SCIENTIFIC JOURNALS AND ARTICLES

THE July number (volume 11, number 3) of the *Transactions of the American Mathematical Society* contains the following papers:

Eduard Study: "Die natürlichen Gleichungen der analytischen Curven im Euklidischen Raume."

J. W. Young: "Two-dimensional chains and the associated collineations."

L. I. Neikirk: "Groups of rational transformations in a general field."

P. F. Smith: "On osculating element-bands associated with loci of surface-elements."

G. A. Bliss and Max Mason: "Fields of extremals in space."

G. A. Miller: "Groups generated by two operators s_1, s_2 satisfying the equation $s_1s_2^2 = s_2s_1^2$."

L. P. Eisenhart: "Congruences of the elliptic type."

THE July number (volume 16, number 10) of the *Bulletin of the American Mathematical Society* contains: "A theorem on the analytic extension of power series," by W. B. Ford; "Extensions of two theorems due to Cauchy," by G. A. Miller; "Existence theorems for certain unsymmetric kernels," by Anna J. Pell; Review of Baker's Multiply Periodic Functions, by J. I. Hutchinson; Review of Bôcher's Higher Algebra (English and German editions), by Arthur Ranum; Review of Coolidge's Non-Euclidean Geometry, by Joseph Lipke; Review of Wieleitner's Spezielle Ebene Kurven, by E. G. Bill; Shorter Notices: Borel-Stäckel's Elemente der Mathematik, Band II.: Geometrie, by C. H. Sisam; Carus's Foundations of Mathematics, by F. W. Owens; Cox's Mechanics, by W. H. Jackson; Abraham's Theorie der Elektrizitat, volume 2, Elektromagnetische Theorie der Strahlung, second edition, by E. B. Wilson; "Notes"; "New Publications"; "Nineteenth Annual List of Papers read before the Society and subsequently published"; Index of volume.

SPECIAL ARTICLES

THE COMPOSITION OF SOME MINNESOTA ROCKS AND MINERALS

THE writer after spending two summers in the field for the Geological and Natural History Survey of Minnesota, has been analyzing and gathering data regarding the composition of typical materials, and some interesting variations. The detail of field observations, the petrographic descriptions and the less important types are reserved for future possible bulletins of the survey, but three lines of investigation have given results of general interest: (1) analyses of typical acid and basic igneous rocks, (2) mineral analyses, (3) tests for copper in the Keweenawan lavas.

1. Rock analyses are available from central and eastern Minnesota.[1] In the central area excellent building and monumental stone is obtained from two or three types of granite, which occur in laccoliths of considerable size, in Kewatin schists, and are probably themselves of that age. There are a few masses of gabbro, and the granites are intersected by many diabase dikes and a smaller number of quartz-diabase and quartz-porphyry dikes. In the eastern area are the basic Keweenawan lavas, continuous with the copper-bearing rocks of Michigan. Most of the lavas in Minnesota can be classed in three types of diabase, which show quite distinct field appearance and are mineralogically three points in a series, varying from a mottled rock high in augite to one with conchoidal fracture low in augite, the other constituents showing minor changes.

The attempt has been made to produce analyses of much greater completeness and somewhat greater accuracy than those heretofore available, so as to estimate the approximate composition of the fundamental magma existent in this petrographic province. Broadly considered, these two districts are the southwestern extreme of a long series of outcrops of igneous material extending northeast to Labrador and northwest to McKenzie. They are thus near the point of a great V. The Wisconsin igneous rocks may be assigned a similar position farther east. South and west, some few igneous materials outcrop on the Minnesota River, but then there is a break to the Ozark Mountains and the Black Hills. Northward the outcrops are much more abundant.

[1] Previous work is mostly referred to in the state survey reports.

