ART. XXXIX.—*A Newly Discovered Dike at De Witt, near Syracuse, New York. Geologic notes by* N. H. DARTON, U. S. Geological Survey. *Petrographic description by* J. F. KEMP, Columbia College.

IN November, 1894, I received intelligence of an occurrence of intrusive rock penetrating the Salina formation near Syracuse, and soon after had an opportunity to visit the locality. The materials obtained were submitted to Prof. J. F. Kemp for microscopic study, and an analysis of the rock was made in the laboratory of the U. S. Geological Survey.

The locality is at the new reservoir on the top of an isolated hill, a half mile south of Dewitt Center (De Sono station on the West Shore railroad), 3 miles east of Syracuse. Mr. Phillip F. Schneider, a professor in the High School at Syracuse, was the discoverer of the dike, and to him also we are indebted for information regarding its relations. The dike was exposed by the excavations for the reservoir and does not appear to reach the natural surface. It was buried under a mantle of glacial drift, and in part, at least, was covered by shales and limestones of the Salina formation. Unfortunately the reservoir was practically completed and filled with water before Mr. Schneider learned of the dike, so that he was unable to observe the relations. According to the statements of the contractor, the rock occurred in masses imbedded in a greenish-yellow earth which underlaid the entire area of the excavation, which was about 200 by 250 feet. The masses varied greatly in size. Some were 20 by 50 feet and afforded an adequate supply of building stone for the walls of the reservoir. A considerable amount of the excavated materials now remains on the banks and it was from that source that I secured specimens. The greenish-yellow earth in which the rock masses occurred is undoubtedly a product of the decomposition of the intrusive rock. The original surfaces of all the rocks are more or less deeply decomposed to a serpentinous matter, and some of the smaller rocks are filled with calcite veins and other secondary products. Whether the mass was really a dike or mainly an intruded sheet was not determined. No traces of the rock have been found on the surface or in wells in the vicinity.

The dike at Dewitt is in the upper portion of the Salina formation which consists of shales and limestones. A short distance south, rise the slopes of the Helderberg escarpment, and to the north are wide plains of the lower Salina beds. The dip is a gentle monocline to the southward. The rocks adjoining the intrusive were thrown out in considerable amount in the

excavation of the reservoir. They present signs of slight metamorphism, consisting of increase in hardness and darkening in color. Mr. Schneider has called my attention to an exposure 600 yards north of the reservoir, in which there is considerable flexing in the shales, but this was the only signs of disturbance noted and may not be due to the intrusion.

The intrusive rock contains many inclusions of various rocks which will be referred to by Prof. Kemp. They were of course brought up from below by the dike.

The relations of the Dewitt dike to the Syracuse occurrence are not known, but as the rocks and relations are so similar it is probable that they are connected underground. It is very desirable that a careful search should be made in the region for other dikes at the surface.

Petrography of the Dewitt Dike.

J. F. Kemp.

The interest of geologists was greatly excited when Dr. G. H. Williams announced, in 1887, the undoubted igneous nature of the serpentine, which, in 1839 had been recorded by Vanuxem as occurring in the Salina salt group at Syracuse, N. Y. The region of undisturbed sedimentary strata of central New York was generally regarded, with much reason, as one of the least likely of all localities to contain intrusive rocks; and although scattered mention of dikes had been made for at least two other localities, the microscopic determinations of Dr. Williams were the first really conclusive evidence of their igneous character. In but two particulars did this paper leave anything to be further desired; first, the specimens, as stated in the paper, were of weathered material, such that the larger minerals, with the exception of a few small cores of enstatite had to be determined from the alteration products and the ground-mass was represented by a mass of carbonates and serpentine; and, second, Dr. Williams was unable to obtain, either from his own collections or those at Hamilton College, the "granitic" and "syenitic" (or micaceous and hornblendic) "accretions," mentioned by Vanuxem.

