uninucleate condition of these æciospores was due to an artefact. The young æciospores near the spore-bed of every æcium of monosporidial origin that I have investigated more recently have all proved to be binucleate.

In conclusion, I desire to thank Prof. Buller for assisting me with valuable suggestions and helpful criticism.

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Winnipeg, Oct. 13.

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### The Cellulose Space Lattice of Plant Fibres.

Two different types of X-ray diffraction patterns and their interpretations, made from cellulose fibres, have appeared in the literature; one associated with a 'point diagram,' presented by R. O. Herzog,[1] the other, with a 'line diffraction pattern,' by the writer.[2]

Although the two methods used were slightly different, both depend upon 'reflection' of monochromatic X-rays from the uniformly spaced planes of atoms in the fibres, and should therefore be capable of identical interpretation. The data in general are in fair agreement, except in two or three examples where the differences cannot be accounted for by experimental errors. It is the purpose of this communication to direct attention to this lack of agreement, and to point out its effect upon the lattice structure proposed by Herzog.

In the *Journal of Physical Chemistry*, April 1926, pp. 455-467, Herzog discusses a lattice for cellulose which he considers a revision of his earlier work. In the data for this revised lattice there appears a series of interference points which are associated with planes parallel to the *c* axis of the elementary cell; that is, planes parallel to the long axis of the fibres. In that series particular attention is directed to points $A_3$ and $A_4$. The data given below were taken from his Table I., and from them the interplanar spacings *d* were computed by means of the Bragg formula:

$$n\lambda = 2d \sin \theta,$$

where $\theta$ is the glancing angle, and $\lambda = 1{\cdot}54$ A. the $K_\alpha$ wave-length for copper, since the radiation used was from a copper target.

| Point. | Sin $\theta$. | *d*. |
|---|---|---|
| $A_3$ | 0·17909 | 4·30 A. |
| $A_4$ | 0·1981 | 3·89 |

In the other type of diffraction pattern, as published in the *Journal of General Physiology*, Nov. 1925, pp. 221-233, and May 1926, pp. 677-695, I found no line corresponding to the 4·30 interplanar value for planes which were parallel to the long axis of the fibres. In making these patterns the X-ray beam was passed through a filter to ensure a monochromatic beam of $K_\alpha$ wave-lengths only. When, however, diffraction patterns were made later with the unfiltered radiation, a line which corresponded to the 4·30 value always appeared prominently. Since this interference maximum failed to appear when $K_\alpha$ wave-lengths only were used, and on the other hand always appeared clearly when the beam was a composite of all of its wave-lengths, it was suspected immediately that a single set of planes with strong reflecting powers had produced two interference lines, one from the $K_\alpha$, the other from the $K_\beta$ wave-lengths.

Calculation shows that the point $A_3$ might have been produced by the $K_\beta$ wave-lengths from the very strong 3·89 planes;

| Point. | Sin $\theta$. | $K_\alpha$ $\lambda = 1{\cdot}54$ A. | $K_\beta$ $\lambda = 1{\cdot}39$ A. |
|---|---|---|---|
| $A_3$ | 0·17909 | 4·30 | 3·89 |
| $A_4$ | 0·1981 | 3·89 | |

and since no line was found corresponding to the $A_3$ point when the $K_\beta$ wave-lengths were filtered out of the beam, one must conclude that Herzog failed to recognise the $K_\beta$ origin of the $A_3$ point and gave it the 4·30 value as though it were of $K_\alpha$ origin. That value, therefore, should be discarded from the data.

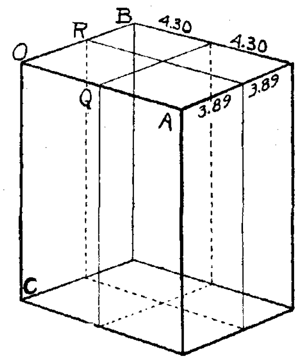


FIG. 1.

Attention was directed to a similar use of a $K_\beta$ interference point (NATURE, Aug. 15, 1925, p. 243) in the original data of Herzog and Janeke which was published in *Zeitsch. für Physik*, 3-3, 196-198, 1920, and in which incidentally this 4·30 value does not appear. That value apparently had been discarded at that time as of $K_\beta$ origin.

When, however, one attempts to discard the 4·30 value now, a new importance is found placed upon it. The dimensions for the axes of the revised elementary cell as proposed by Herzog are given as $a : b : c = 8{\cdot}60 : 7{\cdot}78 : 10{\cdot}22$. This elementary cell may be represented by Fig. 1, where

$$OA = a = 8{\cdot}60 = 2 \times 4{\cdot}30$$
$$OB = b = 7{\cdot}78 = 2 \times 3{\cdot}89.$$

The two planes passing through Q and A respectively and parallel to the plane OBC are considered as being separated by the 4·30 distances, OQ and QA. Likewise OR and RB are the 3·89 distances. That the *a* axis is directly associated with the 4·30 value and the *b* axis with the 3·89 value is definitely fixed by the indices (200) and (020) respectively, given in his Table II.

It seems, then, that the values used for the *a* axis and the *b* axis of the elementary cell proposed were both produced by the same set of planes, and when the 4·30 value is discarded, as it seems evident that it must be, the axial dimensions proposed by Herzog lose their significance, and therefore a number of conclusions must be discarded. (1) That four anhydro-glucose units are contained in the elementary cell is now of course without foundation. (2) The assumptions that certain interference maxima are produced by impurities in the fibre, or that there are two types of carbohydrates embodied in the cellulose of the fibre, are now also without adequate basis. (3) The correspondence between the 4·30 value and a certain interference maximum obtained from mercerised cellulose likewise now has no significance. These conclusions at least must be discarded if the only basis for them lies in the elementary cell as suggested by Herzog. A lattice based upon the 'line diffraction patterns' seems to be in better agreement with the properties of the fibres, both physical and chemical. This structure is discussed in detail by Sponsler and Dore in "Colloid Symposium," Monograph 4, pp. 174-202, 1926, and in the papers mentioned above.

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[1] Herzog, R. O., "Nature of the Structure of Cellulose and its Significance in Chemical Transformations," *Jour. Phys. Chem.*, 30-4, 455-467; April 1926.

[2] Sponsler, O. L., "Molecular Structure of Plant Fibres determined by X-ray," *Jour. Gen. Physiol.*, 9-2, 211-233; 1925: 11-5, 677-695; 1926.