Of the several dozen analyses made in this study, it has been possible to select those of Table I as representing extensive types and it is desirable to have them on record. Attention may be called to certain peculiarities in these rocks as compared with world averages. The calcium is uniformly high compared with magnesia. In the average Minnesota rock soda is predominant over potash, but there are some decided exceptions to this. A similar discussion of Wisconsin igneous rocks, south of the Keweenawan area, by Weidman[2] shows essentially the same peculiarities, even more extreme. Present data are rather insufficient to yield a serviceable estimate of the average igneous rock for the whole state. In the chem-

TABLE I

Rock Analyses and Averages. (*By F. F. Grout.*)

	1	2	3	4	5	6	7
SiO	72.41	64.40	68.87	48.88	48.27	53.16	48.95
Al_2O_3	14.33	14.93	14.93	16.39	16.29	15.12	16.92
Fe_2O_3	1.09	1.63	1.70	5.51	4.55	5.95	6.35
FeO	1.47	3.13	2.41	7.21	10.09	6.75	5.74
MgO	0.30	3.05	1.25	5.80	4.94	4.76	5.42
CaO	1.66	4.18	3.00	9.11	8.42	5.74	7.70
Na_2O	5.14	3.31	3.52	2.08	2.14	2.38	2.71
K_2O	3.45	3.95	3.06	0.47	0.77	1.54	1.15
H_2O-	0.02	0.07	0.05	0.19	0.64	0.38	0.65
H_2O+	0.08	0.15	0.64	2.15	1.67	1.92	2.70
CO_2	0.21	0.18	0.11	0.09	0.05	0.05	0.20
TiO_2	0.23	0.57	0.58	1.84	2.46	1.68	1.68
ZrO_2	trace	0.07	0.03	none	none	none	0.01
P_2O_5	0.23	0.57	0.29	0.10	0.14	0.09	0.14
S	none	0.12	0.09	0.05	0.04	0.04	0.08
Cr_2O_3	none	trace	0.04	none	none	none	0.03
CuO	none	none	none	0.02	0.03	0.02	0.02
MnO	0.03	0.09	0.09	0.15	0.17	0.17	0.19
SrO	none	none	none	none	none	none	trace
BaO	none	0.05	0.06	0.02	0.04	0.02	0.02
	100.65	100.45	100.72	100.06	100.70	99.77	100.61
Specific Gravity	2.640	2.680		2.974	2.986	2.882	
Name	Toscanose	Harzose	Lassenose (Toscanose)	Hessose	Auvergnose	Bandose	Hessose

1. Typical red granite of central Minnesota. T. 124 N., R. 28 W. Contains quartz, soda-orthoclase and microcline, a little oligoclase, biotite and hornblende, and accessory magnetite, apatite and sphene. Augite has been found as cores in the hornblende.

2. Typical gray granodiorite of central Minnesota. T. 124 N., R. 28 W. Contains quartz, oligoclase, orthoclase, microcline, augite and hornblende with accessory ilmenite, magnetite, apatite, sphene and zircon. Hornblende and in some cases biotite develop from augite. Much of the quartz and feldspar is secondary and enlarged original crystals.

3. Approximate average composition of Minnesota granites from all available analyses. (17 new analyses included.)

4. Mottled diabase, Keweenawan of Taylors Falls. T. 34 N., R. 19 W. Contains altered augite and plagioclase with ophitic texture; olivine and magnetite. The alteration gives much chlorite and epidote.

5. Hackly diabase, Keweenawan of Snake River. T. 39 N., R. 21 W. Similar to the preceding number, with less augite, thus leaving the texture diabasic.

6. Conchoidally fracturing diabase, Keweenawan of Crooked Creek. T. 42 N., R. 18 W. Similar to No. 5, with so little augite that the texture is granular.

7. Estimate of the average composition of Keweenawan lavas from all analyses available from the Lake Superior Region. (15 new Minnesota analyses.)

[2] Wisconsin Survey, Bulletin XVI.

TABLE II

Mineral Analyses. (All material air-dried.)

