THE INTERMICELLAR SYSTEM IN CELLULOSE FIBRES

by

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Knowledge of the form of the intermicellar system in cellulose fibres rests to a large degree upon the X-ray investigations of FREY-WYSSLING[1,2] who determined the size of gold and silver crystals deposited in fibres from solutions. He recognized two systems of spaces: (a) those about 10 A in width between micelles and within the microfibrils and (b) those about 100 A in width and between the microfibrils, in which non-cellulosic constituents were located.

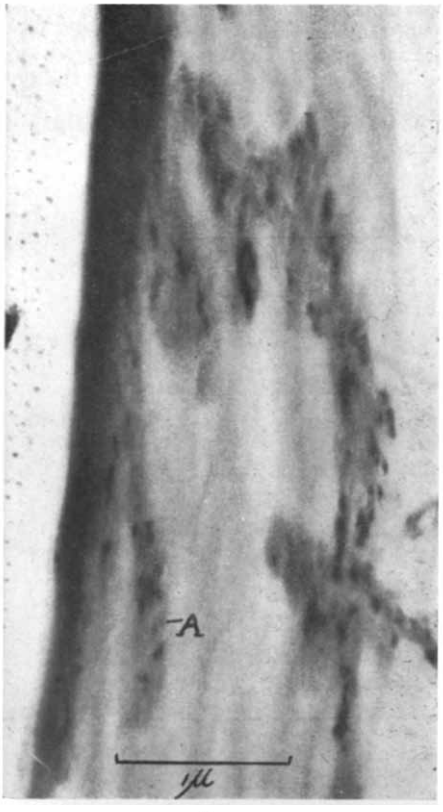

Fig. 1.

Recently in this laboratory fibres treated with a solution of gold chloride have been examined in the electron microscope and a fragment of a delignified flax fibre so treated is shown in the accompanying electron micrograph. It can be seen that deposition of the metal was irregular and, in those regions where the crystal aggregates (*e.g.*, the region *A*) are clearly resolved, it is considered that surface crystallization had commenced, the aggregates forming in the "grooves" between adjacent microfibrils. The aggregates in the region *A* are about 70–100 A in width which agrees reasonably well with the apparent crystal size of 120 A determined from the breadth at half maximum intensity for the 111 diffraction line of gold in this material.

The objection raised against FREY-WYSSLING'S X-ray data on the size of these intermicellar spaces, namely that deposition of the gold swells the fibre and so gives high values for the breadth of the spaces, also applies in the present case. This is confirmed by the observation that in wood the maximum scattering angle is much less in gold-impregnated specimens in comparison with untreated specimens. On the other hand specimens delignified before deposition of the gold gave increased values for the apparent crystal size as calculated from the breadth of the 111 diffraction line at half maximum intensity (see Table I).

TABLE I

THE APPARENT CRYSTAL SIZE OF GOLD DEPOSITED IN CELLULOSE FIBRES BEFORE AND AFTER DELIGNIFICATION
(Cu K_α radiation)

Specimen	*Apparent Crystal Size* (A)	
	Untreated	*After delignification*
Picea sp. (late wood)	122	163
Picea sp. (early wood)	75	100
Eucalyptus regnans (late wood)	73	111
Linum usitatissimum	80	123

Thus, although admittedly too high, it is apparent that the magnitude of the gold crystals does give some indication of the size of the spaces present in the fibre. The results given in Table I are also consistent with the view that non-cellulosic constituents are located within the larger intermicellar regions of the fibre although the more recent data of SEN AND WOODS[3] makes it probable that lignin is present at the edges of the finest capillaries of the cell wall, probably in association with paracrystalline cellulose surrounding the micelles[4].

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A PRELIMINARY STUDY OF THE INCORPORATION IN GROWING TURNIP YELLOW MOSAIC VIRUS AND ITS RELATED NON-INFECTIVE ANTIGEN OF LABELLED AMINO ACIDS

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The presence in plants infected with tobacco mosaic virus of a non-infective RNA-free protein having a much lower sedimentation rate than the virus, but crystallizing in needles like it and having very similar immunological properties, has recently been reported[1,2,3,4]. Similar observations had already been described by MARKHAM[5] in the case of turnip yellow mosaic virus (TYMV) where the virus and its antigen have however more similar sedimentation constants. Our lack of knowledge about the signification of these non-infective proteins and especially about their possible role in virus multiplication has prompted us to approach such problems with the aid of radioactive tracers, a method which does not seem to have been used so far for this purpose.

When chinese cabbage plants are infected with TYMV, a massive infection appears only in the new leaves which grow after infection. The virus, the RNA-free antigen and the normal proteins are synthesized simultaneously and form an actively growing system where the proportions of these constituents remain approximately constant. Such conditions are sufficiently simple to give us some indications of the relations that might exist between the virus and its associated antigen on the basis of measurements of the rate of incorporation of labelled amino acids in these two components. In the experiments to be reported here we always used plants bearing only these new leaves, the others having previously been sectioned.

Plants infected 2 or 3 weeks beforehand, cultured in identical conditions and as similar in size as possible, are placed, in the presence of $^{14}CO_2$, in a glass cage strongly illuminated by fluorescent tubes. After 5 or 21 hours, the virus and non-infective antigen are separated from the normal proteins of the extract by alcohol fractionation, followed by several crystallizations in the presence of ammonium sulfate[5]. A 6–8% solution of the crystals is then fractionated by centrifugation, according to the technique of MARKHAM[5,6], into the two constituents described by this author: the infective virus containing 28% RNA and a protein immunologically similar but containing no RNA or only traces. An electrophoretic study, in the PERKINS-ELMER apparatus, shows that the two fractions which have been isolated contain no observable amounts of normal proteins. Both give very similar precipitation curves with the serum of a rabbit immunised against purified virus (determination of the nitrogen of the precipitate as a function of the nitrogen of the antigen, added to a constant quantity of antiserum).

After precipitation with trichloracetic acid, washing of the precipitate and extraction with alcohol-ether, the RNA is eliminated by cold 10% perchloric acid. Specific radioactivities of the dry powders finally obtained are determined on equal weights of material with a thin window counter, taking care to avoid geometrical errors. The results are shown in Table I. The differences observed between the specific radioactivities of the virus and of its RNA-free antigen have been confirmed