ore Deposits in Cuba, Trans. Am. Inst. Min. & Met. Eng., vol. 63, p. 51-104, 1920.

which pitches to the west. The southern limit of the trough is the igneous complex of the Sierra Maestra; the northern limit is a group of low ranges near the north coast, largely made up of serpentine. The trough comprises a great thickness, possibly 8,000 to 10,000 feet, of bedded volcanic breccias, and tuffs with andesite and latite flows, and limestone. On the southern limb of the trough tuffs, breccias and flows constitute more than 95 per cent of the lower 2,000 or 3,000 feet but the proportion of limestone is larger than that of the igneous rocks in the upper 2,000 feet or more. The lower course of the Cauto River approximately follows the trough. The manganese deposits occur over a wide stratigraphic range in the middle part of the section, to which an upper Eocene age has been tentatively assigned.

The minerals of the manganese deposits of Cuba, in order of abundance, are psilomelane, both hard and soft varieties, manganite, pyrolusite, wad, neotocite and orientite.

The accessory minerals include "bayate" or ferruginous jasper, glauconite (?), barite, quartz, calcite and several zeolites. Although a few bodies of manganese oxides occur in limestone or the clay resulting from its decay, most of them replace fine tuff or volcanic ash. They assume many forms, dependent upon local structural features.

Orientite was first found in a group of deposits on the Costa, Manuel and Vicente claims, 6 miles south of Bueycito and 20 miles southwest of Bayamo. Later it was found in material from the Santa Rosa prospect, near Banes, north of Antilla. An amorphous hydrous silicate of manganese which is probably neotocite, was found in material from the Abundancia mine at Manganeso. Material encountered in several other deposits (Isabelita, Ponupo, Llave) indicates that neotocite, and possibly orientite, was once present but has been destroyed by weathering. Neither mineral was definitely recognized, however, in the Jutinicum, Dos Bocas and Baire districts, which were also examined.

Orientite was first recognized as minute reddish-brown crystals that lined drusy cavities in Open Cut No. 8 on the Costa claim, and similar material was later found at many other open cuts on the Costa, Manuel and Vicente claims. Later, when thin sections of material from other openings were studied, it was found that orientite was widespread, even where it could not be distinguished in hand specimens.

The Costa, Manuel and Vicente claims,[5] aggregating 403 hectares (995 acres), cover an area of alternating bedded tuffs and breccias of latitic andesitic type, latite flows and thin limestones. These rocks dip northward at 10° to 15° and are broken by two systems of faults. Several andesite dikes occur in faults. The fine tuffs that have been studied under the microscope contain oligoclase, orthoclase, diopside, hornblende, and rock fragments which are largely glass, here and there reddish in color, due to included ferric oxide grains and containing laths of feldspar. The matrix of the tuffs contains glass which is generally altered near the ore bodies. The ore-bodies of these claims contain psilomelane, manganite, pyrolusite and orientite and are wholly in the fine tuffs. Where coarse breccias are adjacent to ore-bodies, some manganese oxides may occur in the fine matrix of the breccias. The manganese oxides and silicate were deposited in the tuffs largely by replacing the glassy portion of the rock fragments.

Associated Minerals.—Psilomelane is present in most of the deposits and both the variety, harder as well as that softer than a steel knife, were recognized. It forms fibrous masses that commonly range from 1 to 50 mm. in maximum size. Some plumose aggregates having similar associations are probably manganite. Commonly, these masses occur in layers roughly parallel to layers of tuff; in some places they are sporadically distributed through relatively unaltered tuffs. The available thin sections of the larger masses indicate that the manganese minerals have locally completely replaced all of the minerals and rock fragments that previously were present, feldspar, diopside and glass. In some sections of material that shows disseminated minute particles of psilomelane, largely found on the borders of the deposits, the manganese minerals fill the space between the residual feldspar grains, which clearly have survived the process of replacement. In other thin sections, there are minute opaque grains in the crystals and other particles of orientite (fig. 1) that are probably psilomelane. Psilomelane and the plumose manganite were clearly the first minerals to be deposited in the tuffs. Veinlets of orientite in fig. 2

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[5] Burchard, E. F., loc. cit., p. 80.

fill cracks that cut across plumose manganite and are clearly later than that mineral.

