the lower felsitic rock spoken of as lava is really of a fragmentary character; secondly, the existence of dykes and intrusive masses of felstone; and thirdly, the highly metamorphic rocks of Cwm Llan and Llyd Nadroedd. These three things are all new. Fourthly, the occurrence of diorite in the Snowdon area is a discovery.

X.—DIAGRAM OF COMPOSITION OF IGNEOUS ROCKS.

By H. WARTH, Esq.

RECENT studies about the average chemical composition of larger numbers of igneous rocks in the aggregate have shown that figures obtained from any one hundred or more samples are very similar, in fact practically equal. (See A. Harker, "On the Average Composition of British Igneous Rocks": *GEOL. MAG.*, No. V, May, 1899.) This will be found also the case when comparing the following average which I calculated from the analysis of igneous rocks compiled by Roth in his "Petrographie der plutonischen Gesteine."

Now if it is of interest to discuss these average results, notwithstanding the wide discrepancies of many individual compositions, it may also be worth while to find out how on the average the compositions vary with the relative acidity of the rocks. For this purpose I have arranged the bulk of Roth's samples in the order

DIAGRAM—FIG. 1.

of acidity, and after calculating average compositions of eighteen groups of closely approaching acidity, I constructed from the figures the subjoined diagrams. The first diagram (Fig. 1) shows the actual results, the second (Fig. 2) shows them rounded off.

The percentage of silica varies from 80 to 40, and the usual limits between acid, intermediate, and basic rocks are indicated by the vertical lines on the diagrams. The diagrams show the percentage of the different bases which corresponds with the percentage of silica indicated on the straight diagonal boundary-lines of the silica which rise from the points marked 80 per cent. on the left of

DIAGRAM-FIG. 2.

each diagram to the points marked 40 per cent. on the right of each diagram. As it would not be possible to give so many details on the diagram, small quantities of other acids have been reckoned with the silica and treated as such. These acids are titanitic acid, phosphoric, carbonic, and in rare cases also sulphuric acid. In the case of the bases I also included the manganous oxide, and a few other rarer metallic oxides with the ferrous oxide. The total number of specimens which were calculated amounted to 428. About sixty-six of Roth's analyses were omitted, partly because they referred to strongly weathered specimens, and partly to exclude serpentines and some other more purely magnesian silicates. The specimens as given by Roth are from generally distributed localities, and the following are the compositions of extremes and of the total average in numerical figures:—

	Si	Al	Fe	Fe	Mg	Ca	Na ₂	K ₂	H ₂
Most acid...	79.7	11.4	1.1	0.3	0.7	0.9	2.6	2.5	0.8
Most basic ...	40.0	12.3	10.2	5.8	14.2	10.5	3.1	1.2	2.3
Average ...	58.3	15.3	5.0	3.6	4.0	5.9	3.4	3.0	1.6

The diagrams show the alumina to be nearly constant, only slightly diminishing towards both extremes. The soda is also tolerably constant, diminishing slightly at both ends. The potash is decidedly stronger at the acid end, whilst the other oxides increase from left to right so as to show quite a fan-like expansion from the acid end towards the basic end.

The diagrams show also that the arbitrary boundaries between acid, intermediate, and basic rocks are very suitably chosen.

REVIEWS.

BOLLETTINO DELLA SOCIETÀ SISMOLOGICA ITALIANA, Vol. V (1899-1900).

EXCLUDING two bibliographical notices, the present volume contains nineteen papers, of which all are interesting and one is important. In addition, is the catalogue of earthquakes recorded in Italy during the year 1898, compiled by Dr. G. Agamennone and his successor Dr. Cancani. The value of this work is abiding, and increases with every fresh year of its existence.

If we may judge from this volume, the recent energies of Italian seismologists have been directed less to the invention of new instruments and more to the study of their records. Nevertheless, Drs. Vicentini and Pacher have made an important addition in the form of a vertical component microseismograph. The paper in which it is described, and the representations of some of its records, are most interesting. Dr. G. Agamennone has devised a new seismoscopic clock, and Dr. G. Pericle one more seismoscope.

Professor A. Riccò, of Catania, gives a summary of a report on the destructive earthquake of November 16, 1894, in Calabria and Sicily, and on its relations with the earthquakes of 1783. From the same writer we have also an account of the Etnean earthquake of May 14, 1898. Dr. Agamennone describes the Balikesri (Asia Minor) earthquake of September 14, 1896, the Apennines earthquake of March 4, 1898, and the Modena-Bologna earthquake of February 2, 1900; while Dr. Cancani studies the Latian earthquake of July 19, 1899. In connection with barisål guns Professor Issel's supplementary paper on the Umbria Marches earthquake of December 18, 1897, is deserving of study.

Professor Mercalli contributes observations on Vesuvius (July-December, 1898), and Mr. R. V. Matteucci others on the Italian volcanoes generally. On July 19 and 25, 1899, violent explosions occurred in the central crater of Etna; these are carefully described by Mr. S. Arcidiacono, and their effects on the condition of the crater by Mr. A. Mascari.

C. DAVISON.