limitations were, in themselves, probably effective in arresting some development of parasitic plant diseases that require large amounts of rainfall. However, diseases needing the least amounts of moisture were also found to be quite uniformly absent in certain of the garden spots.

It is safe to estimate that in some situations human beings had grown crops under these difficulties for centuries. It is likely that in those days as soon as diseased plant materials were encountered in the gardens, they were removed and consumed by human beings or stock, or else dried and burned. Yellowed or spotted leaves were likewise removed and used as forage by early gardeners, as they are at present. Consequently, it seems the most severely diseased plant materials may well have been fed to animals, the manure collected and dried and used as fuel; thereby disposing of infective material. On questioning it was found the peasantry do not eat noticeably decayed vegetables. Indeed, at the present time, they eat comparatively few raw vegetables, and presumably they have not changed greatly in their dietary practices from long ago. It is reasonable to conclude that during many generations of cultivating these fields, little infective material has passed through the human digestive tract to be applied to gardens as night soil.

Manifestly what would appear to be an unintentional system of field sanitation has evolved in certain regions in Turkey. Restrictive causes have led to practices which might well be considered antagonistic to the perpetuation of many plant diseases. Of course it is appreciated that the inadvertent selection of disease-resistant strains of crops in some communities, together with the relatively dry climates encountered, may have been in themselves operative to a considerable extent in producing disease-free vegetables.

It was notable that in many places visited where human economy was unfavorable, vegetables were found growing markedly free from diseases of a bacterial nature, leaf spots of a parasitic fungus nature were lacking, stem or root-rotting diseases did not occur, and there was apparent absence of seedling trouble. While in other regions of the country where climatic conditions were similar but poverty of materials and resources was somewhat less apparent, plant diseases of all classes just noted were found in fair abundance, and in some cases they occurred with considerable severity.

It is to be regretted that numerical data could not be gathered that would give statistical evidence of the effect of unconscious field sanitation practices necessitated by meagerness of available natural resources. The securing of such figures would obviously require prolonged residence in the country so that observational evidence could be supplemented with experimental activities. Needless to state, human poverty is not suggested as a remedy for plant diseases nor as a beneficial state from any standpoint, even though gardeners of very poor economic status, living in regions of extremely scanty natural resources, may in some cases produce comparatively disease-free crops. Human poverty, unless it results in agricultural practices and economies of the character here described, can not be expected to bear any relation to plant diseases. The important point is that in certain areas visited in which there existed the most serious deficiency of human requisites, the dearth of those requisites had necessitated an agriculture that is essential to even a bare human existence and which appeared to inhibit the perpetuation of crop plant diseases.

A more detailed account of these plant disease surveys is being prepared, and will be presented at a later date.

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## IRREVERSIBILITY OF CONDUCTION IN THE REFLEX ARC[1]

CONDUCTION in the reflex arc is said to be irreversible; but, inasmuch as no nerve cell has yet been found to have but a single synapse upon it, nor has a nervous impulse ever been shown to be effective across a single synapse in either direction, there is neither logical nor empirical justification for inferring any irreciprocity of the individual synapse.

There is good evidence that a synapse is, as Keith Lucas suggested, a "region of decrement" which, in the cases so far reported, reduces the impulse to subthreshold value and thus, for transmission, requires summation. Lorente de Nó's recent measurements of the period of latent addition at the synapse have shown it to be of the same order of magnitude as the refractory phase. Hence, temporal summation at a single synapse is extremely improbable—whereas spatial summation from neighboring synapses is possible anatomically and known to occur physiologically.

Because subthreshold stimulation does not set up a propagated disturbance, spatial summation can only occur from synapses close together on the cell receiving the impulses; and, because the separation of synapses, measured along that axon whose endings they are, is great in comparison with the separation of synapses, measured along the surface of that cell body and its dendrites, to which they are applied, spatial summation will occur mainly in one direction only—and this will obtain though many synapses upon a single cell be terminations of a single axon.

[1] From the Laboratory of Neurophysiology of the Yale University School of Medicine, New Haven, Conn.

If, then, for any reason, summation is required for transneuronal conduction and temporal summation at the individual synapse does not occur while spatial summation occurs from many axonal terminations upon one cell but not in the reverse direction, transneuronal conduction can only occur in the direction in which it does occur in the reflex arc.

