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ADDRESS TO THE MINERALOGICAL SOCIETY.

By Professor T. G. BONNEY, D.Sc., LL.D., F.R.S., P.G.S., &c.

AT the conclusion of my term of office it is a great pleasure to me to be able to congratulate the Society on the condition of its finances. This, three years since, caused some of us no little anxiety; now, thanks to the efficient management of our Honorary Secretary, we can look forward to the future with confidence.

A slight diminution in the number of our members is, however, to be regretted, as well as some falling off in the number of papers read at the meetings and in the amount of our publications. It would, no doubt, have been easy to have increased the last by the occasional admission into the Journal (as has been done in some of the earlier volumes) of papers which dealt as much with general geology as with mineralogy, but the Council is of opinion that it will prove ultimately more for the real interest of the Society to risk some temporary reduction in the amount published, and even some arrest of its increase in numbers, in order to maintain and strengthen its distinctive character. There are in

Britain many Geological Societies, and many publications devoted to that science, none of which would exclude papers containing mineralogical information. But our own is the only Society which by its title is restricted to the study of mineralogy, and to whose Journal the inquirer would naturally turn for information on that branch of Geognosy. It is a great advantage to a student to know that in a particular Journal he is likely to find the best papers on any special subject, and I believe that we shall do well in the future to secure the high character both of our Journal and of the Mineralogical Society, by avoiding any thing which may look like competition with the publications of Geologists.

Last year I ventured to call your attention to an evil—as it seemed to me—too prevalent among mineralogists, that of distinguishing by new names minerals which either are merely varietal or are in some cases actually indefinite. I again recur to it, because I do not see many signs of a change for the better, and because I am more than ever convinced of the mischief which is being done by this habit of species-splitting to the true progress of mineralogy. There is, perhaps, no one of the Natural Sciences which more than it stands in need of a philosophical treatment, or which has progressed so little beyond a system of classification. In the hands of too many students the notation of difference seems the one thing desired. Numbers of minerals are at present in a worse position than the genus *Rubus*, when more than a hundred species in Britain alone were invented for it by some systematic botanists, for even then there was a genus *Rubus*. Now my complaint is that the idea of *genus* has been only very imperfectly admitted into mineralogy. Yet, as I pointed out last year, this idea, viz. that of relationship, is for purposes of scientific progress of higher value than the idea of species, viz. that of distinction. Inductive reasoning, which is the basis of all science, has far too little scope in mineralogy as ordinarily pursued. Indeed it is hardly too much to say that, were it not for crystallography or crystallology, as it might be more properly called—a department of applied mathematics—mineralogy would be more appropriately named mineralography—that is to say, it could not really claim to rank among the sciences. I do not forget in thus saying that chemistry forms a part of mineralogy, and necessitates processes of inductive reasoning; but, as applied to mineral analysis, this reasoning is not of a high order, so that it is possible for a man to be an excellent practical analyst, and yet neither to have acquired the habit nor to possess the capacity of regarding any question in a truly scientific spirit.

The careful notation of differences, whether these be of form, of chemical composition, or of physical characters, is, of course, valuable; but their co-ordination, with a view of bringing them into systematic relation and of ascertaining in some sense their cause, is far more valuable. In mineralogy the former process is a familiar one, but the latter is at present comparatively strange to us. The science, in fact, still needs its Darwin.

A first step in the development of mineralogy as a science will be made, in my opinion, by following the example of the biological sciences and adopting a binomial nomenclature. It is true, this is done, though timidly and half-heartedly, by the recognition of groups, such as the garnets, the micas, the felspars, the pyroxenes, &c.; but I contend for the admission of this as an accepted principle, and for the use in all scientific writings of the name of the genus (or group) as well as of that of the species. It is, perhaps, immaterial whether we adopt the biological practice (which I should prefer) of placing the generic name first and the specific second, or follow that which custom in mineralogy has to some extent sanctioned, and reverse the order; *i.e.* whether we say garnet-melanite or melanite-garnet, mica-biotite or biotite-mica. It may, perhaps, be urged that every one knows that melanite and essonite are both garnets, biotite and phlogopite both micas; but relationships among rarer minerals are not so readily learnt and retained, and, in any case, I maintain that a system of nomenclature which deliberately excludes relationships is philosophically unsound.

