Union, but all crystallographers are cordially invited to attend the International Congress. Those outside of the U.S.A. expecting to be present are requested to inform the General Secretary at a very early date in order that detailed planning may proceed without delay; those willing to contribute papers should at the same time forward details for consideration by the Programme Committee. Crystallographers in the U.S.A. will receive separate notification from the A.S.X.R.E.D. or the Crystallographic Society of America. It will unfortunately not be possible for the Union to provide funds to assist delegates in attending the Congress and crystallographers should therefore make their own arrangements in this matter.

kX and Ångström units

The following letter is reprinted by permission from *J. Sci. Instrum.* (1947), **24**, 27:

At the annual conference of the X-ray Analysis Group of the Institute of Physics in July 1946 it was announced that agreement had been reached concerning the factor for converting measurements in kX units to Ångström units. The factor agreed upon, after consultation with the American Society for X-ray and Electron Diffraction and Prof. Siegbahn was 1·00202. This factor is probably correct to 0·003 %. Since wave-lengths in X-units have been measured to an accuracy of 0·001 %, the wave-lengths in Ångström units can be taken as accurate to 0·004 % in general.

The following is a list of values of wave-lengths in Ångström units of certain emission lines and absorption edges in common use. The column headed $K\alpha$ gives the mean value of $K\alpha_1$ and $K\alpha_2$, $K\alpha_1$ being allowed twice the weight of $K\alpha_2$.

Current values of the physical constants, such as those quoted by Birge in the 1941 volume of the Physical Society's *Reports on Progress in Physics*, should be used in conjunction with these wave-lengths. In particular, density ρ is given by the equation

$$\rho = 1{\cdot}66020\ \Sigma A/V,$$

where ΣA is the sum of the atomic weights of the atoms in the unit cell, and V is the volume of the unit cell in A^3.

	$K\alpha_1$	$K\alpha_2$	$K\alpha$	$K\beta_1$	Absorption edge
Cr	2·289 62	2·293 52	2·290 9	2·084 79	2·070 1
Mn	2·101 74	2·105 70	2·103 1	1·910 16	1·895 4
Fe	1·935 97	1·939 91	1·937 3	1·756 54	1·742 9
Co	1·788 90	1·792 79	1·790 2	1·620 73	1·607 2
Ni	1·657 83	1·661 68	1·659 1	1·500 08	1·486 9
Cu	1·540 50	1·544 34	1·541 8	1·392 17	1·380 2
Zn	1·435 10	1·438 94	1·436 4	1·295 20	1·283 1
Mo	0·709 26	0·713 54	0·710 7	0·632 25	0·619 7
Rh	0·613 26	0·617 62	0·614 7	0·545 59	0·534 1
Pd	0·585 45	0·589 82	0·586 9	0·520 52	0·509 0
Ag	0·559 41	0·563 81	0·560 9	0·497 01	0·485 5

It is recommended that in any published work the values of the wave-lengths used should be explicitly stated.

W. L. Bragg, Chairman,
X-ray Analysis Group of the Institute of Physics

Cavendish Laboratory,
Cambridge, England

Authors of papers intended for publication in *Acta Crystallographica* are requested to express cell dimensions and related quantities in Ångström units and, when the accuracy of the work justifies the distinction between these and kX units, to avoid all possible confusion by quoting also explicitly the wave-length of the radiation used.

Book Reviews

Works intended for notice in this column should be sent direct to the Editor (P. P. Ewald, The Queen's University, Belfast, Northern Ireland). As far as practicable books will be reviewed in a country different from that of publication.

Grundlagen der allgemeinen Mineralogie und Kristallchemie. By F. Machatschki. Pp. vii + 209, with 151 figs. Springer Verlag, Vienna, 1946. Price, 16 schillings; $2.80.

Professor Machatschki, who now occupies the chair of mineralogy in the University of Vienna, has been associated with the development of the X-ray analysis of the crystal structure of minerals since 1927. For a time he joined the group of brilliant research workers who formed the Bragg school in Manchester and first suggested in outline the framework of the felspar structures. Since then he has produced an unceasing flow of papers ranging over the whole field of mineral chemistry.

The book now under review is a well-written, clearly printed, and adequately illustrated class-book suitable for teaching elementary students. It is divided into three main sections; crystallography, crystal physics, and crystal chemistry, and concludes with brief accounts of the genesis of crystals, etch figures and pseudomorphs. Particularly commendable are the introductions to crystal optics and crystal chemistry. The author's method of tabulating the thirty-two crystal classes, however, is less in keeping with the up-to-date treatment in the rest of the book. Although two systems of naming the crystal classes are given, only Schoenflies symbols are used. Most teachers of the subject will regret his missing the chance of introducing students as soon as possible to the simpler and more elegant Hermann-Mauguin nomenclature.

F. A. Bannister

British Museum (Natural History),
London, S.W. 7,
England.

Die Bewegungsgruppen der Kristallographie. By J. J. Burckhardt. Pp. 189, with 56 figs. Verlag Birkhäuser, Basel. Price, 29 Swiss francs.