	1	2	3	4	5	6	7
SiO_2	61.69	66.62	47.25	63.37	55.76	36.50	51.34
Al_2O_3	19.46	22.20	31.56	21.08	23.24	} 3.58	22.48
Fe_2O_3	} 1.89	trace		} 0.36	} 0.97	}	} 0.72
FeO	}	none	2.29	}	}	}	}
MgO	0.52	0.77	0.29	trace	0.55	1.25	0.97
CaO	none	1.40	15.39	1.72	trace	33.28	10.68
Na_2O	0.20	8.82	2.52	9.32	11.79	none	1.23
K_2O	15.00	0.37	0.37	4.04	0.07	0.10	0.40
H_2O-	0.10	—	—	—	0.10	0.16	1.66
H_2O+	0.97	—	0.40	0.57	8.06	5.95	10.14
Other	TiO_2=0.10 CO_2=0.15				CO_2=0.15	B_2O_3=18.88 *est.* CO_2= 0.20 TiO_2= 0.10	CO_2=0.10
Total	100.08	100.18	100.07	100.46	100.68	100.00	99.72
Sp. G.	2.615	2.645			2.283	2.951	2.353

	8	9	10	11	12	13	14
SiO_2	49.66	53.73	53.02	62.78	31.87	31.84	44.60
Al_2O_3	21.15	15.08	20.55	15.52	17.58	18.32	6.93
Fe_2O_3	} 1.55	4.24	1.94	} 2.28	7.63	2.59	9.59
FeO	}	2.36	1.36	}	8.67	13.80	3.94
MgO	1.44	9.12	7.31	3.19	20.81	20.64	19.98
CaO	9.16	0.08	0.08	none	trace	none	0.74
Na_2O	1.49	0.38	0.72	none	none	trace	0.61
K_2O	1.38	8.02	6.20	5.82	0.92	trace	0.15
H_2O-	2.90	1.02	1.82	6.23	0.47	1.80	8.00
H_2O+	10.80	5.55	5.36	4.50	11.63	10.40	5.00
Other	CO_2=0.12	TiO_2=0.03		TiO_2=0.06	TiO_2=0.15	CO_2=0.13	CO_2=0.13 TiO_2=0.06
Total	99.65	99.61	98.36	100.39	99.73	99.52	99.73
Sp. G.	2.315	2.750	2.677	2.581	2.777	2.739	2.500

1. Orthoclase. Small light brown tufts (resembling stilbite in form) lining amygdaloidal cavities. T. 39 N., R. 21 W. Analysis by F. F. Grout.

2. Albite. Separated by specific gravity from an albite-epidote rock. T. 126 N., R. 35 W. Analysis by F. F. Grout.

3. Anorthite. Beaver Bay, north shore of Lake Superior. Analysis by C. P. Berkey.

4. Soda-microcline phenocrysts in red granite. T. 123 N., R. 29 W. Analysis by L. Pease and F. H. Keller.

5. Analcite. Trapezohedral crystals (211), colorless to red in amygdaloidal cavities. T. 39 N., R. 21 W. Analysis by F. F. Grout.

6. Datolite. New occurrence for Minnesota except in glacial drift. Enamel-like bunches occurring like No. 1 and No. 5 above. T. 39 N., R. 21 W. Analysis by F. F. Grout. A rough determination of boric acid gave 17.36.

7. Laumontite. Light pink amygdules. T. 39 N., R. 21 W. Analysis by F. F. Grout.

8. Laumontite. Dark red vein filling. T. 39 N., R. 21 W. Analysis by F. F. Grout.

9. Pseudomorph after No. 8, especially near calcite contacts. Analysis by F. F. Grout.

10. A further alteration of No. 8, to white soapy earth with loss of the original form and structure. Analysis by F. F. Grout. Average of four analyses with uniformly low summation.

