LETTERS TO THE EDITORS

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NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 911.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

An Inhibitor of Growth Extracted from Pea Leaves

RECENTLY, Stewart, Bergren and Redemann[1] and Stewart[2] have extracted from the leafy cotyledons of radish seedlings a substance which retards the growth of oat coleoptiles. They extracted by a method devised by van Overbeek[3] for extracting auxin, leaving the material in purified ether without grinding it up, and then drying the extract by distillation and evaporation; and they tested the extract on decapitated coleoptiles by Went's method. Since it is an interesting question how widely growth inhibitors may be distributed in plants, I have made extracts from various parts of pea seedlings by the same method. The dried extracts were dissolved in a few drops of water, slightly acidified with hydrochloric acid, and the solutions, at about *p*H 5·5, were tested by being taken up in little strips of blotting-paper, measuring 8 mm. × 2·5 mm., which were then applied to *intact* dark-grown oat coleoptiles, lengthwise along one of the narrow sides and reaching to the top. The strips stood on little ledges of vaseline placed to support them. As a rule the dried extract from each gram of fresh plant material, weighing about 11 mgm., was dissolved in one drop (50 cmm.) of water, and each drop of solution sufficed for three strips of paper and so for three coleoptiles.

The extracts made from mature pea leaves together with 3 or 4 cm. of stem to each leaf caused the coleoptiles to curve positively, that is, towards the side to which they were applied, showing that they retarded growth on that side. The curves were quite strong after 1 hour or less at about 19° C., and they usually increased up to 1½ or 2 hours and then diminished and sometimes reversed. They varied surprisingly in amount, but often reached 20° and sometimes 25° or 30°. Other tests showed that the curves could not be due to the *p*H or to the osmotic value of the solutions, so that they must have been due to an inhibiting substance or substances. The curves started close to the extreme tip and spread downwards very slowly, reaching a level 10–12 mm. below the tip, and 2–4 mm. below the base of the strip of paper, after 2–3 hours. So this inhibiting substance differs from that obtained by Stewart and others, which travelled much faster. It is not the same as the wound substance, which had no effect in the same test. Extract from stem alone caused no curves, so that the inhibitor is presumably contained in the mature leaves. Extracts from growing apical buds caused only few positive curves, or sometimes none. But they often caused negative curves which developed later and at a lower level, and may possibly have been due to auxin. Extracts from correlatively inhibited leafy lateral shoots caused positive curves, indicating inhibitor.

These results suggest the question whether this inhibitor is involved in correlative inhibition. If so, it should disappear after several days from decapitated disbudded shoots: for in such shoots a lateral bud, if allowed to remain, grows out rapidly after about 3 days, showing that inhibition has practically ceased. But actually in some experiments (though not in all) the leaves of such decapitated shoots were found still to contain abundant inhibitor after from 4 to 8 days. However, this objection is perhaps not quite conclusive.

The inhibitor when contained in the dried extract was found to be insoluble in dry ether. So it must have diffused out from the etherized plant material in the water which was present: for a little water was, of course, introduced in the plant material itself, and also the ether used in the extraction was not quite dry. Accordingly, in order to collect the whole of the inhibitor, the distilling flask was rinsed out with 2 or 3 c.c. of water after the ether had been distilled off (at 60° C.): this water was added just before the distillation.

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Nov. 4.

[1] Stewart, W., Bergren, W., and Redemann, C. E., *Science*, N.S., **89**, 185 (1939).
[2] Stewart, W., *Bot. Gaz.*, **101**, 91 (1939).
[3] Overbeek, J. van, *Proc. Nat. Acad. Sci.*, **24**, 42 (1938.)

Utilization of Carbohydrates in Leguminous Symbiosis

EXPERIMENTS carried out in this department during the past summer may be of interest in connexion with a recent letter from Allison and his collaborators[1] in which they conclude for field-grown leguminous plants that the associated nodule bacteria consume only a relatively small proportion of plant carbohydrates in their respiration. In these experiments, determinations have been made of the rate of evolution of respiratory carbon dioxide from the root systems of two series of soya bean plants growing in water culture (Crone's solution), one series (of fifteen plants) being nodulated, the other (of ten plants) being kept free of infection by the nodule organism and supplied with sodium nitrate. During the determinations, which were made at the flowering stage and at a temperature of 20°–21° C., air initially free of carbon dioxide was bubbled through the culture solution in which the root systems were growing and then passed into absorption towers containing standard baryta. For the nitrate plants the evolution of carbon dioxide was of the order of 0·8 c.c. (at N.T.P.) per hour per gm. dry weight of root tissues. Allison *et al.* report an average Q_{O_2} of 2·2 for detached root fragments, equivalent to an absorption of 2·2 c.c. of oxygen per hour per gm. dry weight. They used young roots only, whereas the figure of 0·8 c.c. is an average for the whole root system: again, it is