Somewhat later in further excavations, additional material was obtained, on which a brief note was presented to the Geological Society of America, at New York, December, 1889.* The geological relations proving the intrusive character, are set forth, and the general statement is made that the minerals of the rock are not all altered to serpentine, but beyond this, no further determinations are recorded than were given in the

* Bulletin, vol. i. p. 533.

earlier paper. Dr. Williams also found abundant inclusions—doubtless Vanuxem's "accretions"—even of the acidic crystallines on which the sedimentary series must rest. It is evident, however, from comparative remarks made upon the peridotite described by R. N. Brackett,* from Pike Co., Ark., that abundant and unaltered little augites in the ground-mass were also noted.

It would appear that in some respects the material collected by Mr. Darton is in an even fresher and less altered state than any yet examined, and as it occurs some three miles from the former locality, a few additional notes are not out of place. The writer is fortunate in having had for comparison some of the original specimens collected by Prof. Oren Root, the discoverer of the outcrop, and also a representative set of pieces from Dr. Williams's collection, given him by the latter in 1889. Comparisons have also been made with slides of some other allied rocks, as indicated below.

The Dewitt rock belongs to the porphyritic type of Williams. While in some specimens much altered, yet in others it contains olivine, as fresh and unchanged as if it had come from the most recent of basalts. Almost no traces of serpentinization are present in some of the slides. In addition to the olivine, whose crystals vary from 1^{mm} to 8^{mm} in diameter, the only other large phenocrysts are biotite and one or two crystals of augite. In the ground-mass are innumerable small augites, which seem to have made it up in largest amount, shreds of biotite, magnetite, apatite and perofskite. It is probable that there was also an original glass, now mostly devitrified by alteration.

The olivine is often idiomorphic, and the elongated, lozenge-shaped cross-sections are common. It is practically colorless. The figure given on page 142 of Dr. Williams's paper, would answer excellently for the new occurrence. The phenocrysts of biotite are smaller, 1^{mm} being the general diameter. They are hexagonal, and the outer portions are thickly set with included grains of magnetite. The color is the usual rich brown of the biotite in basic rocks, and there is a slight separation of the optic axes. The augite is a rather rare phenocryst, but two or three crystals having been seen in a half dozen slides. It is, however, well marked, has an extinction ranging from 30°–40°, and is perfectly fresh.

The little rods of augite in the ground-mass are very small, $\cdot 05^{mm}$ or less in diameter, and perhaps twice as long. They are faint green, have a high extinction, and are normal in their properties. The ground-mass is practically like that of the basic

* This Journal, July, 1889, p. 57, second paragraph and top of p. 59.

dikes called monchiquite, and the resemblance is very close in this respect to those met by the writer on Lake Champlain.*

The shreds of biotite are irregular and small. It is not certain that they are not, in large part, secondary. One vein of yellowish-brown biotite was found running across a thoroughly serpentinized olivine crystal, and hence must have been secondary. The occurrence casts a doubt over the shreds in the more or less decomposed ground-mass, and gives ground for thinking them likewise secondary. The magnetite and apatite deserve no special comment, although the analysis indicates that as regards the former, some chromite is also present. Dr. Williams came to the conclusion that the greater part of the black opaque grains met at Syracuse were chromite; but as so little Cr_2O_3 is shown by the analysis of the Dewitt material, and as the grains are quite abundant, and the rock magnetic, it is probable that most of them are magnetite. They show no alteration to leucoxene. Not a few of the small grains, on being highly magnified in a strong light, are seen to be translucent and brown. They are undoubtedly perofskite, and a close parallel to the occurrence at Syracuse. The translucency was not detected in the hasty examination made by the writer prior to the meeting of the Geological Society of America in Baltimore last December, and it was then stated verbally, that no perofskite had been detected. The minuteness of the grains and their high refraction led to this erroneous inference from study with low powers. The web of apparently devitrified glass in which these small crystals of the ground-mass are caught, is an unsatisfactory subject of study. Some clear patches are perfectly isotropic, while others show irregular spherulitic crosses, and even colors of the first order. Where the network of small augites is thick, the interstitial masses are too minute to be satisfactorily studied. Careful search was made for melilite, because the abundant perofskite and the interesting occurrence of this mineral at Manheim, N. Y., described by C. H. Smyth, Jr.,† gave some ground for suspecting it, but none could be detected.