In some places manganite forms plumose aggregates that have associations similar to psilomelane and is therefore probably contemporaneous with it. It also forms short wedge-shaped prisms 1 to 2 mm. long, which occur

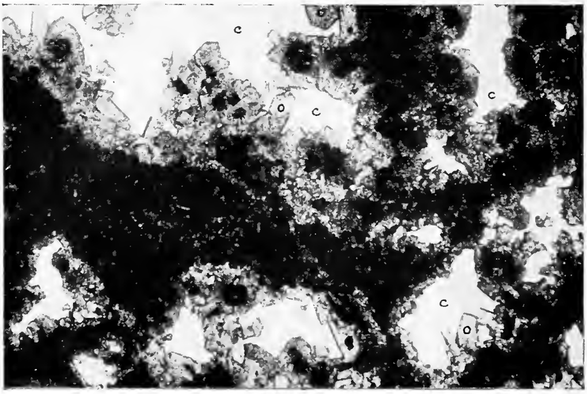

Fig. 1.—Black, manganese oxide (psilomelane?); gray, crystals (o), orientite; white (c), calcite. × 25 diameters.

Oxides form nuclei in orientite; druses are filled with calcite. Mottled appearance of orientite is due to its high index of refraction.

Open cut. No. 20, Costa Claim, 6 miles south of Bueycito, Oriente, Cuba.

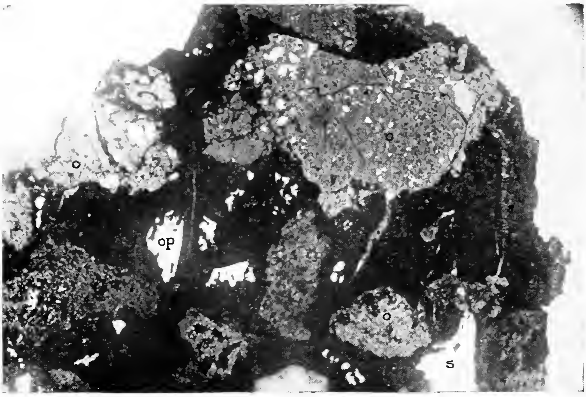

Fig. 2.—Black, plumose aggregates of manganite (?); gray (o), orientite; white (op), opal (?); white (s), open space. × 6 diameters.

Veinlets of orientite cut and are later than the aggregates of manganite.

Open cut No. 8, Costa Claim, 6 miles south of Bueycito, Oriente, Cuba.

in druses, and fills veinlets which commonly rest upon or cut the psilomelane and orientite, and is, therefore, later than these minerals. It has been impossible to accurately discriminate between manganite and pyrolusite; the hardness of the crystals corresponds with that of manganite, and water was given off when numerous specimens were heated in a closed tube. On the other hand, it is possible to sort out from the material from most of the deposits, a portion that contains considerable crystalline material, which is shown by analysis to contain 90 to 92 per cent MnO_2, and is therefore undoubtedly pyrolusite.[6] Wad is sparingly distributed in the deposits. but appears to be a product of recent weathering.