In brief, even though there be no irreciprocal property of the individual synapse, there may still be irreciprocity of transneuronal conduction.

Three characteristics of such conduction have in times past been commonly explained by attributing special properties to synapses. Lorente de Nó has demonstrated that the prolonged period of temporal summation in such conduction depends upon delay paths (Forbes) and reverberating chains of internuncial neurons and not on any protraction of the period of latent addition at the synapse itself. Gasser has already accounted for the inhibition in reciprocal innervation in terms of threshold changes in necessary internuncial neurons, instead of in terms of inhibitory synapses. Thus the explanation here offered for the irreversibility of conduction in the reflex arc, without the assumption of irreciprocity of the synapse itself, renders it now unnecessary to attribute to any individual synapse any property except that of a region of decrement.

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## DARWIN AND EARLY DISCOVERIES IN CONNECTION WITH PLANT HORMONES

In the November 19 issue of Science (p. 468) Professor N. Cholodny calls attention to the point that Charles Darwin first set forth the basic idea of the present hormone theory of tropisms, and that the subject is incorrectly treated in P. Boysen Jensen's "Die Wuchsstofftheorie" (G. Fisher, Jena, 1935), as well as in our English translation and revision of the book.[1]

Reference to the original text (p. 1) shows Darwin's name the first to be treated in the historical discussion of the subject, and Darwin (p. 405)[2] is quoted: "Wir müssen daher folgern, dass, wenn Sämlinge einem seitlichen Lichte frei ausgesetzt sind, ein gewisser Einfluss vom oberen Teil nach dem unteren hingeleitet wird, welcher die Ursache ist, dass sicht der letztere biegt." Similarly, on page 3 of the translation it is stated that Darwin (p. 474)[3] concluded "when seedlings are freely exposed to a lateral light, some influence is transmitted from the upper to the lower part, causing the latter to bend," and on page 4 in the pictorial treatment of the "historical outline of the early discoveries concerning plant growth hormones," Darwin's classic experiment is illustrated, together with those of other early workers. Cholodny cites Darwin as concluding that "these results seem to imply the presence of some matter in the upper part which is acted on by light, and which transmits its effects to the lower part." Boysen Jensen in 1910–11 supplied the *evidence* which enabled him to establish as a fact the opinion which Darwin expressed thirty years earlier; this evidence permitted the definite conclusion that the influence transmitted in tropic curvatures consists of a "substance or of ions."

If we erred or inadequately treated the work of Darwin or any other contributor to this field, it was entirely unintentional. We felt that Professor Boysen Jensen had, as a matter of fact, done a real service in calling attention to Darwin's work. No important mention of it has been found in English reviews published before the translation.

We had hoped that the pictorial treatment referred to above might be perfectly just to all workers, and at the same time illustrate the point so aptly brought out by Professor W. J. Robbins[4] in his reference to the history of growth substance discoveries: "This history, brief and fragmentary as it is, demonstrates that scientific knowledge accumulates slowly; that it does not spring full-formed from the mind of any one individual, but is the result of the contributions of many."

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[1] P. Boysen Jensen, "Growth Hormones in Plants." Translated and revised by Avery, Burkholder, Creighton and Scheer. McGraw-Hill. New York, 1936.

[2] C. and F. Darwin, "The Power of Movement in Plants." London, 1880.

[3] C. and F. Darwin, "The Power of Movement in Plants." D. Appleton-Century Co., New York. 1881.

[4] W. J. Robbins, *School Science and Mathematics*, 158–167, February, 1937.

## NITROGEN IN THE NUTRITION OF TERMITES

The rôle of the symbiotic protozoa found in the hind-gut of certain species of wood-eating termites has been the subject of numerous investigations and is still a debatable question. Cleveland (1925)[1] cultivated reproductive colonies of termites for more than 18 months on a diet of filter paper and concluded that the termites could live indefinitely on a diet of pure cellulose, although he was at a loss to account for the source of nitrogen required for their forty-fold increase in weight. He concluded that "they must be able in some way to fix atmospheric nitrogen which

[1] L. R. Cleveland, "The Ability of Termites to Live Perhaps Indefinitely on a Diet of Pure Cellulose," *Biol. Bul.*, 48: 289–293, 1925.