The Dewitt rock might, with perfect propriety, be called a picrite, as a porphyritic form of peridotite, or a monchiquite as a dike rock without feldspar and containing olivine, there being no real need for both these names. It corresponds to picrite as used by Rosenbusch, except that it has abundant biotite, and therefore is related to the mica-peridotite of J. S. Diller,‡ from the very similar Flanary dike of Crittenden Co., Ky., but biotite, as shown by a comparison of slides, is less

* Kemp and Marsters, Bulletin 107, U. S. Geological Survey, p. 33.
† This Journal, Aug., 1893, p. 104.
‡ Ibid, Oct., 1892, p. 289.

abundant at Dewitt, while augite, even in the ground-mass, is absent in the Kentucky occurrence. It is practically the same as the peridotite of Pike Co., Ark., referred to above, and both Williams in the original papers on the Syracuse occurrence, and Brackett in the one earlier cited, on the Arkansas exposure, were abundantly justified in placing these rocks with Lewis' kimberlite* from South Africa. The writer has compared the Dewitt rock with slides of all the American related dikes, and with others of the dike in the De Beers mine of South Africa. It is practically the same rock as the last, except that in the specimens at hand, the latter appears to have had a glassy ground-mass now devitrified, which lacks augite. The writer is in thorough sympathy with the growing opinion, that rocks should be classified on texture, and, broadly speaking, into granitoid, porphyritic and glassy groups: that dikes should be referred to their nearest granitoid or porphyritic relatives, and called by their names. Taking plutonic rocks as practically the granitoid, and volcanic as the porphyritic, the Dewitt rock is a basaltic dike of the same composition and texture as limburgite, and should be called limburgite, even if it is not a surface flow. It would probably simplify matters in a commendable degree if all the other names of feldspar-free, olivine-bearing dikes with a glassy ground-mass, be allowed to drop out of use, and if in this and other similar cases, large resemblances, rather than small differences, were brought out in our nomenclature.

At Mr. Darton's request, the following analysis was made of the Dewitt rock, in the laboratory of the U. S. Geological Survey, by Dr. H. Stokes. With it are placed analyses of the Syracuse serpentine, made by T. S. Hunt† in 1858, and of the mica-peridotite from Crittenden Co., Ky., made by W. F. Hillebrand for J. S. Diller.‡ Although an analysis of the badly-weathered Ithaca dike was made for the writer, and published, it is here omitted, because it is clearly untrustworthy, the high Al_2O_3 and low MgO, being unlikely.

Mr. Darton collected a coarsely crystalline rock, which occurred with the fragments of peridotite. In thin sections it is seen to contain brown, basaltic, quite idiomorphic hornblende, plagioclase, one large untwinned feldspar with parallel extinction, apparently orthoclase, and many quite large bits of magnetite. This is probably one of the syenitic accretions of Vanuxem, and an inclusion of wall rock in the peridotite, brought up from great depth. It may be, it should also be stated, a drift-boulder, as it was found with the loose, blasted peridotite,

* Geol. Mag., 1887, 22.
† This Journal, Sept., 1858, 237.
‡ Ibid., Oct., 1892, 288.

but the indications were that it came from the excavation. In studying a series of slides, however, from the material received five years ago from Dr. Williams, one slide contained a crystal of brown hornblende like the above, and another had in the midst of the porphyritic peridotite, a chance inclusion about 10^{mm} across which consisted of microperthitic orthoclase, in largest part, with some plagioclase, brown hornblende and titaniferous magnetite. It is undoubtedly a fragment of the underlying Archæan crystallines, picked up by the intrusive peridotite, for its edges are sharp and all the associations are of this character. Mr. Darton also gathered specimens with undoubted inclusions of sedimentary rock. One of these is an argillaceous sandstone formed of quartz grains and interstitial clay; and the others are earthy limestones showing, under the microscope, sections of small brachiopod shells. No appreciable evidence of contact metamorphism could be detected.