Orientite assumes several forms, depending apparently on whether it is abundant or scarce. Where it is abundant in the Bueycito region, myriads of small reddish-brown prismatic crystals cover drusy cavities (fig. 1) in psilomelane. Some specimens that appear to be made up largely of psilomelane, are shown by thin sections and polished surfaces to be an intricate mixture of psilomelane and orientite (fig. 2). In such mixtures, the orientite grains are made up of aggregates of minute tabular crystals. Elsewhere in the neighborhood there are large bodies of tuffs that appear to be impregnated with disseminated psilomelane and contain 5 to 20 per cent manganese. A number of thin sections of such material shows that orientite is universally associated with the manganese oxide, but like it forms small grains in the matrix of the tuff, or replaces the glass of the rock fragments, leaving the included feldspars unaltered (fig. 3). Some sections in which the feldspars are quite fresh, show diopside crystals which are surrounded by a border of orientite. Such relations suggest that the diopside is more readily replaced than the feldspar.

Several thin sections of material from the Bueycito region show orientite pseudomorphs of foraminifera imbedded in manganese oxide (psilomelane ?) (fig. 4.). It would appear that this selective replacement of the foraminifera by the silicate of manganese and calcium is due to the high calcium content of the fossils.

An amorphous silicate (neotocite ? see p. 492) is present in material from Vicente Open Cut No. 15 near Bueycito, from the Abundancia Mine near Manganeso, and the

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[6] Watson, T. L., Pyrolusite in Virginia, Jour. Wash. Acad. Sci., vol. 8, p. 550-560, 1918.

Santa Rosa prospect near Banes. Thin sections of material from the Vicente claim show irregular areas of

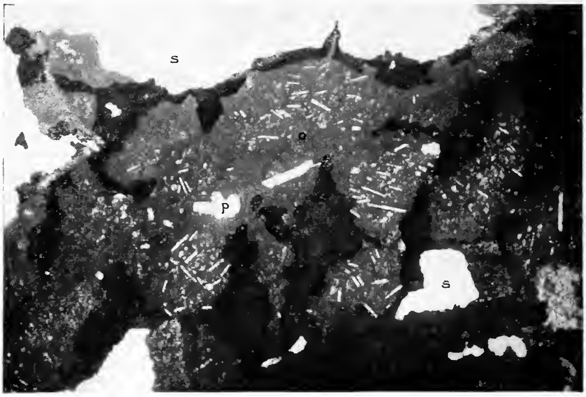


FIG. 3.—Black, manganese oxide; dark gray (o), orientite; light gray (p), plagioclase crystals; white (s), open space. × 25 diameters.
The alignment of the fresh plagioclase laths in the grains of orientite indicates flow structure in original glass, now replaced by orientite.
Open cut No. 8, Costa Claim, 6 miles south of Bueycito, Oriente, Cuba.

a clear light brown amorphous mineral in which there are minute rosettes of orientite crystals. It was first thought that the amorphous mineral was a variety of orientite, but

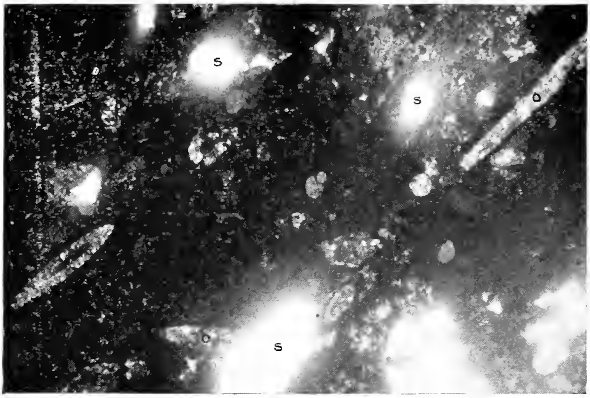


FIG. 4.—Black, manganese oxide; gray (o), orientite pseudomorphs of foraminifera; white (s), open space. × 25 diameters.
Foraminifera (calcite) replaced by orientite; remainder of rock largely replaced by manganese oxide.
Open cut No. 8, Costa Claim, 6 miles south of Bueycito, Oriente, Cuba.

the analyses which follow show that although it is a hydrous silicate of manganese, it is deficient in lime, if indeed lime is a part of it. Its relation to the oxides, bayate, and orientite, indicates that it was deposited essentially contemporaneously with orientite.

