

Laboratory Notes

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A goniometer for large single crystals

A highly accurate goniometer head for large single crystals was designed using the principle of two rotational axes (Denne, 1971). This device is better than any other classically designed goniometer of the same size, giving an accuracy of 0.1° without the need of a Nonius scale. It is mainly used in our laboratory for orienting large single crystals by means of the photographic method. Detailed drawings are given in Fig. 1 and the very simple calculations necessary for its adjustment are described below.

The goniometer consists of three round parts of 58 mm diameter. Two parts have a wedge-shaped cross section inclined 9° , while the third part is flat (see Fig. 1a). Part C is the rigid component and can be attached to any stationary apparatus by the thread hole T. It should be mounted so that its base stands perpendicular to the incident X-ray beam. Parts A and B rotate and are held together and to part C by retention grooves and locking screws. The crystal holder is connected to part A by the screw S. Part A has four fiducial marks 90° apart. The wide side of part B is engraved on both edges in 2° divisions from zero to 180° . Part C has two fiducial marks 180° apart. The engraving positions are shown in Fig. 1b. The angular range of this device is $\pm 18^\circ$.

The calculations for the adjustment of the moving parts for a film-to-crystal distance of 30 mm are described with the aid of the stereogram in Fig. 2. Point O is the center of the photographic film to which the required Laue point L should

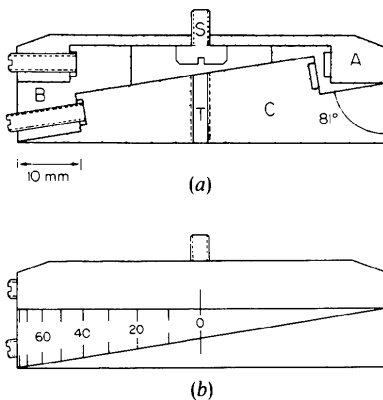


Fig. 1. (a) Cross section of the goniometer head viewed from the side. (b) Outer surface of the goniometer head as seen from above.

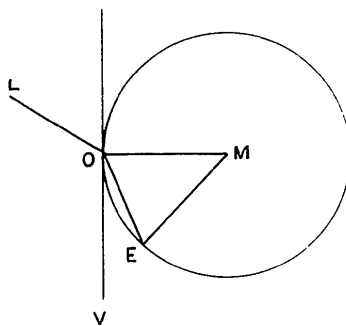


Fig. 2. Stereogram showing the steps of the crystal orientation.

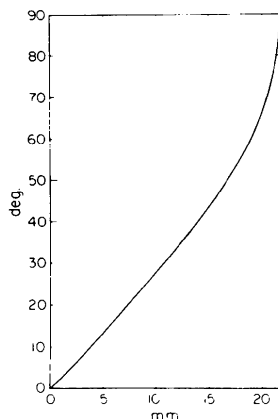


Fig. 3. Values of angle VOE as a function of the length of LO .

be brought. Circle M is the locus of rotation at 9° from point M .

In order to orient the crystal, point L is brought to point E , located on the lower half of the circumference of the circle M , by rotating part A. It is then brought from E to O by rotating part B. The angle of rotation of part A, angle LOE , contains the angle LOV , which is measured directly on the film, and the angle VOE , which is calculated by means of the formula:

$$\text{angle } VOE = \arcsin \frac{\frac{1}{2}LO}{MO}$$

The LO distance should be measured directly on the film in millimeters (not with the Geringer chart). Its maximum value can be 21.8 mm which is equivalent to an 18° deviation from the center of the film. The length of MO is 10.9 mm and it is equivalent to a 9° deviation. A useful graph showing the values of angle VOE as a function of the length of LO is given in Fig. 3. From geometrical relations in Fig. 2 it is evident that angle VOE is half of the angle EMO and, therefore, the angle of rotation of part B should be twice the angle VOE .

It seems to us that the geometrical configuration of this device is the most versatile one for practical use. However,

the accuracy could be further improved by decreasing the angular range by several degrees.

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Reference

Denne, W. A. (1971). *J. Appl. Cryst.* **4**, 60–66.

Crystallographers

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This section is intended to be a series of short paragraphs dealing with the activities of crystallographers, such as their changes of position, promotions, assumption of significant new duties, honours, etc. Items for inclusion, subject to the approval of the Editorial Board, should be sent to the Executive Secretary of the International Union of Crystallography (J. N. King, International Union of Crystallography, 5 Abbey Square, Chester CH1 2HU, England).

Dr K. Aurivillius died on 22 March 1982. She was well known for her extensive X-ray and neutron diffraction studies of the crystal chemistry of mercury compounds, which brought her a position as docent at the University of Stockholm in 1965. Later she moved to the University of Lund to become a lecturer in organic chemistry. In spite of poor health over many years she was able to continue her research, together with many students, particularly on organo-metallic complexes.

Professor G. Lundgren suddenly died on 19 March 1982. He received his doctor's degree and became docent in inorganic chemistry. His thesis described research on the crystal structures of some basic salts, conducted at the University and the Royal Institute of Technology in Stockholm. In 1963 he became Professor of Inorganic Chemistry at the University of Gothenburg, where he built up strong research groups in crystallography and materials research. Since 1972 he was Rector Magnificus of the University. His extraordinary capability as an organizer and administrator was extensively used in Swedish and international scientific organizations.