11. An earthy product resembling No. 10 occurring with chlorite No. 12 on Upper Tamarack Creek. T. 42 N., R. 16 W. Analysis by F. F. Grout.

12. Chlorite from the same rock as No. 11. Analysis by F. F. Grout.

13. Chlorite amygdules. T. 39 N., R. 21 W. Analysis by F. F. Grout.

14. Chlorite (or green earth) vein. T. 42 N., R. 18 W. Analysis by F. F. Grout.

The high hygroscopic moisture is recovered on standing in ordinary air.

ical classification, a Hessose and the closely related Bandose and Auvergnose are the most widely represented types.

2. The table of mineral analyses shows the degree of purity of the material found and needs little explanation. Several of the occurrences are here recorded for the first time, notably the datolite. Laumontite furnished material for a crystallographic study now in progress. The angles observed between the simple prisms and oblique terminations are too far from those recorded to be easily explained by the impurity of the mineral. Further, an alteration of laumontite is found clearly formed at a dump of a new deep shaft on Snake River. Coarse red laumontite grades into light earthy green, especially along contacts of two crystals or the coating of calcite which is common on laumontite. Well-developed pseudomorphs occur, retaining the peculiar angles mentioned for the original. A study of occurrence on the dump, indicated that further alteration yielded a much lighter green soapy to earthy product. Thin sections show a confused aggregate, even in the pseudomorphs, none of the particles reaching one hundredth of a millimeter in length, and none showing a high interference color. The analyses show that these are no simple minerals, but they represent a remarkable substitution in the laumontite. Lime is completely removed, as is part of the water, while potassium and magnesium increase. The variability in similar material in other outcrops is also shown. Tests are in progress to determine its homogeneity if possible. It is proposed to call it pseudo-laumontite. A mottled diabase, altered very green, gave further evidence of the prevalence of alteration to some mineral or mixture high in potash and magnesia. Unless this soft aggregate contains orthoclase, the alteration is not previously recorded for laumontite. The solubility in sulphuric acid makes orthoclase quite impossible. Dana mentions alteration by "magnesian solutions." Van Hise[3] and Clarke[4] in discussing the alteration of rock minerals mention no such products, but Pumpelly[5] speaks of a replacement of many zeolites by chlorite, and a pseudomorph of "clay (?) after laumontite" which probably refer to similar material as it is common throughout the Keweenawan. Neither chlorite nor clay is an accurate name.

3. A study of the prospective copper deposits of the southwestern extreme of the Keweenawan rocks led to a test of the country rock for traces of copper. The common theory of origin of the Lake Superior copper deposits is that of lateral secretion from the diabases, but both ascending and descending solutions have been credited as supplying part or all of the copper. Direct evidence has not been found in the literature, except a reference to a few grains of sulphids in the fresh diabase. The present tests are reasonably conclusive. Copper does occur in all the main types of rock, and as far as can be judged from ten samples, *the fresher the rock the larger the amount of copper.* The type of rock shows less effect on the proportion of copper than the alteration. An olivine rock, high in the series on Snake River, with hardly alteration enough to yield chlorite, gave a maximum, 0.029 per cent., and the altered rocks a minimum, 0.012 per cent. Blank analyses were made and all due precautions observed. A test of the compound in which copper exists gives signs of an insoluble silicate, probably augite. Only one tenth of the copper was soluble in nitric acid in the rocks tested. A calculation shows that a concentration of copper from 500 parts of rock to one part of ore must have occurred to produce the known ores from such rock. Such a concentration, though extreme, is by no means impossible.

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January, 1910

THE TOADS OF THE NORTHEASTERN UNITED STATES

SINCE the publication of the "Frog Book" by Miss Mary C. Dickerson, in 1906, consid-

[3] U. S. Geological Survey, Monograph 47.

[4] U. S. Geological Survey, Bulletin 330.

[5] Michigan Geological Survey, Vol. I., Pt. II., p. 45.