Zeolites are present at many openings on the Costa, Manuel, and Vicente claims near Bueycito, but are not conspicuous in several other localities that were examined. The commonest zeolite near Bueycito is stilbite which generally fills veinlets that cut the mineralized tuffs. Analcite in crystals up to 1 cm. in diameter, chabazite in rhombohedrons up to 5 mm. in diameter and laumontite in bundles of lath-shaped crystals, cover drusy cavities at a number of localities. These four zeolites uniformly appear to be deposited later than orientite and the manganese oxides.

Quartz occurs in druses, here and there as doubly terminated dark gray crystals. The color is due to included minute grains of manganese oxide and here, at least, appears to have been deposited contemporaneous with and later than the oxides. Its relation to the zeolites has not been determined. On the other hand, "bayate," a brownish jasper or chalcedony which is made up of minute spherulites and is almost universally abundant near every manganese deposit in Cuba, appears to be earlier than or contemporaneous with the manganese oxides.[7] A clear limpid amorphous mineral that is probably opal is present in some thin sections. It appears to have been deposited after the oxides of manganese and orientite, but its relation to calcite and the zeolites is not clear.

Barite occurs in the deposits as radiating aggregates of thin tabular crystals intimately associated with orientite, and as clusters of tabular crystals in druses in manganese oxides. Most of it appears to have been deposited contemporaneously with orientite.

Glauconite (?) is intimately associated with bayate in most deposits. It forms thin fibrous green films on the borders of the bayate masses generally adjacent to the unaltered tuffs and most remote from the bodies of manganese oxide and orientite. The identification of the mineral near Bueycito is based wholly on the index of refraction (1.61) and the birefringence.

Materials having the same properties and associations was collected by Burchard in several districts in Cuba.[8]

[7] Burchard, E. F., loc. cit., p. 58-60.

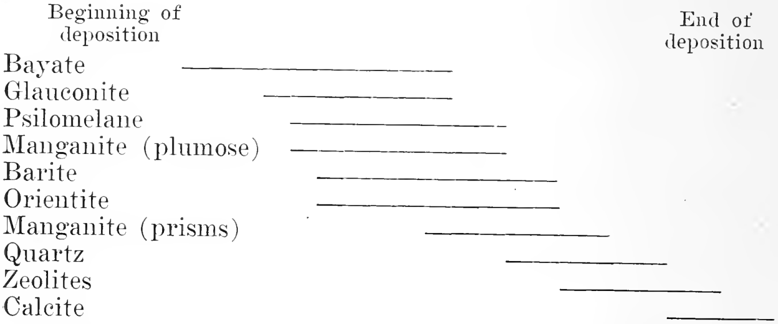
[8] Burchard, E. F., loc. cit., p. 89.

Calcite is present in many deposits near Bueycito, and uniformly is the latest mineral. It occurs as short scalenohedrons terminated by flat rhombohedrons which line drusy cavities and commonly rest upon one of the zeolites. Elsewhere it fills the space remaining after the other minerals were deposited (fig. 1).

It should be noted that in the Bueycito region orientite and the other silicates susceptible of decomposition by weathering are uncommonly fresh and that the ordinary products of weathering characteristic of residual deposits, wad, variegated clays, etc., are practically absent. In general the rocks adjacent to the bodies of manganese oxide and orientite are quite fresh. Burchard, however, has described[9] several deposits, such as those near Palmarito, where manganese oxides are imbedded in clays that lie in solution cavities in limestone.

Summary of Paragenesis.—In the Bueycito region, the several minerals that make up the manganese deposits have been deposited by the replacement of latite tuffs. Here and there, in parts of some of the richer deposits, the tuffs have been completely replaced and no traces of the original minerals remain. In some of the poorer deposits however, and on the borders of all of the deposits, replacement has been selective; the fine matrix of the tuffs in general is replaced by oxides of manganese and the glassy fragments and calcareous fossils are replaced by orientite. The feldspars resist replacement in this zone.