This book represents the result of a twenty-year investigation of the intrinsic mathematical theory of the crystallographic groups. In the words of Burckhardt: 'Mich heute von dieser Arbeit zu trennen, fällt mir schwer: während zwanzig Jahren war sie mein Stab und meine Stütze zugleich.' The basic point of view of the book resembles closely that adopted by the reviewer in a series of articles in the *Zeitschrift für Kristallographie* in the early 1930's under the title 'A Matrix-Algebraic Development of the Crystallographic Groups'. That is, an attempt is made to abstract the process of deriving the crystallographic groups from the somewhat earth-bound tactics of straight-edge and compass geometry used by the group of theoretical

crystallographers who developed the subject in the last century. However, whereas the reviewer held uppermost the problem of placing the subject in a form that might be useful for application in quantum mechanical calculations, Burckhardt has mathematical completeness and elegance in mind, and as a result goes much farther along the road of refinement. His goal in brief is to place the crystallographic groups upon the same plane as that on which Speiser placed the general theory of finite groups in his well-known book. He is eminently successful and may as a result have placed his work out of the orbit of the more literal minded crystallographers who find a complete understanding of the visual geometrical development necessary for the everyday problems of the field.

The book is divided into three large chapters which discuss, respectively, the point lattices, the crystal classes and the space groups. The opening sections present the elements of linear algebra and matrix theory and thereby set the mathematical background of the work. Great care is taken in this presentation to establish the position of the crystallographic groups among the family of groups. Most of the discussion is valid for a space having an arbitrary number of dimensions.

The second chapter, which deals with the crystal classes or point-groups starts again with a formal mathematical discussion of the subject. However, the formal reasoning is soon applied to the two-dimensional net both to give concrete working examples and to derive the conditions which restrict the purely rotational point operations to rotations through 0°, 60°, 90°, 120°, etc. The complete two-dimensional groups are presented and the discussion is then extended to the three-dimensional classes. Burckhardt employs Schoenflies' notation for all of the three-dimensional groups and tabulates the results in a mathematical form that is quite useful, namely as a code from which the symmetrically equivalent points may be derived in either rectangular or hexagonal Cartesian co-ordinates. For example, the group D_4 is expressed in the form

$$D_4 = C_4 + (x, \bar{y}, \bar{z})\ C_4 = D_2 + (y, \bar{x}, z)\ D_2$$

to indicate first that D_4 may be generated both from C_4 and D_2 by augmentation with suitable generating elements, and second that the equivalent points of D_4 contain, in addition to those of C_4 and D_2, the points obtained by allowing C_4 to act upon the point $(x, \bar{y}, \bar{z})$ in the first instance or upon $(y, \bar{x}, z)$ in the second. The equivalent points of the Abelian groups, which contain only powers of a single element, are tabulated explicitly.

The second chapter closes with the development of the fourteen translation groups and their point-symmetry.

The third chapter contains a development of the space groups. Again, the chapter starts with a formal presentation of the mathematical theory of the groups and uses the two-dimensional case both for illustrative purposes and to provide a method of approach to the three-dimensional problem. The three-dimensional space groups, like the classes, are expressed in a form that makes it possible to derive the sets of equivalent points within the unit cell, Schoenflies' notation being used throughout.

The third chapter ends with a twenty-page discussion of the mathematical features of the space groups in n-dimensions.

It is the reviewer's opinion that all but the small group of readers who enjoy formal mathematics for its own sake will find the book less readable than Schoenflies' original work on the subject. On the other hand, its conciseness would probably make it a suitable reference text for anyone brave enough to attempt a series of lectures on the theory of the space groups. On the whole, the book will undoubtedly find a place of permanent value in the literature of the field.

Unfortunately, the writer has not attempted to discuss the phases of the theory of the crystallographic groups which centre about the work of Schur and which have proved to be so valuable for quantum physics when placed in the hands of Wigner and Weyl. The subject of reducibility is touched upon at several places in the book, but always in a rather specialized manner that is of interest primarily for the discussion at hand. Theoretical physicists will not find the present book useful if they are looking for something in the nature of an additional chapter to the books of Wigner or Weyl. Perhaps Burckhardt will oblige this potential audience with a second volume, extending the subject in this direction, at some time in the future.

Anyone with scholarly inclinations who has found his life seriously interrupted by the events of the last two decades will undoubtedly be touched with an air of wistful envy as he turns the pages of this book, for it exudes the spirit of classical academic leisure. To this reader Burckhardt offers advice in the words of Kepler: 'When the storm rages and society threatens to founder, we can do nothing that is of more value than to sink the anchor of our peaceful study into the grounds of eternal science.'

Carnegie Institute of Technology, F. SEITZ
Pittsburg 13, *Pa.*,
U.S.A.

Les Rayons X et leurs Applications. By H. BRASSEUR. Pp. 366+xlvii, with 257+36 figs. Editions Desoer, Liège, 1945. Price, 595 Belgian francs; 31*s*.

This book is a general survey of the applications of X-rays and covers a very wide field. The first 50 pages are devoted to a brief account of the production and properties of X-rays. Then follow 40 pages in which the author covers medical radiology, industrial radiography and chemical analysis by the methods of absorption- and emission-spectra. The rest of the book deals with diffraction methods under the following main headings:

	No. of pages
1. The atomic scattering factor	5
2. Study of molecular structure in gases	18
3. Diffraction by liquids and solutions	25
4. Diffraction by monoperiodic substances	8
5. Diffraction by crystals	
(*a*) Determination of crystalline structure	176
(*b*) Results of crystal-structure work	36
6. The structure of glass	8
EXERCISES (on some diffraction methods)	31

Under the various sub-headings of 5 (*a*) a brief account is given of crystal symmetry, of various methods of structure-determination, and of the methods of taking X-ray photographs—rotation, powder, Laue, fibre, but not moving-film methods. Under each method a survey of the chief applications is given.

The book is well printed on excellent paper and most of the illustrations are good. The reproduction of the powder and rotation photographs of Figs. 6–13 (p. viii of Exercises)