DISCUSSION AND CORRESPONDENCE.

THE TEACHING OF CRYSTALLOGRAPHY.

SEVERAL weeks ago Professor A. F. Rogers called attention through the columns of this journal[1] to a number of points concerning the teaching of crystallography, especially as a part of the work in an *elementary* course in mineralogy. In order to discuss Professor Rogers's paper, the end to be attained by such a course must be clearly understood. If the work in the *elementary* or *beginning* course has as its object the training of professional crystallographers much may be said in favor of a course similar to the one outlined by Professor Rogers. If, however, on the other hand, the course is to be only a part of the general education of the geologist, chemist, civil or mining engineer, forester, or teacher of science in the secondary school, the practical side of the work must be emphasized as much as possible. In such a course crystallography must, hence, be considered simply as a means to an end, that is, it should train the student in the rapid recognition of crystal forms. The handling of a large number of forms—models and crystals—tends to train the eye better than do extended discussions concerning the measurement, calculation, and projection of crystals.

The question which confronts most students of mineralogy—here it may be mentioned that in most institutions where mineralogy is taught at all only a very small percentage of the students have time to pursue more than the elementary course—is the rapid determination of minerals and, hence, theoretical considerations, which are of vital importance to the crystallographer, may in general be dispensed with. To be sure, some theory must be given, but all the theory necessary can be readily given by means of lectures and the laboratory work devoted entirely to the acquiring of a comprehensive knowledge of forms by contact and inspection rather than by analysis. (Formenanschauungsunterricht of von Groth.)

The writer agrees with Professor Rogers that the classification of crystal forms based upon symmetry is the best to use even with beginners, but would add that the older ideas of holohedrism, hemihedrism, etc., should—even though there be no structural connection between such forms—be retained on account of the many advantages they offer in acquiring a clear understanding of the forms possible in the various classes of symmetry. That these advantages are recognized as of considerable importance, it may be well to state that most of the German texts on crystallography, *designed for beginners,* retain them; among such works those of Bauer (1904), Bruhns (1904), Klockmann (1903), Linck (1896) and Naumann-Zirkel (1901) may be mentioned.

It is also common practise with German mineralogists to follow the older methods in the *elementary* course of instruction and treat the cubic or isometric system first and then the others in order. Even von Groth, who is no doubt one of the strongest advocates of the newer classification, retained to the knowledge of the writer, who was a student in his laboratory during the years 1899–1901, the older method of treatment (including holohedrism, hemihedrism, etc.!) in his beginning course rather than discuss the forms as outlined in his 'Physikalische Krystallographie,' the third edition of which had appeared several years before, namely, in 1895.[2] In fact Professor von Groth was accustomed to state in an introductory lecture that from the theoretical point of view the order as outlined by him—begin with class of lowest grade of symmetry and discard ideas of holohedrism and so forth—was the natural one to follow, but that certain practical and pedagogical reasons demanded that the reverse order be pursued especially when discussing crystallography with *beginners.*

There is no denying the fact that the measurement, calculation and projection of crystals are of great value to obtain a clear insight into the true meaning of crystallography and, hence, ought to be pursued by at least all

[1] N. S., Vol. XXIV., pp. 620–621.

[2] Compare Bruhns, 'Elemente der Krystallographie,' 1904, preface and foot-note on page 2. Also Baumhauer, 'Die Neuere Entwickelung der Krystallographie,' 1905, pp. 26–53.

graduate students in geology, chemistry and physics. But such work should follow the introductory course. In this advanced course a full treatment of the Miller indices, axial ratios, etc., finds its proper place. Would it not be the height of folly to recommend that extended philological researches be introduced into the beginning course of one of the modern languages? At any rate, Professor Rogers's statement that 'without something of the sort (meaning crystal measurement, calculation and drawing) the time given to crystallography may almost be a waste of time unless it is taken up at some future time' is to my mind altogether too sweeping and certainly needs qualification. I would like to ask what student of mineralogy has not found a course in elementary crystallography of the highest value and interest, even though it did not include the work supposed by Professor Rogers to be of paramount importance.

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Chamberlin and Salisbury's Text-book of Geology.

The review of the three-volume 'Text-book of Geology' by Professors Chamberlin and Salisbury in a recent number of Science, is likely to convey to the general reader an erroneous impression of that publication. Certain idiosyncrasies of style and little errors of detail, some of which are not real, are dwelt upon at such length that one becomes imbued with the idea that such mistakes are abundant and that they detract largely from the value of the text. It is natural that in a book of this size a number of things may be found worthy of criticism, and especially is this true of little matters which are likely to escape notice in reading the proof of the first edition. Mistakes of this class are better brought to the attention of the authors through the medium of a personal communication than by making them the subject of complaint in the public prints. Enough of such details can be found in any work to convey a wrong impression of the whole, if they are given so large a space that the main features of the work receive subordinate notice. It should be the function of a review to give the reader a correct understanding of the important and readable qualities of the book, whether they are good or otherwise, and not simply to recount trivialities. While in this case the reviewer finally gives adequate expression of his appreciation of the high value of the books concerned, this expression is prefaced by so many criticisms of details that the effect of his commendation is largely lost.

Some of the criticisms affect mere oversights in proof-reading, which are bound to occur in any publication of this magnitude. Several of these have been corrected in the second edition of volume I. Such an error was the use of 'syncline' for 'anticline' as pointed out by Dr. Branner.

A large number of the specific faults mentioned in the review are found on closer inspection to be imaginary rather than real, and one is forced to conclude that the reviewer was somewhat hasty in his perusal of the text. Of this nature is the criticism of the statement that "theoretically the rotation of the earth should increase erosion on the right bank of streams in the northern hemisphere and on the left bank in the southern," because "no reference is made to the direction of the streams," for this tendency is not dependent upon the direction of the streams, and the authors were correct in leaving their statement unqualified in this particular.

The reviewer takes exception to the statement that the advent of the Ammonites occurred in the Permian and cites Monograph XLII., U. S. G. S., as showing that they were abundant in the coal measures. The genera described in that work, however, belong to the types most widely known as Goniatites and Ceratites, the occurrence of which was duly mentioned by the authors. These are ammonoids, of course, but not Ammonites as the term is generally understood. The specific statements of the authors are therefore discriminative.

The statement of the authors that 'differences in density of sea water are due to differences in temperature and salinity' is criti-