From the study of thin sections and polished opaque sections the following tentative order of genesis is indicated:



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[9] Burchard, E. F., loc. cit., p. 25.

Genesis.—It is not possible at this time to present all of the geologic data that bear upon the genesis of the deposits in which orientite is persistently present. It may be only briefly stated that the intimate association of the manganese oxides and orientite with zeolites and quartz, apparently without a pronounced interruption of the process of deposition, indicates that the first group have the same mode of origin as that commonly ascribed to the second, *i. e.*, deposition by warm hypogene waters. It should be noted that this is essentially the mode of origin suggested by Spencer in 1902,[10] although the evidence apears to be more conclusive at this time.

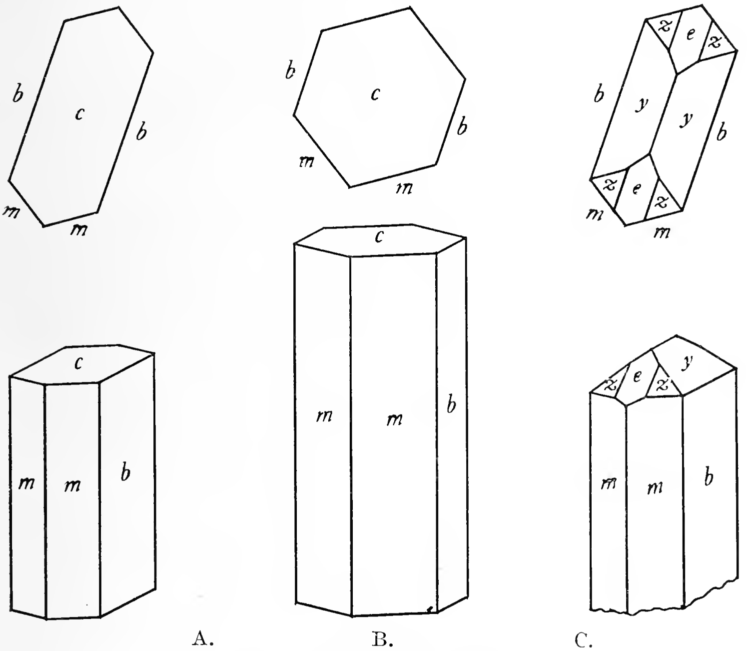

Fig. 5. Orientite from Cuba.

Part II.

Crystallography.—Orientite crystallizes in the orthorhombic system. It occurs as granular masses, as rosettes of radiating prismatic blades, and as distinct crystals making up drusy crusts. The crystals are small, the largest not exceeding 1 mm. in length and the average being very much less than this. There are two principal habits which grade into each other. Crystals of the most

[10] Hayes, C. W., Vaughan, T. W., and Spencer, A. C., loc. cit., p. 63.

common habit are prismatic with the length 1½ to 4 times the diameter. These show only the basal pinacoid *c* (001), the brachypinacoid *b*(010), and the unit prism *m*(110). The prism and brachypinacoid are about equally developed so that the crystals appear very much like hexagonal prisms (fig. 5, B). The second habit has the same simple combination but the crystals are distinctly tabular parallel to the pinacoid *b*(010) with the length 1½ to 2 times the breadth (fig. 5, A). The larger crystals are often composite being made up of smaller individuals in parallel position. The faces of all crystals large enough for goniometric measurement are imperfect, the prism faces being striated horizontally and more or less bulged while the base is usually somewhat concave. The only crystal found which was not terminated by the base alone was very minute and as shown in fig. 5 C was tabular parallel to *b*(010) and was terminated by forms which, by their zonal relations, were identified as *y*(011), *e*(102) and *z*(112). This crystal could not be measured on the goniometer and the only angular value obtained was measured under the microscope. This was the angle *e*(102): *e′*(102) = 61°00′ or,