Dr Lester W. Strick died on 21 March 1982. He was a familiar figure at meetings of the American Crystallographic Association and its predecessor societies from their inception until he retired. He made many contributions to crystal chemistry, including solution of the α silver iodide structure.

Professor **J. D. H. Donnay** celebrated his 80th birthday on 6 June 1982. He spoke on *The unveiling of the mystery of the Miller indices* at the 13 May colloquium of the Ottawa Crystallographers Group. Afterwards the crystallographers present held a ceremony to honour his eminent contributions to the study of crystallography.

International Union of Crystallography

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Bibliography of Mathematical Crystallography

For many years Professor W. Nowacki of the University of Bern has kept, for his own purposes, a bibliography of mathematical crystallography. In the late 1970's he agreed to make this generally available to interested crystallographers and it had been hoped that it would have been made available on demand as a booklet. However, in view of the high cost of publication, it has instead been decided to make available photocopies of specific sections of Professor Nowacki's typescript on request. In total there are about 4750 references on 286 pages. The sections are as follows:

Introduction (4 pages – this will be sent with all sections)

1. Point groups (10 pages; 159 references)
2. Space groups of E^1 (E =Euclidean space) (2 pages; 25 references)
3. Space groups of E^2 (5 pages; 90 references)
4. Space groups of E^3 (12 pages; 190 references)
5. Nomenclature, Tables (3 pages; 46 references)
6. Space groups of E^4 (4 pages; 60 references)
7. Space groups of E^n ($n \geq 5$) (6 pages; 94 references)
8. Theory of representation (with application to physics) (16 pages; 284 references)
9. Subgroups and supergroups (6 pages; 93 references)
10. Lattice complexes and orbits in E^2 (2 pages; 21 references)
11. Lattice complexes and orbits in E^3 (5 pages; 77 references)
12. Hauptpunkte i.S. Weissenberg's (1 page; 8 references)

13. Space forms (differential geometry) (2 pages; 31 references)
14. Space partitionings of E^2 (10 pages; 181 references)
15. Space partitionings of E^3 (12 pages; 193 references)
16. Space partitionings of E^n ($n \geq 4$) (4 pages; 61 references)
17. Packings of circles (and of other polygons) (2 pages; 25 references)
18. Packings of spheres (and of other polyhedra) (14 pages; 233 references)
19. Groupoids; OD-structures; polytopes; enhancement of symmetry (6 pages; 110 references)
20. Characters (1 page; 4 references)
21. Homology, similarity (3 pages; 33 references)
22. Semicontinua, continua (Lie groups) (1 page; 17 references)
23. Coloured point and space groups in E^n ($n=0, 1, 2, \dots$); magnetic structures (16 pages; 282 references)
24. Generalised crystallography (modulated structures, space-time groups, non-Euclidean spaces), modulated structures (10 pages; 178 references)
25. Quadratic forms, theory of reduction, translation lattices, geometry of numbers, twins, relation: structure-morphology (19 pages; 307 references)
26. Polygons and polyhedra (12 pages; 213 references)
27. Polytopes ($n \geq 4$) (8 pages; 129 references)
28. Theory of graphs, topology (5 pages; 78 references)
29. Isomers, molecular structure (2 pages; 24 references)
30. (a) General chemistry, crystallography, mathematics and physics; (b) History; (c) Symmetry in philosophy, arts and biology (72 pages; 1340 references)

Appendix. Theory of Patterson syntheses and vector sets (but mainly only when point 'atoms' are considered; otherwise it is part of diffraction theory) (12 pages; 159 references).

Within each topic the titles are basically arranged alphabetically and within each author chronologically, although there are significant number of (non-alphabetical) addenda.

The original bibliography (but not the addenda) has been checked as far as possible by R. Allmann (Marburg/Lahn), L. N. Smirnova and L. A. Shuvalov (Moscow) and D. G. Watson (Cambridge). Requests, stating which sections are re-

quired, should be sent to The Executive Secretary, International Union of Crystallography, 5 Abbey Square, Chester CH1 2HU, England. Photocopies will be sent at reduced size, *i.e.* two pages per A4 sheet of paper.

Book Reviews

Works intended for notice in this column should be sent direct to the Book-Review Editor (J. H. Robertson, School of Chemistry, University of Leeds, Leeds LS2 9JT, England). As far as practicable books will be reviewed in a country different from that of publication.

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Nondestructive evaluation of materials. Edited by *John J. Burke* and *Volker Weiss*. Pp. XI + 530. New York and London: Plenum Press, 1979. Price US \$49.50.

This volume constitutes the proceedings of the 23rd Sagamore Army Materials Research Conference on the Nondestructive Characterization of Materials, held at the Sagamore Conference Center, New York in August 1976. Leading materials scientists and technologists from universities, industry and government agencies have contributed to this volume, which deals with in-depth studies in the field of nondestructive testing.

The subject matter has been grouped distinctly into four areas, namely, X-ray, sonic, optical and other methods. It is quite a respectable academic piece of work, which is full of interest from both practical and theoretical points of value. Specific topics covered include neutron radiography, polychromatic stress analysis, the Moire method, quantitative magnetic methods and the use of positrons as a nondestructive probe.

Some typographical errors in the text slightly discredit this otherwise valuable book, which is generously backed by well reproduced figures and illustrations. On the whole, this book could be considered a welcome addition to the literature, both as a text and as a work of reference.

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