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Crystallographic data for certain alkaloids. IV. By D. C. PHILLIPS,† *Viriamu Jones Laboratory, University College, Cardiff, Wales*

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Arecoline hydrobromide, $C_8H_{13}NO_2 \cdot HBr$

Crystals grown from solution in hot ethanol were very small prisms of too poor a quality for a useful optical examination. The Laue symmetry appeared to be mmm , but oscillation and Weissenberg photographs showed systematic peculiarities in the diffraction pattern which are not readily interpreted in terms of the orthorhombic crystal system. A diagram of the observed $h0l$ reciprocal-lattice plane is shown in Fig. 1(a). The crystals are con-

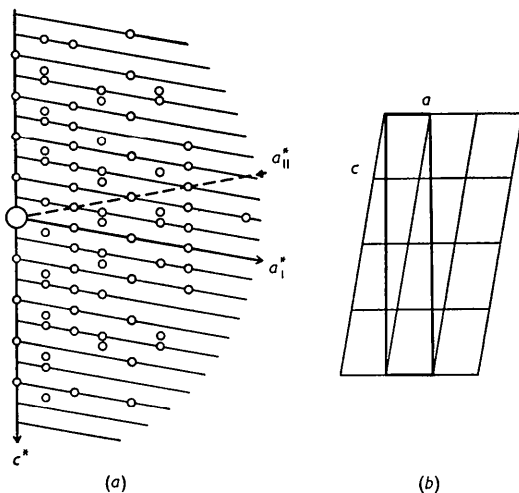


Fig. 1. (a) Observed $h0l$ reflexions with reciprocal-lattice axes marked for normal twinning. (b) Monoclinic and pseudo-orthorhombic unit cells.

sidered to belong to the monoclinic system and to be twinned polysynthetically with b^* and c^* in common and two orientations of a^* . The unit-cell dimensions (accurate to within about 1%) are then:

$$a = 9.90, b = 7.40, c = 14.1 \text{ \AA}; \beta = 100 \pm 1^\circ$$

with 4 molecules per unit cell. Density: calculated 1.54 g.cm.^{-3} ; observed $1.5 \pm 0.1 \text{ g.cm.}^{-3}$.

Reflexions $0k0$ are present only when $k = 2n$. Not all the $h0l$ reflexions can be indexed unambiguously because

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of the seemingly exact overlapping of independent reflexions from the twin components. The absences which can be established all comply, however, with the rule that reflexions $h0l$ are present only when $h+l = 2n$. Reflexions hkl are present in all orders. The probable space group, therefore, is $P2_1/m$.

This appears to be an example of 'twinning by reticular pseudo-merohedry' (Friedel, 1905): a multiple lattice simulates a symmetry higher than that of the lattice. Here the axis $[104]$ is very closely perpendicular to (001) , $\cos \beta = -a/4c$, making possible the pseudo-orthorhombic unit-cell base outlined in Fig. 1(b).

The twin operation is one of the operations of orthorhombic pseudo-symmetry associated with this quadruple cell but not included in any possible monoclinic symmetry.

Sparteine sulphate pentahydrate, $C_{15}H_{26}N_2 \cdot H_2SO_4 \cdot 5H_2O$

Crystals grown from dilute ethanol were plates with well formed pinacoids $\{001\}$. Oscillation and Weissenberg photographs showed the Laue symmetry to be $2/m$ and gave the monoclinic unit-cell dimensions:

$$a = 8.03, b = 15.2, c = 8.84 \text{ \AA}; \beta = 91^\circ 30' \pm 1^\circ$$

There are 2 molecules per unit cell. Density: calculated 1.30 g.cm.^{-3} ; observed 1.28 g.cm.^{-3} .

Reflexions $0k0$ are present only when $k = 2n$. All other classes of reflexions are present in all orders so that the space group is either $P2_1$ or $P2_1/m$. Since the compound is optically active, however, $P2_1$ must be chosen. This choice has been confirmed by an investigation of the distribution of intensities among the $h0l$ and $0kl$ reflexions (Wilson, 1951).

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On the substantialization of sign sequences. By I. J. GOOD, 25 Scott House, Princess Elizabeth Way, Cheltenham, England.

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Woolfson (1954) describes a method for the determination of the signs of the structure factors of a centrosymmetrical crystal. The method depends on a standard set of sixteen sequences of seven signs (7-sequences) such that each of

the 128 possible 7-sequences differs from one of the set in at most one sign. In the present note the structure of the set is explained and is extended to a set, S , of 2048 15-sequences such that each of the 32,768 possible