$$e\ (102) \qquad \phi = 90°00' \qquad \rho = 30°00'$$

The value given for the *c* axis, based, as it is, upon this measurement alone, is obviously only an approximation. The mean of 9 good measurements on crystals of the simpler types gave as the angle for the prism:

$$m = (110) \qquad \phi = 56°06' \qquad \rho = 90°00'$$

or *m*(110): *m‴*(110) = 67°48′. From the above angles the following constants are derived:

$$a = .6720 \qquad p_o = 1.1780 \qquad \log.\ p_o = 10.07115$$
$$c = .7916 \qquad q_o = .7916 \qquad \log.\ p_o = 9.89851$$

These values give the following theoretical angles for the forms observed:

Forms, Goldschmidt Symbols, and calculated angles of orientite

Letter	Miller	Gdt. symbol	ϕ	ρ
b	010	0 ∞	0°00′	90°00′
c	001	0	0°00′	0°00′
m	110	∞	56°06′	90°00′
e	102	½ 0	90°00′	30°30′
y	011	0 1	0°00′	38°22′
z	112	½	56°06′	35°22′

Physical properties.—Single crystals of orientite are transparent except where clouded by disseminated oxides. The crystalline druses are bright and sparkling and are light brown in color when the crystals are free from impurities. In the majority of specimens, however, the crystals themselves contain more or less finely divided black impurity and consequently range from dark brown to almost black in color. The crystalline-granular massive material is dark brown in color with pitchy to dull luster. The luster of the crystals is more or less resinous. Occasionally they are iridescent to submetallic or metallic in luster due to very thin exterior coatings of a steel-gray manganese oxide. The powder is light hair-brown and the streak slightly darker. The mineral shows a very imperfect cleavage parallel to *m*(110) and probably also a still less perfect cleavage parallel to *c*(001). It is brittle with a hardness of 4.5-5. The mean of four closely agreeing determinations of the specific gravity is 3.05.

Optical properties: Orientite is biaxial positive with the optic plane parallel to *c*(001). The optical orientation is:

$$\mathrm{X} = a \qquad \mathrm{Y} = c \qquad \mathrm{Z} = b$$

Crystals of the tabular or type 2 habit lie on the face of *b*(010) and yield a symmetrical interference figure indicating that the obtuse bisectrix is perpendicular to this plane or that the acute bisectrix is perpendicular to *a*(100). Type 1 crystals often rest on a face of *m*(110) and then yield a figure showing a perfectly centered optic axis indicating that the optic axes coincide with the normals to the prism faces; therefore $2V = 67°$; 2E (calculated) $= 156°$. The pleochroism is marked: X, red brown; Y, yellow; Z, brownish yellow. Absorption $X > Z > Y$. The dispersion is pronounced but owing to the large value of 2E the bars of the optic axis are so straight that the direction of curvature is difficult to distinguish. So far as could be determined the dispersion is $\rho < v$. The indices of refraction are high while the birefringence is moderate. The values for the indices of refraction and the birefringence are as follows:

$$\alpha = 1.758 \quad \beta \doteq 1.776 \quad \gamma = 1.795 \qquad \gamma - \alpha = .037 \text{ all } \pm 1.005$$

Composition and chemical properties.—Crystallized orientite is unattacked by cold dilute hydrochloric acid but is readily soluble in hot hydrochloric acid with evolution of chlorine and separation of flocculent silica. It is practically insoluble in concentrated nitric acid but is partly decomposed by boiling with moderately concentrated sulphuric acid and yields a rose-purple solution which becomes brown on dilution, precipitating brown manganic hydroxide.