	Dewitt.	Syracuse.	Kentucky.
SiO_2	36·80	40·67	33·84
TiO_2	1·26	----	3·78
Al_2O_3	4·16	5·13	5·88
Cr_2O_3	0·20	----	0·18
Fe_2O_3	----	----	7·04
FeO	8·33	8·12	5·16
MnO	0·13	----	0·16
NiO	0·09	----	0·10
CoO	----	----	trace
CaO	8·63	----	9·46
BaO	0·12	----	0·06
SrO	trace	----	----
MgO	25·98	32·61	22·96
K_2O	2·48	----	2·04
Na_2O	0·17	----	0·33
H_2O	----	12·77	7·50
P_2O_5	0·47	----	0·89
CO_2	2·95	----	0·43
Cl	----	----	0·05
F	----	----	?
SO_3	0·06	----	----
S	0·95	----	----
H_2O below 110°	0·51	----	----
H_2O above 110°	6·93	----	----
	100·22		
Less O=S	·47		
	99·75	99·30	99·86

It is interesting to note the thickness of sedimentary strata through which this dike must have come from its source in or

below the old crystallines. F. E. Englehardt* gives as the result of the State well at Syracuse, 1969 feet from the surface Salina to and 154 feet into gray Medina sandstone. Forty miles due west, at Clyde,† a well, begun in the Salina, went 1792 feet and stopped, being then 92 feet into the Hudson River shales. A few miles north of Clyde, a well at Walcott† penetrated from the Niagara on the surface 2700 feet, and stopped 750 feet into, but not through the Trenton. While at Rochester,‡ beginning in the Niagara, a well was put down 3078 feet, ending in white ferruginous quartz, supposed to be Archæan. Ashburner's generalized section along the meridian of Clyde, gives 4800 feet from the Helderberg to the Archæan, and the dike must have come up through some such section as this, until it stopped in the Salina strata.

NOTE:—The following igneous intrusions have now been determined microscopically in central New York. At Syracuse, peridotite, G. H. Williams, this Journal, Aug., 1887, p. 37, Bull. Geol. Soc. Amer., I, 533; at Ithaca, 75 miles south of Syracuse, presumably peridotite, like preceding, J. F. Kemp, Idem., Nov., 1891, p. 410. The analysis given in this paper, as regards Al_2O_3 and MgO is undoubtedly untrustworthy. At Manheim, 75 miles east of Syracuse, alnoite, C. H. Smyth, Jr., Idem. Apr., 1892, 322, Aug., 1893, 104. At Dewitt, 3 miles east of Syracuse, as above. In addition, boulders of a most interesting rock have been found at Aurora, N. Y., about 25 miles north of Ithaca, which consisted of great crystals of pyroxene and hornblende in a glassy ground-mass, and with no certain olivine. (J. F. Kemp, Trans. N. Y. Acad. Sci., XI, 126. 1892.) Boulders of the same rock with attached, fossiliferous Trenton limestone, have been found by J. M. Clarke, on Canandaigua lake, 30 miles west of Aurora, and have been described by B. K. Emerson. (12th Ann. Rep., N. Y. State Geologist, 1892, published 1893.) We may expect other dikes of these curious basic rocks to be discovered in the New York Palæozoic series, as time goes by.

* N. Y. Assembly Doc., 1885, No. 32, p. 15. Quoted by Ashburner in Trans. Amer. Inst. Min. Eng., XVI, 944.

† C. S. Prosser. Amer. Geol., Oct., 1890, 203–204. The same figures are given by Ashburner, loc. cit.

‡ H. L. Fairchild, Proc., Rochester Acad. Sci. I, 184, 1891.