[15] Honda, S. I., Hongladarom, T., and Laties, G. G., *J. Exp. Biol.*, **17**, 460 (1966).
[16] Leech, R. M., in *Biochemistry of Chloroplasts* (edit. by Goodwin, T. W.), **1**, 65 (1966).
[17] Ridley, S. M., and Leech, R. M., *Planta*, **83**, 20 (1968).
[18] Lowry, O. H., Rosebrough, N. J., Farr, A. L., and Randall, R. J., *J. Biol. Chem.*, **193**, 265 (1951).
[19] Arnon, D. I., *Plant Physiol.*, **24**, 1 (1949).
[20] Reynolds, E. S., *J. Cell Biol.*, **17**, 208 (1968).

Light Compensation Points and Photorespiration

SOME results of an investigation into light compensation points of photosynthesizing leaves are relevant to arguments about the occurrence or absence of photorespiration in illuminated leaves of species which do not release carbon dioxide into carbon dioxide-free air, and which have a carbon dioxide compensation point (Γ) close to zero[1–3].

At the light compensation point equivalent amounts of carbon dioxide are evolved and fixed photosynthetically within leaves, and because increases in temperature cause greater increases in the rates of processes which produce carbon dioxide than in rates of photosynthesis, light compensation points increase with temperature (Fig. 1). The points shown are the means of values obtained with four leaves from each species; temperatures stated are measured leaf temperatures. Light was supplied by water-cooled incandescent lamps suspended at variable heights above a constant temperature leaf chamber; intensities were measured with a barrier cell held in a very flat frame and calibrated with a megatron light meter; the cell could be moved to immediately above the leaf surface inside the chamber. The light compensation point was taken as the intensity at which the concentration of carbon dioxide in the closed circuit was maintained at 310 p.p.m. for 30 min.

With one notable exception the light compensation point was apparently most closely related to leaf thickness and the amount of non-chlorophyllous tissue in the leaves; this is best illustrated by the sun and shade leaves of *Impatiens parviflora* (Balsam) and of copper beech. In the latter, however, the sun leaves were reddish-brown and the shade leaves a dull green. There was a similar relation between the light compensation points of sun and shade leaves in *Rhododendron*.

The somewhat fibrous leaf of sugar cane (a zero-Γ plant) was clearly exceptional but the other zero-Γ plant, maize, did not have this exceptionally low light compensation point and differed very much from sugar cane in its temperature response. Both plants were grown in a glasshouse; it was not possible to distinguish between sun and shade leaves in these plants. On many days during the growth of these plants light intensities reached 80,000 lux. Day temperatures were usually hotter than 25° C and often reached 37° C.

It could be argued that in sugar cane leaves the rate of evolution of carbon dioxide in the light was as low as in shade leaves, but this is not so for maize with a light compensation point of 2,300 lux at 35° C—its optimum temperature for photosynthetic performance. As reported earlier[4], maize does not establish zero-Γ at temperatures hotter than 30° C and the minimum light intensity to reach zero-Γ at 30° C is about 5,000 lux. In spite of its low light compensation point the same is true of sugar cane; its light requirement for establishing zero-Γ at 30° C was higher than that of maize. The dark respiration rate of sugar cane was 0·8 mg of CO_2 dm^{-2} h^{-1} at 25° C and 1·6 mg of CO_2 dm^{-2} h^{-1} at 35° C; for maize the values were 1·6 and 3·4 mg of CO_2 dm^{-2} h^{-1} respectively. Anatomical differences between the two species relate to the distribution of chlorenchyma, but it is difficult to see a connexion between these and the very different light compensation points.

These results support the view that in illuminated maize leaves (and perhaps sugar cane too) carbon dioxide is evolved but not released into carbon dioxide-free air, because of an effective carboxylation mechanism which is probably not restricted to cells containing distinct chloroplasts[5,6]. This does not preclude the possibility that at intensities above the light compensation point the evolution of carbon dioxide is progressively inhibited, but there is no good evidence for this view.

HANS MEIDNER

Department of Biology,
University of Stirling,
Stirling (Scotland).

Received September 1, 1970.

[1] Forrester, M. L., Krotkov, G., and Nelson, C. D., *Plant Physiol. Lancaster*, **41**, 427 (1966).
[2] Meidner, H., *J. Exp. Bot.*, **18**, 178 (1967).
[3] Jackson, W. A., and Volk, R. I., *Nature*, **222**, 269 (1969).
[4] Meidner, H., *J. Exp. Bot.*, **13**, 284 (1962).
[5] Hatch, M. D., Shack, C. R., and Johnson, H. S., *Biochem. J.*, **102**, 417 (1967).
[6] Meidner, H., *J. Exp. Bot.*, **21**, 1067 (1970).

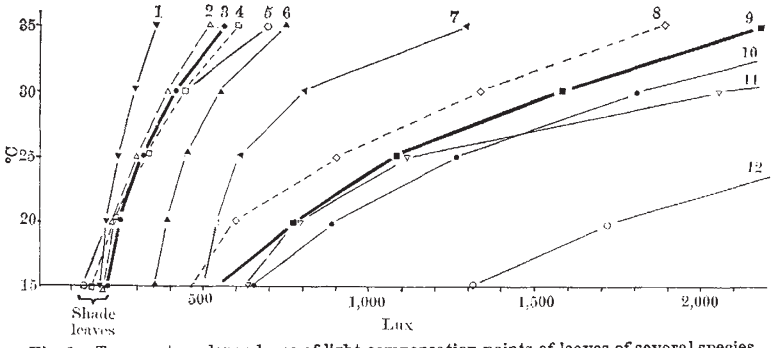

Fig. 1. Temperature dependence of light compensation points of leaves of several species. The percentages indicate the proportion of light transmitted by the leaves when placed directly on the barrier cell. Leaf thicknesses are shown for those species of which sun and shade leaves were used. 1, 27 per cent, shade balsam, 80μ; 2, 30 per cent, lettuce, 120μ; 3, 13 per cent, sugar cane, 375μ; 4, 20 per cent shade beech, 80μ; 5, 8 per cent, shade *Rhododendron*, 220μ; 6, 17 per cent, partial sun balsam, 120μ; 7, 13 per cent, sun balsam, 180μ; 8, 4 per cent, sun beech, 150μ; 9, 8 per cent, maize, 270μ; 10, 11 per cent, sugar beet, 260μ; 11, 10 per cent, wheat, 230μ; 12, 4 per cent, sun *Rhododendron*, 480μ.

CO_2 Assimilation by Chloroplasts illuminated on Filter Paper

CHLOROPLAST suspensions from *Spinacea oleracea* or *Pisum sativum* assimilate CO_2 in the light at rates comparable with those observed with intact leaves[1–3]. With most preparations the major photosynthetic products are phosphoglyceric acid (PGA) and dihydroxyacetone phosphate (DHAP)[2,4,5]. Although the synthesis of these compounds is consistent with the operation of the photosynthetic carbon reduction (PCR) cycle[6] in the isolated plastids it is still not clear why these particular intermediates accumulate. It has been shown[5] that the outer membranes of the chloroplasts are permeable to both PGA and DHAP. Thus a large proportion of the carbon fixed into these compounds may diffuse into the external medium. The amount of carbon lost from the chloroplasts will presumably depend on the ratio of the volume of external medium to that of the aqueous phase of the chloroplasts. For chloroplast suspensions containing 100 μg chlorophyll per ml. this