Material for analysis was selected with extreme care as it was necessary to avoid, so far as possible, included calcite and manganese oxides and also those portions of the drusy crusts which bore superficial coatings of oxides or of the colorless transparent opaline material. The best specimens consisted of cellular masses made up of thin ribs coated on both sides with drusy crystals. Such masses were crushed and the purest grains and aggregates of crystals were selected by hand under a high-power binocular microscope. In many cases the thicker ribs have a medial line of gray oxide and the groups of crystals are often grown around a nucleus of opaque steel-gray oxide as shown in the photomicrograph (fig. 1). It was possible to recognize these areas of oxide under the binocular microscope and to avoid them. The selected samples were ground for analysis but, when examined optically, they presented a rather unsatisfactory appearance as many of the grains were more or less dusted with what appeared to be a black opaque pigment of oxide. The dark material appears to be an exceedingly fine dust and many of the clear brown crystals have a central nucleus of the dust-like material, the opaque core locally having exactly the same form as the exterior of the crystal. The samples on which the analyses given in columns 1 and 2 below were made contained more or less of this opaque material in from 10 to 20 per cent of the grains. As treatment with heavy solutions and with an electromagnet failed to effect any further purification of the mineral, the muddy and the transparent grains have practically identical specific gravity and magnetic attractibility. During microscopic examination of sample 2 it was noted that the muddy impurity was practically confined to the larger grains while the smaller grains were mostly clear and transparent. Accordingly the finer material was separated by livigation with water and the product thus obtained showed very little of the opaque impurity. An analysis of this last portion is given in column 3 below. As will be seen, the analyses show but little variation which can be ascribed to the dust-like material and it seems probable that, despite its conspicuous appearance under the microscope, this is exceedingly tenuous and of practically negligible mass. It is believed that no appreciable amount of extraneous manganese oxide was included in any of the samples analyzed.

The results obtained upon analysis of the three separate samples are given in the following table. Standard analytical methods were used; the state of oxidation of the manganese was determined by collecting, in potassium iodide solution, the chlorine evolved upon solution of the mineral in hydrochloric acid and titrating the liberated iodine with standard sodium thiosulphate solution.

Analyses of crystalline orientite.

Constituent	1	2	3	Average
SiO_2	32.97	31.42	33.05	32.48
Al_2O_3	2.05	1.03	.17	1.08
Fe_2O_3	1.36	1.62	1.70	1.56
MnO	29.93	28.60	31.22	29.92
O	3.39	3.24	3.21	3.27
CaO	22.04	21.90	23.47	22.47
MgO	trace	trace	trace	trace
ZnO	trace	....	....	trace
H_2O — 110°C.	.03	....	.04	.03
H_2O + 110°C.	8.48	....	7.39	7.93
Cl	trace	....	....	trace
Total	100.25		100.25	98.74

The excess of oxygen shown in each analysis indicates that essentially all of the manganese is in the manganic state; the average column of the above table with the excess oxygen united with an equivalent amount of MnO to form Mn_2O_3 yields ratios as follows:

Ratios of orientite.

SiO_2	.5386	53.86	1.02 x 5
Al_2O_3	.0108	22.48	1.05 x 2
Fe_2O_3	.0098		
Mn_2O_3	.2044		
MnO	.0130	41.36	.97 x 4
CaO	.4006		
H_2O	.4402	44.02	1.04 x 4

The formula derived from the final column of ratios is then:

$$4CaO.2\overset{III}{Mn}_2O_3.5SiO_2.4H_2O.$$

This may be expressed as a hydrous orthosilicate thus:

$$Ca_4\overset{III}{Mn}_4(SiO_4)_5.4H_2O.$$

The water is not given off much below a red heat and in this it behaves like constitutional water and it is perhaps possible to regard it as such. This may be done by making half of the water acid and half basic, the formula then being written:

$$H_4Ca_4(MnOH)_4(SiO_4)_5.$$

The condensed percentages of the average column of analytical figures are compared with the theoretical composition required to satisfy this formula as follows:

		Average per cent.	Theory per cent.
CaO	22.47	23.39	24.56
MnO	92		
Al_2O_3	1.08	34.91	34.56
Fe_2O_3	1.56		
Mn_2O_3	32.27		
SiO_2		32.48	33.00
H_2O		7.93	7.88
Total		98.71	100.00

The agreement is satisfactorily close, especially when the difficulty of securing pure material is considered.

