centration alone, suggesting a boosting of the osmotic potential of the tomato sap by the hydrolysis of osmotically inactive substances, which is known to occur under water strain, and which may perhaps contribute to the commonly observed senescence and withering of herbaceous leaves when water is short in the field[4]. Thus it appears that woody leaves may both surrender water more freely than herb leaves, and be able to do so with less injurious consequences. We do not know how far these different responses of detached leaves to water stress are reproduced in attached leaves in the field, but the observations would fit the hypothesis that the leaves of woody plants may be adapted to undergoing considerable dehydration while retaining the capacity to resume normal activity when water is again available. Their development of greater diffusion pressure deficits as water content falls would, on this hypothesis, serve mainly as a brake on the process of dehydration in the field, not preventing it but permitting it to proceed with less injury. In short, among the mesophytes, woody plants may be more drought-resistant than herbs growing in the same place.

These observations were made during work on the ecology and physiology of aphids[5], many species of which abandon their woody hosts for herbaceous ones in the summer. We are deeply indebted to Dr. P. E. Weatherley and Prof. F. L. Milthorpe for advice and criticism on this plant-physiological side.

J. S. Kennedy
C. O. Booth

Agricultural Research Council
Unit of Insect Physiology,
Entomological Field Station,
34a Storey's Way,
Cambridge.
Feb. 25.

[1] Weatherley, P. E., and Slatyer, R. O., *Nature*, **179**, 1085 (1957).
[2] Slatyer, R. O., *Austr. J. Biol. Sci.*, **10**, 320 (1957).
[3] Miller, E. C., "Plant Physiology" (McGraw-Hill, 1938).
[4] Russell, E. J., "Soil Conditions and Plant Growth" (Longmans, 1950).
[5] Kennedy, J. S., *Ent. Exp. Appl.*, **1**, 50 (1958).

Relation between Chlorophyll Metabolism and Nodule Formation in Soya Bean

It has been shown that day-length regulates both the number of the root nodules and the chlorophyll content of the leaves in the soya bean[1,2]. There now arise the questions of whether the leaves are receptive organs for the control of nodule formation by day-length, and whether the action of day-length on chlorophyll-content is related to its action on the formation of functional nodules.

An experiment has been carried out to elucidate these problems. Soya beans of the variety *illini*, cultivated at a constant temperature of 20° C. (in a phytotron room), under artificial light given by six fluorescent 'Phytor' lamps, 65 cm. from the soil (providing an intensity of illumination of 4,500 lux at the soil surface), are inoculated with a specific strain of *Rhizobium* in the manner previously described[2]. The plants are divided into two sets : one is cultivated in long-day (16 hr.), the other in short-day (8 hr.) conditions. When the second leaf begins to grow, the apex, lateral buds and all other leaves are removed. The plants—having only their very young second leaf—are immediately separated into four series : (1) control plants remaining in 16-hr. day ; (2) plants transferred from 8- to 16-hr. day ;

Table 1. Effect of Change in Day-length on the Number and the Dry Weight of Root Nodules in Soya Bean, var. *illini*

Day-length	No. of nodules per 100 plants	Dry weight of 100 nodules (mgm.)
(1) Controls in 16 hr.	543	107
(2) Transferred from 8 to 16 hr.	322	81
(3) Transferred from 16 to 8 hr.	354	35
(4) Controls in 8 hr.	42	11

(3) plants transferred from 16- to 8-hr. day ; (4) control plants remaining in 8-hr. day. After thirty days, the number of nodules and their dry-weight are measured. The chlorophyll content of the leaves is estimated in each series after fifteen and thirty days.

Table 1 shows that the controls grown in long-day conditions produced about twelve times as many nodules as those in short-day conditions. Long-day nodules are also ten times heavier (dry-weight) than short-day nodules. The plants transferred from 8- to 16-hr. days produced many more nodules than controls remaining under 8-hr. days and the nodules of the transferred plants are appreciably heavier than those of the controls. On the other hand, the plants transferred from 16- to 8-hr. days produce fewer nodules than controls remaining under 16 hr., and their average dry-weight is also lower.

It appears that transfer from long- to short-day, or from short- to long-day conditions has an effect on nodulation which, in the circumstances of this experiment, is only explicable if the (second) leaf acts as the receptive organ for the control of nodulation by day-length.

Fig. 1 shows the evolution of the chlorophyll content in the second leaf after change in day-length, the values at the moment of the transfer being taken as 100. The control plants in 16-hr. days accumulate the pigment at a relatively rapid rate, doubling their content in thirty days. It has been shown previously that the rate of accumulation under short days is at first low, but later becomes more rapid[2]. In the transferred series, two distinct regimes are observed. When transferred from short- to long-days, the plants augment their chlorophyll content very rapidly up to four times the initial value. On the other hand, in plants transferred from long- to short-days, accumulation practically stops.

Comparing these results with those for nodulation, it appears that, especially in the transferred series, nodulation proceeds parallel to the accumulation of pigment. A very rapid accumulation of pigment in

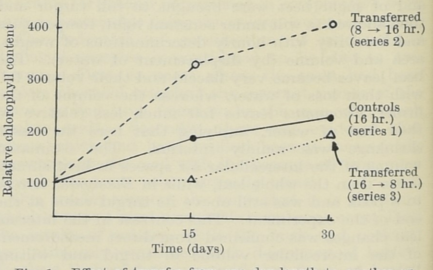

Fig. 1. Effect of transfer from one day-length to another on chlorophyll content of the second leaf in soya bean, var. *illini*. Chlorophyll content at the moment of the transfer, 100

ɒries 2 corresponds to a drastic augmentation both ꞉ the number and weight of the nodules; while ı arrested accumulation of pigment in series 3 ɔrresponds to an arrested formation of nodules.

