

## PROCEEDINGS OF SOCIETIES

### NEW YORK MINERALOGICAL CLUB

A regular meeting of the New York Mineralogical Club was held at the American Museum of Natural History on the evening of April 15, 1931, with an attendance of 65. President Allen was in the chair.

The meeting was called to order at 8:15 p.m. The Secretary not being on hand, the reading of the minutes and communications were deferred for the moment. The President appointed Dr. Horace R. Blank to act as Secretary *pro tem.*, and then proceeded with the annual election of officers. As President Allen had been nominated for reelection, Mr. Ernest A. Maynard was elected President *pro tem.*

The nominations of the Nominating Committee were read and additional nominations from the floor called for. There were no additional nominations and the election of the following was made unanimous:

Officers of the Club for the present year: President, Frederick I. Allen; first vice-president, George E. Ashby; second vice-president, Horace R. Blank; secretary, Daniel T. O'Connell; treasurer, Gilman S. Stanton.

President Allen resumed the chair. Mr. Morton meanwhile had arrived and relieved Dr. Blank as Secretary. The regular order of business was then resumed. The minutes of the February and March meetings were read and approved. The committee on Membership reported favorably on the names of Mr. John H. Fisher, Mr. W. R. Schneck, Miss Jane Kesler, Mr. H. Alban Anderson, and Miss Lillian Frazer, who were proposed for membership at the March meeting. On motion they were elected to membership. Mr. H. R. Lee, 31 Midland Avenue, White Plains, N. Y., was proposed for membership by Mr. Stanton; Mr. John C. Boyle, Children's Museum, Brooklyn, N. Y., was proposed by Mr. Hoadley.

Communications were read by the Secretary from the following:

The Roerich Museum of New York, describing the work of Urusvati, their newly organized Himalayan Research Institute and offering joint cooperation in any field of research in their field of interest to the club. They also requested an exchange of publications.

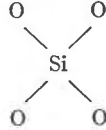
Professor R. J. Colony of Columbia University, expressing regret at being unable to give the lecture scheduled for the February meeting owing to being called away suddenly to report on the effects of an earthquake in Oaxaca, Mexico. He offered to give the lecture announced at any open date in the future.

Mineral Department of the British Museum (Natural History), London, England, requesting certain copies of the Club's *Bulletin* which are needed to complete the set on file in their library.

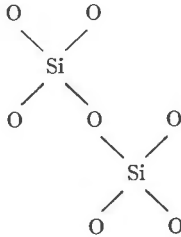
Science Service, Washington, D. C., thanking the club for its offer of cooperation and the copy of Mr. Manchester's book which was forwarded to the Editor of *Science Service* in accordance with the deliberations of the Club at the February meeting, and promising to publish a review of the book in their weekly magazine, the *Science News Letter*.

The newly elected Secretary was then invited to take his post and President Allen introduced the speaker of the evening, Dr. Ralph W. G. Wyckoff, who addressed the club on *The Crystal Structure of the Silicates*. Dr. Wyckoff outlined recent work, due mainly to Professor W. L. Bragg and his students at Manchester Univer-

sity, England, which has been concerned with the difficult task of unraveling the structure of the silicates through the use of  $x$ -ray diffraction effects. As a result of their study, the silicates no longer need be considered as the salts of a hypothetical series of acids based on analogy with the sulphur and phosphorus acids. It has been found that in every silicate, the silicon atom is at the center of a tetrahedron of oxygen atoms.



These tetrahedrons of  $\text{SiO}_4$  have the property of linking up together with other  $\text{SiO}_4$  groups resulting in such combinations as  $\text{Si}_2\text{O}_7$  and  $\text{Si}_3\text{O}_{10}$ , extending on in this manner indefinitely.



These studies have led to the following principles:

1. The existence of a universal  $\text{SiO}_4$  group of atoms which are found in all the silicates.
2. The property of these  $\text{SiO}_4$  groups to attach themselves together through having one oxygen atom in common.

The structure of the silicate minerals may be classified under four headings:

- (A) Discrete silicate groups; (B) Chain structures of linked silicate groups; (C) Sheet structures of linked silicate groups; (D) Network structures of linked silicate groups.

The discrete silicate groups include "Island  $\text{SiO}_4$  groups," and more or less complex silicate groups. If these  $\text{SiO}_4$  groups do not form islands in crystals they will form *chain structures* and by linking up, double chains and even sheets, may be developed giving *sheet structure*. Sheets linked together would give a 3-dimensional or solid structure of Si and O atoms linked together giving a *network structure*.

The oxygen atoms are relatively very big and the silicon atoms small. The latter fit into the spaces between the oxygen atoms. Thus is explained the enormous stability of the  $\text{SiO}_4$  group because of this extra close packing of atoms.

Dr. Wyckoff, by means of lantern slides, showed the atomic structure of a number of the silicate minerals, based on the  $x$ -ray investigations. Examples of discrete silicate groups mentioned include zircon, olivine, sillimanite, andalusite, cyanite and titanite. In the case of titanite,  $\text{CaTiSiO}_6$ , it was formerly believed that Si and Ti were interchangeable. But the  $x$ -ray patterns show that this is not the case, for

Si forms a group with 4 oxygen atoms and Ti forms a group with 6 oxygen atoms. In substitutions of one element for another it was found that valence was not the determining factor but rather the size of the atoms. Calcium and sodium atoms substitute for each other readily because their atoms are about the same size.

Examples of chain structures are diopside, and enstatite, which has a chain structure similar to diopside but one in which the chains are in pairs. This doubled chain structure is also found in the amphibole group including tremolite. All the varieties of asbestos show the same structure of chain and paired chain structure including chrysotile. It is thus seen that the chain structure is likely to give a fibrous character to the mineral.

The chain structure and reflected chain structure may give rise by repetition to a sheet structure. The sheet structure gives a micaceous cleavage as in muscovite. This structure is also indicated by preliminary results to be present in talc and the brittle micas also.

Researches on the network structure have not been carried very far as yet but it has been found to be the structure of sodalite, analcite and the zeolites and probably also the feldspars and nephelite.

Dr. Wyckoff completed his lecture at 9:27 P.M. In the questioning that followed, the following points were brought out:

1. The crystal structure as indicated by the *x*-rays is controlled by the chemical composition of the mineral and is not affected by its pseudomorphic structure.
2. When a bivalent element is replaced by a univalent element in a network structure, the replacement is not dependent on the spaces between the building units, necessarily, because the spaces between the units may be expanded.

In closing the discussion, President Allen called attention to Prof. F. W. Clarke's study of the silicates based on valency, "The Constitution of the Silicates," and pointed out that in accordance with the information given to the Club this evening, valency no longer appears to be the dominant factor in the structure of the silicates but rather the size of the atoms.

A rising vote of thanks was voted Dr. Wyckoff for his excellent presentation of this exceedingly important subject.

The meeting adjourned at 9:46 P.M.

DANIEL T. O'CONNELL, *Secretary*