Pyrognostics.—The mineral yields neutral water in the closed tube with or without decrepitation. The roasted and dehydrated material is brownish-black in color with a brownish-black streak and is opaque under the microscope. In the forceps before the blast the mineral fuses readily with pronounced intumescence to a blebby black glass. It reacts for manganese with the fluxes.

Relationships.—A search of the literature has revealed no mineral to which orientite is closely related. The only other mineral which contains manganic manganese in similar ratio.is kentrolite which is similar crystallographically and the possibility of including the new mineral in the kentrolite group has been carefully considered. The similarity is shown by the following comparison:

	Kentrolite	*Melanotekite*	*Orientite*
Form	orthorhombic	orthorhombic	orthorhombic
Habit	short prismatic	short prismatic	short prismatic
a	.6334	.6338	.6720
c	.8830	.9127	.7916

Orientite differs from this group chemically by having a higher silica ratio as well as in its content of water. The degree of chemical similarity to the members of the kentrolite group may be shown by comparing the formulas thus:

$4PbO.2Mn_2O_3.4SiO_2$	Kentrolite
$4PbO.2Fe_2O_3.4SiO_2$.	Melanotekite
$4CaO.2Mn_2O_3.5SiO_2.4H_2O$.	Orientite

Setting aside the excess of silica and writing all the water as basic these minerals may be compared as follows:

$Ca_2(Mn(OH)_2)_2Si_2O_7.\frac{1}{2}SiO_2$	Orientite.
$Pb_2(MnO)_2Si_2O_7$.	Kentrolite.

The excess of silica precludes the inclusion of the mineral in this group, however, there being no sufficient evidence for regarding such an amount (5½%) as other than essential. The formulas of the minerals of the kentrolite group have, however, been derived from analyses made upon small amounts of material of doubtful purity and their accuracy has been questioned. It is possible that new analyses of these minerals might show them to be more closely related to orientite.

The amorphous material.—The amorphous material is all very impure from the presence of various included substances, chiefly black opaque grains of manganese oxide. It was so obviously impossible to learn much from analyses made upon this impure material that it was not examined in any great detail. The mineral varies from light to dark brown in the hand specimen, the variation being caused by varying amounts of included impurities. The purest grains are clear dark brown in color, having much the color of the crystalline-granular orientite. The luster is resinous and the mineral greatly resembles common brown opal. The powder and streak are pale brown. The material is very brittle and has a conchoidal fracture. The specific gravity is about 2.5 and the hardness is 2.5. Under the microscope the powder is in part composed of a clear light-brown isotropic material the mean index of refraction of which is 1.55. In selecting material for analysis it was possible to avoid silica which occurs along cracks but the analyzed powder showed a large proportion of black opaque oxide as well as a considerable proportion of a fine-grained crystalline mineral thought to be orientite. The analysis gave the following results:

Analysis of amorphous material.

CaO	4.36
MnO	20.91
Mn_2O_3	21.31
Fe_2O_3 ($+ Al_2O_3$)	4.50
SiO_2	23.76
H_2O + 110°C.	8.20
H_2O — 110°C.	15.60
Insoluble	1.24
Total	99.88

The material is a typical colloid and the water content is extremely variable, a considerable portion being lost over sulphuric acid in a desiccator. The above analysis may be interpreted as an orientite in which the lime has been replaced largely by manganous oxide. This leaves a considerable excess of both manganous and manganic oxides together with the large excess of loosely held water. If the lime be deducted as orientite and the trivalent bases be set aside, the remaining constituents give the ratios of neotocite. In view of the colloid nature of the substance as well as its manifest impurity it appears best to avoid further discussion of the analysis at this time.