It may be concluded that the action of day-length ı chlorophyll content is related in some way to its ction on the formation of root nodules.

C. Sironval

Laboratoire de Physiologie
; Centre des Hormones Végétales,
IRSIA, Institut de Botanique,
Liège.
Dec. 28.

Bonnier, Ch., and Sironval, C., *Nature*, **177**, 93 (1956).

Sironval, C., Bonnier, Ch., and Verlinden, J.-P., *Phys. Plant.*, **10**, 697 (1957).

Xylose as a Specific Inhibitor of Photosynthesis

The energy requirements of certain green algae can e met by photosynthesis when they are supplied vith carbon dioxide in light, or by chemosynthesis, ısing organic substrates, in light or darkness. Bristol Roach[1], Neish[2], Taylor[3] and Samejima and Myers[4] ave found considerable differences in the ability of arious species of algae to utilize carbohydrates as nergy sources, but all have found xylose to be mong those which cannot be metabolized.

In work planned to standardize the growth of *Chlorella pyrenoidosa* for herbicide tests, the organism vas grown at 27–30° C. under sterile conditions in lasks around filament lamps. With minor modificaions, the mineral medium was that used by Pearsall nd Loose[5]. As applicable, sugar solutions were dded, or carbon dioxide/air mixture was bubbled in. Preliminary tests showed that D-xylose could not be ısed as a substrate for chemosynthesis, but differed rom all the other sugars which were tested, including D-ribose, in arresting cell division when present at 0·5 per cent in flasks where the algae were assimilating carbon dioxide.

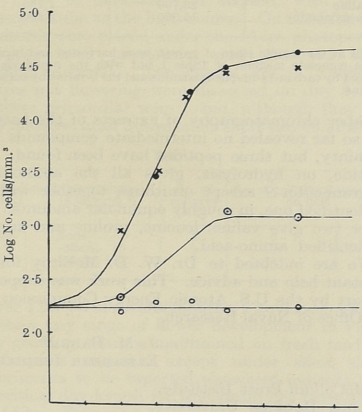

Fig. 1. Growth of *Chlorella pyrenoidosa* on glucose, and the effect of D-xylose. (Light, 470 ft.-candles.) ●——●, 0·5 per cent and 1·0 per cent glucose in light; ⊙——⊙, 1·0 per cent glucose in darkness; O——O, 0·5 per cent xylose in light; ×——×, 0·5 per cent glucose + 0·5 per cent xylose in light

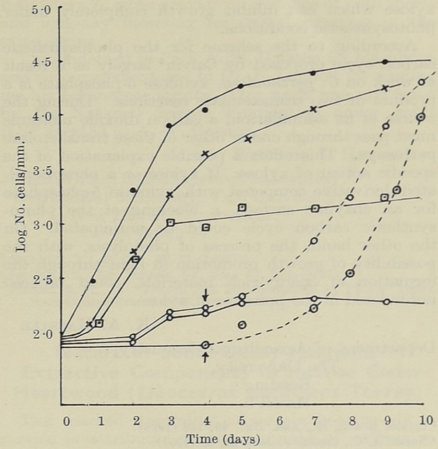

Fig. 2. Effect of D-xylose on photosynthesis of *C. pyrenoidosa*, and its reversal by addition of glucose. (Light, 470 ft.-candles; 5 per cent carbon dioxide in air.) ●——●, Control, no xylose; ×——×, 0·033 per cent xylose; ⊡——⊡, 0·1 per cent xylose; O——O, 0·5 per cent xylose; ⊙——⊙, 1·5 per cent xylose; ↑------, 0·5 per cent glucose also present

Cell division was not affected by 0·5 per cent xylose when glucose, fructose or mannose was also present (Fig. 1). When glucose was the energy source, 1·5 per cent xylose in a total carbohydrate content of 2·0 per cent did not retard growth compared with that in 2 per cent glucose, even when carbon dioxide was also supplied. Thus xylose is not toxic so long as a chemosynthetic energy source is available. Neish[2] has shown that the osmotic limit for optimum utilization of glucose is 1–2 per cent, so the only factor limiting the dose of xylose which can be tolerated by *C. pyrenoidosa* when it is not living photosynthetically is the total concentration of carbohydrate.

By contrast, under photosynthetic conditions (Fig. 2), the number of cells present at the end of the exponential period at a xylose concentration of 0·033 per cent is less than one-third that in the control. Cells in flasks containing 0·5 per cent and 1·5 per cent xylose lost their colour within a few days, although some initial cell division sometimes occurred in the former. However, when 0·5 per cent glucose was added on the fourth day, the cells recovered their green colour and ability to multiply within 48 hr. This suggests that the xylose may cause the death of the cells by starvation if present under photosynthetic conditions for a sufficiently long time, but causes no permanent injury to cells which survive until an alternative energy source is provided.

C. pyrenoidosa can grow in darkness on glucose, but the growth-rate is much lower than on the same medium in light. Moreover, for the strain employed in this study, the cells were larger, darker and more granular when grown in the dark. The effect of light is frequently attributed to photosynthesis supplementing chemosynthesis. Fig. 1 shows, however, that the effect of light is not photosynthetic, for the better growth in light is fully maintained in the presence of concentrations of