The investigation of the conditions and limits of the genus in mineralogy, I think, cannot fail to lead to most interesting results. Let us take for example that group of bisilicates of lime, magnesia and iron, of which hornblende and augite are leading forms or species—that which is now sometimes called the pyroxene group. I will attempt to sketch out a few only of the questions which will arise in endeavouring to constitute this as a genus. We shall, I suppose, having in view the fact of pleomorphism, admit that chemical composition rather than crystalline form must be the basis of our definition of genus. In this case, then, probably the first definition of the genus which we should suggest would be "a bisilicate of lime, magnesia and iron, in which usually the first two are dominant over the third;" besides this we should admit as possible variations the presence of alumina, sometimes to a considerable amount, or, more rarely, of a small quantity of an alkali. These last rather important chemical differences would suggest the consideration of whether they were sufficiently associated with other characteristics to make them dominant in any minor grouping of the different species, like sub-generic distinctions—a point on which I will not venture to express an opinion; then would arise the important question whether our genus could be extended to include the minerals, which at the present day are sometimes designated the orthorhombic pyroxenes, such as hypersthene, enstatite, bronzite, &c. As these appear to be almost or wholly free from lime they would perhaps require the establishment of a separate genus. Be this as it may, the investigation of the limits which in this case could be conceded to isomorphic replacement would be full of interest. I should hold that if we found a certain chemical variation always produced a change in the crystalline system we might reasonably consider this as cause for a generic separation. Having, then, fixed the limit of our genus "pyroxene" (or whatever it be called), the question of specific limitation will arise. We should have to investigate the marked differences of habit as regards crystalline form, colour, &c., and to determine how far these were related to differences in composition or differences in environment. I will mention two or three questions which have occurred to myself, as examples of those which we should be led to investigate. Why is the augite in lavas generally almost black in colour, while that in crystalline limestones is green? What is the cause of the extraordinary development of a pinacoidal cleavage in diallage? To what is due the actinolitic habit (as I may call it) in certain varieties of hornblende? Is it always indicative of some kind of metamorphic action? Many like questions will arise—in fact I believe that if any skilled mineralogist would undertake the study of the above group of bisilicates, not in the spirit of the species maker, but in that of the true man of science, he could not fail to add very largely to our knowledge, and to establish principles which would be capable of wider application. Such investigations as those of Foerstner on felspars from Pantellaria, or of Klein on leucite, noticed in the last number of our Magazine, and the suggestive remarks on the minerals of some of the Scotch peridotites and gabbros, by my friend Prof. Judd, published in the current volume of the Geological Society's Journal, appear to me very hopeful in regard to future progress.

Let me, in conclusion, draw attention to a series of investigations which seem likely to become valuable in obtaining answers to questions similar to those mentioned above, but which, I think, are not very generally known. I refer to the synthetic or artificial production of minerals, which are not unfrequent constituents of the earth's crust. Its importance is obvious, because thus the inferences may be tested which are suggested to us by the study of minerals as they occur in nature.

In some cases mixtures of simpler substance have been operated upon ; in others, crystalline segregation has been induced in the vitreous products of fusion. In both of these processes the result has been obtained, sometimes by elevation of temperature only, sometimes by the joint action of heat, water and pressure.

