

The four parts of this volume which have appeared bear the following dates, respectively: August, 1904, May, 1907, April, 1908, and August, 1909.

The complete encyclopedia is to appear in seven tomes, each consisting of several volumes, probably ranging from three to five. The first three tomes are to be devoted to pure mathematics, while the following three are to treat the applications of mathematics. The seventh and last tome is to be devoted to historic, philosophic and didactic questions. As a large number of eminent French mathematicians are engaged on the preparation of this edition, its completion within a reasonable number of years seems to be assured and the high standard set by the dozen parts which have already appeared, although they are not free from serious errors, promises to be maintained in the future issues. If this is done the work will be indispensable, not only in the larger scientific libraries, but it will also be one of the most frequently consulted works in many private mathematical libraries. Those who do not have easy access to a large library will frequently find in this work sufficient references to guide them safely in their investigations. It is to be hoped that in this way it will serve as a powerful stimulus to mathematical progress in the highest and widest sense.

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Crystalline Structure and Chemical Constitution. By A. E. H. TUTTON, D.Sc., M.A. (Oxon.), F.R.S., A.R.C.S. (Lond.), Vice-president of the Mineralogical Society; Member of the Councils of the Chemical Society and of the British Association for the Advancement of Science. Cloth, 6 × 9, pp. viii + 200, figures 54. London, Macmillan and Co., Limited, 1910. \$1.50 net.

This interesting volume presents in condensed and connected form the results of a series of investigations in physical crystallography carried out by the author during a period of some twenty years, having for its object the establishment upon the most accu-

rate observational data of the exact relations existing between the chemical constitution and the crystalline form and properties of a series of related compounds.

These investigations consisted of three related parts: namely, the devising of new instruments capable of making more accurate observations than had hitherto been possible in this field; the perfection of methods of preparing crystals for investigation, and the actual measurements of the crystal angles and other constants.

The instruments devised, the description of which occupy chapters V., VI., VII., VIII. and IX., include a *cutting and grinding goniometer* so arranged that the small and soft artificial crystals employed could be cut and polished with absolute control of the direction of the artificial surface; the *spectroscopic monochromatic illuminator* to secure for the optical measurements monochromatic light of any desired wave-length; the *interferometer*, an instrument for fine measurements of length by the interference method, employed by Tutton as the essential optical part of the *dilatometer* for measuring the thermal expansion of crystals and of the *elasmometer* for measuring their elasticity by determining the amount of bending which a plate of the crystal undergoes at the center when supported near its ends, under the influence of a weight applied at the center. By means of these highly elaborate instruments the author considers that he has raised the accuracy of goniometric measurements to the level on which atomic weight determinations now stand and the measurements of the physical constants of crystals to the degree of accuracy of wave-length determinations by the interference method.

The materials studied include some 54 salts in two series; the simple anhydrous sulphates and selenates of potassium, rubidium, cesium, ammonium and thallium, 10 in number; and the double hydrous sulphates and selenates of the above five elements with each of the metals magnesium, zinc, iron, nickel, cobalt, copper, manganese and cadmium, of which 44 were prepared. Many crops of crystals of each salt

were prepared under varying conditions and tested by chemical and spectroscopic methods with utmost refinement as to purity. Not less than 10 crystals of each were measured for crystallographic form and constants and about twelve orientated sections or prisms of each were measured at various temperatures and for six wave-lengths of light in determining the indices of refraction. Determinations of the volume of each salt were also made with great exactness, and the solubility of each in water established. The enormous amount of exacting labor represented by these researches will be abundantly clear to any one who has made such a study of even a single substance.

In chapter X. are presented the results obtained in goniometrical examination of both the normal sulphates and selenates, or orthorhombic series of crystals and of the double sulphates and selenates or monoclinic series.

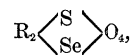
Chapter XI. treats of the volume relationships of the simple and double sulphates and selenates and the conception of molecular distance ratios or topical axes.

Chapter XII. presents the optical relationships of the two series of sulphates.

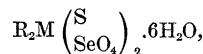
Chapter XIII. is devoted to an explanation of the phenomenon of crossed-axial-plane dispersion of the optic axes which is shown to be "due to very low double refraction, combined with close approximation of the intermediate index of refraction to one of the extreme indices; and to the fact that change of wave-length of light or change of temperature, or both, cause the intermediate index to approach still nearer to the extreme one in question until it becomes identical with it, and eventually to pass it, the relative positions of the two thus becoming reversed." The experimental evidence leading to this explanation is beautifully clear.

In chapter XIV. the results of the thermal investigation of the sulphates is presented, and in chapter XV. a summing up of the chief results of the investigations. This summary seems of sufficient interest to justify somewhat extensive quotation, as it appears to be the clearest statement yet given of just what the modern concept of isomorphism involves.

