BRIEF PAPERS

SOME FURTHER NOTES ON THE HYDROLYSIS OF STARCH GRAINS UNDER POLARIZED LIGHT

(WITH ONE PLATE)

The interest taken by workers in America in the effects of radiation of all kinds and in particular of polarized light, together with the confirmation of my results, kindly expressed by Prof. Macht and Mr. Morrison, lead me to hope that some fuller account of these experiments may be acceptable.

The first paper published in Dec., 1924, was necessarily of a preliminary character, but recent work has completely confirmed these early results and has made the whole process much clearer.

Like all new ideas, this work has not escaped criticism, to which a reply has been given, and it is hoped that the following added notes and photographs will show that the views put forward by our critics are quite untenable.

1. As stated in the above mentioned paper, washed and centrifuged starch grains were suspended in water, to which weak diastase was added and a few drops of the starch suspension were mounted on a microscope slide placed over a Nicol prism. Two controls were always arranged, one in ordinary light, and the other in darkness. It has been suggested that the whole effect was due to pressure of the cover slip, but this factor would have affected the controls also.

2. In the second place, it is most important to note that the whole process was watched carefully under the microscope for four or five hours, the changes were noted and drawings were made. Unless this is done, a superficial observer may easily miss the results, particularly if no cover slip is used, as the grains on hydrolysis become lighter, exude their contents, and the empty coats float to the edge of the slide or vessel.

3. The experiment was repeated nearly twenty times, and the result was shown to nine or ten different observers, chiefly professors and lecturers of the University of London.


201
4. The first change was seen as a light transparent streak, evidently within the grain and starting from the hilum. This increased, and branches were formed extending to the exterior. These are seen on plate VIII, figs. 5 and 6.

5. The whole grain became lighter and more transparent and the edges began to split. Figs. 7 and 8. (This is also seen in fig. 3 where the effect was produced by polarized light alone, acting on well-washed grains in distilled water.)

6. The grain started to swing very slowly from side to side and in some cases moved its position, owing probably to exudation of the hydrolyzed contents of the grain and to changing surface tension. This fact shows that the change observed could not have been due to pressure of the cover slip.

7. Under crossed Nicols the luminescence of the grain gradually disappeared from the center towards the periphery. Fig. 9.

8. The familiar black cross became blurred in the same way and finally disappeared.

9. On drying, a cluster of crystals formed at the point where the grain had been and only the empty shrivelled or broken coat or shell remained. This sometimes became so transparent as to be nearly invisible. Figs. 10 to 12. The arrangement of these crystals most probably depends on the shape of the original starch grain.

10. On addition of Fehling's solution, as before stated, the presence of a reducing substance was indicated. The photomicrographs, figs. 1 and 2, are submitted as showing the results better than those in the original paper. They were not published at the time, as one of the controls was spoiled.

In both controls, however, the whole field on the slide was searched and only two grains were found imperfect on each slide. In fig. 1, over the polarized light, the grains were commencing to break all over the field exposed.

Fig. 3 illustrates the change within the grain before any serration has taken place, except that little canals are forming to the exterior. This result was obtained with long weak exposure to polarized light. No diastase was added to the starch suspension. In fig. 13 this change has gone further; the contents of the grain are forming crystals and the shell is beginning to crack. In fig. 4 and fig. 14 the coat has broken down and the hydrolyzed contents have exuded into the surrounding liquid.

In conclusion, it may be noted that if, as Professor Jones suggests, all these results are due to accidental pressure of the coverslip (even when the exposure took place in a flask!) then there is a by fortune to be made in the sugar industry. The only requisites are a few tons of corn or potatoes and a steam-roller!—Elizabeth Sidney Semmens, Bedford College, University of London.
EXPLANATION OF FIGURES.

Fig. 1. Potato starch exposed to light polarized by a Nicol prism. All stages of hydrolysis are present. (See figs. 5–12.)

Fig. 2. Control of potato starch exposed to ordinary light. Grains A and A' appear to be fractures, as there is no transparency in the middle, which is the mark of hydrolysis.

Fig. 3. Starch grains exposed in flask to polarized light through base of flask, showing hydrolysis of contents, probably to dextrin. C, C: canals to exterior.

Fig. 4. Starch grains exposed to polarized light, with diastase, showing exudation from grain. The coat of the grain is left in the center.

Figs. 5–12. Typical stages of hydrolysis of starch grains exposed to polarized light, with diastase. Note transparent streak in fig. 6, the rod-like crystals from the shell of the grain in fig. 10, and the radiating crystals surrounding the shell in figs. 11 and 12.

Fig. 13. Washed starch grain in distilled water, after several days' exposure, in a flask, to polarized light. Note crystals formed inside; also slits in the coat.

Fig. 14. Starch grains, prepared and exposed as in fig. 1. Note exudation from the grain crystallizing out.