Chlorophyll and Photosynthesis in Stomatal Guard Cells

Investigations in this laboratory carried out by different techniques from those of Shaw and MacLachlan give direct support to their recent statements[1] with regard to the presence of chlorophyll in stomatal guard cells and the ability of these cells to assimilate carbon dioxide by photosynthesis. Measurements of light absorption made on intact plastids in the living guard cells of leaves of *Rumex patientia*, *Chrysanthemum maximum* and *Vicia faba* have shown the presence of chlorophylls *a* and *b*. Moreover, an active synthesis of carbohydrates in the light is clearly indicated by the diurnal changes of sugars and starch in the epidermis of the leaf.

The absorption spectrum of individual plastids in the guard cells was determined by means of a microspectrophotometer developed by Dr. W. K. Metcalf and Mr. K. W. Keohane. Measurements made on *Rumex patientia* are shown in Fig. 1. The absorption at the red end of the spectrum corresponds closely with that expected for a mixture of chlorophylls *a* and *b*. A well-marked maximum was observed at about 6700 A. with a subsidiary maximum at about 6300 A., both attributable to chlorophyll *a*. Indication of a further maximum at about 6550 A. was obtained, which would correspond with chlorophyll *b*. Compared with spectrum determinations made on pure preparations of chlorophyll in organic solvents[2], the absorption is displaced about 100–150 A. towards the red end of the spectrum. The observations of Hubert[3] carried out on chlorophyll of living cells indicate a similar displacement.

Other measurements made with preparations of epidermis from *C. maximum* showed similar absorption spectra with a strong maximum at about 6700 A. With this leaf no qualitative differences could be detected in the light absorption by the plastids of the guard cells and those of normal photosynthetic cells of the mesophyll. Despite the earlier statements of Sayre[4], who failed to detect chlorophyll in the guard cells of *R. patientia*, there can now be little doubt that the green pigment which commonly occurs in the plastids of stomatal guard cells is chlorophyll.

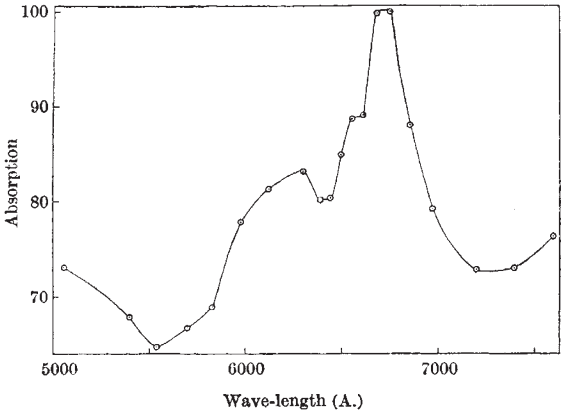

Fig. 1. Absorption spectrum of plastids of stomatal guard cells of the lower epidermis freshly stripped from leaves of *Rumex patientia* and mounted in water. Absorption is expressed as a percentage of the maximum recorded

Typical examples of diurnal fluctuations in carbohydrates of the epidermis and changes of stomatal aperture are shown in Fig. 2. Both with *C. maximum* and with *V. faba* there is evidence, during the morning, of an increase of sugars, mainly of sucrose, and later of an increase of starch; these observations are consistent with the occurrence of active assimilation in the guard cells. It is possible that increase of sugars may promote stomatal opening in the morning; but no simple relation of sugar content of the epidermis and the closure of stomata was found. Other experiments indicate that in these two plants stomatal movements and the transformations of carbohydrates in the guard cells are strongly influenced by the water relations of the leaf. A full account of this work will be published shortly[5].

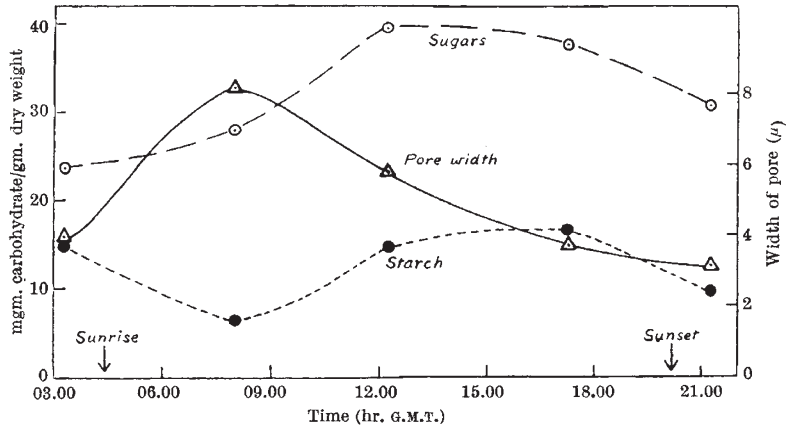

Fig. 2. Diurnal changes of carbohydrates and stomatal aperture in the lower epidermis of leaves of *Chrysanthemum maximum*

We are indebted to Mr. K. W. Keohane and Dr. W. K. Metcalf for the determination of the absorption spectra of plastids.

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Effect of Penicillin on the Pathogenicity of Penicillinase-producing *Aureus staphylococci*

It has been shown[1] that the effect of penicillin on an infection in rabbits which was ordinarily controlled by penicillin was much reduced if penicillinase-producing, non-pathogenic bacteria were present at the site of infection. Thus all rabbits died when a mixed infection caused by a penicillin-sensitive pathogenic *Pasteurella* bacteria and penicillinase-producing non-pathogenic *Aureus staphylococci* was treated with penicillin. Control animals which were infected with *Pasteurella* bacteria alone and which were treated in the same way recovered easily.