The crystals of the different members of the rhombic series of isomorphous sulphates and selenates of the alkalies,



and those also of the monoclinic series of double sulphates and selenates,



while conforming to the same symmetry—that of their particular isomorphous series—and exhibiting the same facial forms inclined at angles which never differ by more than one or two degrees, exhibit progressive variations in their exterior geometrical configurations, interfacial angles and crystallographic elements, in their internal structural properties and constants of which the external form is only the outward symbol, in their optical characters and in their thermal behavior; and these variations follow the order of progression of the atomic weights of the three alkali metals belonging exclusively to the same family group of the periodic classification, potassium, rubidium, caesium, which by their interchange give rise to the series. The variations are, therefore, functions of the atomic weight of the alkali metal. . . . Similar variations attend the replacement of sulphur by selenium in the acid radicle present in the salts.

The thallium and ammonium salts of the two series exhibit properties fully entitling them to inclusion in these respective series of isomorphous salts, understanding by the term "isomorphous series" a series, the members of which bear a definite chemical analogy, crystallize with like symmetry and develop forms the interfacial angles of which differ only by an amount which has not yet been observed to exceed $2\frac{1}{2}$ degrees. The more exclusive "eutropic series" within each of these isomorphous series, that is to say, the series in which the members exhibit the progression of the whole of the crystal properties according to the atomic weight of the interchangeable chemical elements, comprises solely the salts of the alkali metals K, Rb and Cs which belong strictly to the same family group of the periodic classification, the thallium and ammonium salts being excluded by their essentially different chemical nature and their different crystallographic properties which follow therefrom.

Finally, a third general conclusion is drawn:

Specific chemical substitutions are accompanied by definitely orientated changes of the crystal structure, indicating that particular chemical atoms occupy definitely localized positions in the chemical molecule, and therefore, as the molecule is the structural unit of the space-lattice, in the crystallographic structural unit.

This last principle, first definitely established by these researches, is regarded by the author as the most marked step in advance he has made.

Despite its highly specialized character the book is written in a style that is delightful and should surely be in the possession of every student of physical crystallography.

CHARLES PALACHE

Elements of Mineralogy, Crystallography and Blowpipe Analysis from a Practical Standpoint. By ALFRED J. MOSES, E.M., Ph.D., Professor of Mineralogy, Columbia University, and CHARLES L. PARSONS, B.S., Professor of Chemistry, New Hampshire College. Fourth edition, with 448 pages of text and 583 figures. Cloth, 6×9½. New York, D. Van Nostrand Company. 1909. \$2.50 net.

The fourth edition of this well-known textbook differs in no essential matters from the previous edition. The statistics of production of minerals of economic value have been revised, the figures given being those for 1907 and in part 1908. The book gives an excellent presentation of the main facts of mineralogy and deserves to be, as it doubtless is, largely used by teachers of the subject.

It is unfortunate that advantage has not been taken of the opportunity offered by this new edition to improve some of the very poor illustrations that mar certain pages, as well as to eliminate several confusing errors in the crystallographic figures and lettering.

CHARLES PALACHE

Indian Insect Life. A manual of the insects of the plains (Tropical India). By H. MAXWELL-LEFROY, Entomologist, Imperial Department of Agriculture for India, and F. M. HOWLETT, 2d Entomologist, published under the authority of the Government of India, Agricultural Research Institute,

Pusa. 4to, pp. 786, plates 84 (many colored), text figures 536. Calcutta and Simla, Thacker, Spink & Co.; W. Thacker & Co., 2 Creed Lane, London. 1909.

This attractive and well-illustrated volume gives, in convenient form, a summary account of the varied insect life of tropical India, in particular. This limitation necessarily precludes the discussion, except in an incidental manner, of the splendid fauna of the Himalayan region. There is much of interest in the work for the professional entomologist, while the amateur will find a large number of the more conspicuous or common insects noticed, accompanied in many instances by facts of great practical value.

The author finds it convenient to treat the varied forms under nine orders, namely, Aptera, Orthoptera, Neuroptera, Hymenoptera, Coleoptera, Lepidoptera, Thysanoptera, Diptera and Rhynchota (Hemiptera) following, in a large degree, the classification adopted by Sharp. The author's aim has been to produce a readable, convenient volume rather than to rigidly follow a classification with possible inconvenience to his readers. The introduction gives some observations upon the principles of classification, the relation of instinct and habit, the sources of information, and a discussion of the zoogeographical divisions of India, the faunal limits of the work thus being plainly defined. At the outset, insects are roughly classified according to food habits, they being divided, for example, into fruit insects, seed-eating insects, flower insects, etc. There is an illuminating chapter on insects and their relations to man, a much more vital topic in the tropics than in the temperate zone.

The space given to the discussion of the orders is necessarily unequal, owing to the fact that representatives of many Indian groups are comparatively unknown. A most attractive feature for the general student is found in the independent chapters or interludes dealing with such topics as: Where Insects Live, Cosmopolitan Insects, Deceptive Coloring, Relative Duration of Life, Insects and Flowers, How Insects Protect Themselves, etc., each of these summarizing from the en-