HARTREE, D. R. (1955). *Proc. Camb. Phil. Soc.* **51**, 126.
HENRY, W. G. (1954*a*). *Acta Cryst.* **7**, 138.
HENRY, W. G. (1954*b*). *Proc. Phys. Soc.* A, **67**, 789.
HURST, R. P., MILLER, J. & MATSEN, F. A. (1958). *Acta Cryst.* **11**, 320.
IBERS, J. A. (1957). *Acta Cryst.* **10**, 86.
IBERS, J. A. (1958*a*). *Acta Cryst.* **11**, 178.
IBERS, J. A. (1958*b*). *Acta Cryst.* **11**, 447.
Internationale Tabellen zur Bestimmung von Kristallstrukturen (1935). Berlin: Borntraeger.
KATTERBACH, K. (1953). *Z. Astrophysik*, **32**, 165.
KRICHAGINA, M. & PETRASHEN, M. J. (1938). *J. Exper. Theor. Physik USSR.* **8**, 507.
MANNING, M. F. & GOLDBERG, L. (1938). *Phys. Rev.* **53**, 662.
PIPER, W. W. (1957). Private communication.
RIDLEY, E. C. (1957). Private communication.
THOMAS, L. & UMEDA, K. (1957). *J. Chem. Phys.* **26**, 293.
TOMIIE, Y. & STAM, C. H. (1958). *Acta Cryst.* **11**, 126.
WOOD, J. H. & PRATT, G. W., JR. (1957). *Phys. Rev.* **107**, 995.

Acta Cryst. (1959). **12**, 246

Relation of symmetry to structure in twinning.

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In a recent paper with the above title Holser (1958) deals with twin structures belonging to the class which may be characterized as consisting of two crystals with a two-dimensionally periodic layer—the boundary layer —in common. He makes an attempt to derive the possible twinning operations compatible with this characterization. As he shows, such twinning may occur if the boundary layer has an element in its plane symmetry group which is not an element of the space group of the crystal. In this case the structure of the crystal possesses true partial symmetry operations* and should thus be classified as an OD-structure (Dornberger-Schiff, 1956).

The two examples shown schematically in Figs. 1 and 2 prove, however, that the existence of true partial symmetry elements of the plane symmetry group of the boundary layer is not the only source of twinning, as has been formulated by the author (p. 252).

In example 1 (Fig. 1) the only symmetry operation of the boundary layer (a rotation diad) is an operation of the crystal; in example 2 (Fig. 2) the boundary layer has no symmetry (except the translations). Thus in both cases the boundary layer does not possess any symmetry element which the crystal does not possess as well. In both cases there is, however, at least one true partial symmetry operation (partial glide planes in both cases) within the crystal which transforms the boundary layer into an adjacent layer; and these partial symmetry operations serve as twinning operations.

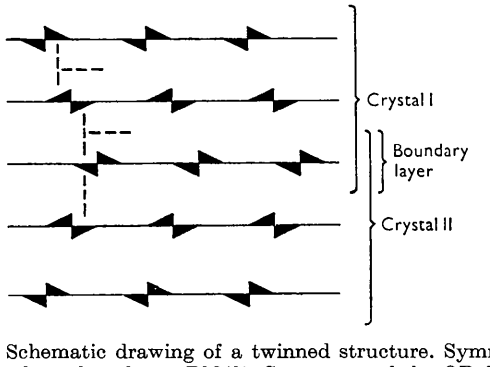

Fig. 1. Schematic drawing of a twinned structure. Symmetry of the boundary layer $P12(1)$. Symmetry of the OD-family characterized by the symbol

$$P\,1\;2\;(1)$$
$$\{c_2\;1\;(a_x)\}\,.$$

* A 'true partial symmetry operation' is a symmetry operation transforming a particular layer of the structure either into itself or into another layer without transforming the crystal into itself.

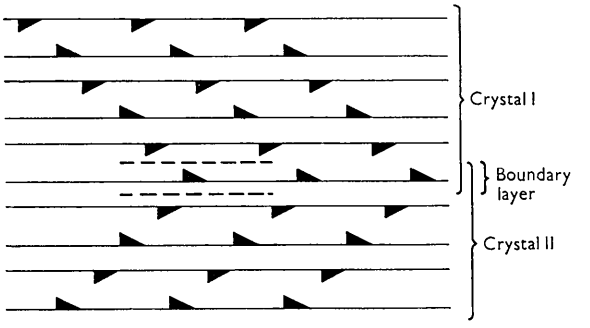

Fig. 2. Schematic drawing of a twinned structure. Symmetry of the boundary layer $P11(1)$. Symmetry of the OD-family characterized by the symbol

$$P\,1\;1\;(1)$$
$$\{1\;1\;(a_x)\}$$
$$\{1\;1\;(a_{x'})\}$$

A general investigation of possible twinning operations is in progress at our Institute, as part of a research programme on OD-structures. Any twin structure, characterized as above, is a member of a family of OD-structures consisting of two-dimensionally periodic layers —either all of the same kind or of not more than three different kinds—one of which is the boundary layer. The twinning operation is in every case a true partial symmetry operation of the crystal, which transforms the boundary layer either into itself or into one of the adjacent layers of the same kind. The deduction of a complete list of the possible twin laws may thus be achieved on the basis of a theory of OD-structures (Dornberger-Schiff and Grell-Niemann).

Literature

DORNBERGER-SCHIFF, K. (1956). *Acta Cryst.* **9**, 593.
DORNBERGER-SCHIFF, K. & GRELL-NIEMANN, H. In preparation.
HOLSER, W. T. (1958). *Z. Kristallogr.* **110**, 249.