With these investigations the names of MM. Daubrée, Fouqué and Lévy are more especially connected, and many of the results are described in the *Géologie Experimentale* of the first, and the *Synthèse des Mineraux et des Roches* of the others. In the experiments of the latter, the materials were, in general, fused by the action of heat alone, while M. Daubrée more commonly produced his results in the 'wet way.' It would occupy too much space did I attempt to enumerate the minerals, known to occur in nature, which have been produced artificially; but, confining myself to silicates only, I may mention the following as of special interest, because they enter into the composition of important rock masses : viz. enstatite, varieties of pyroxene, olivine, leucite, nepheline, the principal species of felspars, some species of garnet, biotite, zircon, sphene, besides other minerals less normally present or belonging to other groups, such as wollastonite, apatite, the spinellids, &c.

Some species also of the igneous rocks have been artificially produced. These are, according to MM. Lévy and Fouqué, andesites and allied rocks; basalts and other rocks of similar chemical composition; nephelinite; leucitite, leucotephrite, and varieties of peridotite. Some of the experiments also were very suggestive in bringing as their result minerals different from those which had been introduced into the original mixture; for example, after fusion, wernerite crystallised as labradorite; a mixture of wernerite and hornblende produced a rock consisting of labradorite and augite; a mixture of oligoclase and hornblende produced an augitic andesite; a mixture of microcline and biotite resulted in a crystalline mass composed of leucite, olivine, melilite and hæmatite, *i.e.* a variety of an olivine-leucitite. Other experiments by their negative results seemed to indicate "that natural rocks composed of quartz, orthoclase, biotite, hornblende," were not formed by a simple process of dry fusion. As might be expected, the time during which a high temperature was maintained and the method of cooling brought about important and suggestive results, upon which, however, I need not now enter. By operating at lower temperatures, in sealed tubes, and in the presence of water, Daubrée converted wood into anthracite, and obtained from an ordinary glass crystallised quartz, diopside and some other silicates. In the latter experiment very remarkable changes were produced in the main mass of the glass itself: parts of it became crowded with microliths, some of pyroxene, some probably of a silicate; while other parts were completely occupied by spherulites, or by tufted masses of elongated microliths of quartz. Similar to these are the results of experiments on the action of dry heat on glasses, at temperatures below their fusing-point. Some of these have been described by myself in another address,* but a more exhaustive investigation is being made by Messrs. Rutley and Herman, the results of which have been in part communicated to the Royal Society. In certain cases, when the glass has been kept for a considerable time at a high temperature, its whole mass appears to have been converted into crystallites; and it is especially interesting to find a close relation between the directions of crystal growth and the form of the substance operated

* To the Geological Society, on Feb. 20th, 1885. See *Quarterly Journal G. S.* Vol. xli

on, indicating the intimate connection of its crystallisation with any thing which disturbs its molecular equilibrium. As I have indicated in the address to which reference has been made above the bearing of these experiments upon the formation of crystalline constituents in rock masses, I will not enlarge upon the subject on the present occasion; but I mention it because it appears to me a very promising field for investigation. The glasses employed in the arts supply us with substances which vary considerably in chemical composition, and can be procured in quantities which renders the determination of their constituents (often not numerous) comparatively easy. The process of devitrification by dry heat does not require either extremely high temperatures or elaborate and expensive apparatus, while crystals are not seldom obtained of sufficient size and in sufficient abundance to render a determination of the resultant minerals not difficult.

There is then, it seems to me, a great field of work, calling for the exercise not only of patient observation but also of close inductive reasoning, open before the mineralogist. Here one and there another is already pressing forward into it, now from the side of crystallology, now of chemistry, now of petrology; hence I venture to predict that in the future mineralogy will occupy a far higher rank than it has done of late among the most exact of the natural sciences. I rejoice to think that I am now giving place to one who is so well qualified to act as a leader in this great work, for which I am disqualified by imperfect knowledge, and from which I am diverted by the attraction of other branches of geognosy. Thus, while thanking the members of the Mineralogical Society most heartily for the undeserved honour which they did me in electing me President, and for their continual kindness during my tenure of office, I congratulate them on having obtained as my successor one who is not only so well qualified in other respects, but also is so vastly my superior in the knowledge of their science.