NOTES.

NOTES ON THE HISTOLOGY OF THE SIEVE-TUBES OF CERTAIN ANGIOSPERMS.—In continuation of the researches on the sieve-tubes of Gymnosperms, which were published in the Annals of Botany, vol. xv, No. lx, December, 1901, the sieve-tubes of certain Angiosperms have been examined in detail by methods similar to those previously employed.

The sieve-tubes of *Vitis vinifera*, *Wistaria chinensis*, *Cucurbita maxmia*, *Tilia europaea*, and *Viscum album* have been studied with special reference to their 'connecting threads' and means of inter-communication, and they have been found to agree in their general characteristics and essential structure with the sieve-tubes of the several species of *Pinus* already described.

In the mature sieve-tubes of these five plants, the end walls or sieve-plates are traversed by relatively large slime-strings, and each slime-string is enclosed in a callus-rod. In the radial and tangential walls slime-strings occur in groups in large or small shallow pits, and, except in the case of *Viscum album*, each of these groups, composed of some three to six fine slime-strings, is contained in a callus-rod. Such a group seen in surface view constitutes a 'sieve-field.' The structure of these lateral sieves and sieve-fields is similar to that of the sieve-plates of *Pinus sylvestris*, &c. A median dot is usually visible on each thread.

In *Viscum album* the lateral walls between two sieve-tubes are crowded with groups of fine threads in small shallow pits, but no callus-reaction is given by the cell-wall in their neighbourhood. Callus, however, does occur in the end-wall sieve-plates in connexion with the slime-strings. With the approach of winter, the callus-rods increase in size at their free ends, which unite to form callus-pads on both the end and side walls. The slime-strings perforate these callus-masses so as to unite the contents of adjacent sieve-tubes.

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With the increase in thickness of the callus-masses the slime-strings become progressively attenuated, and in the case of those sieve-tubes which function for a year only the callus finally blocks up the pores leading from one sieve-tube to another.

Connecting threads also occur in some abundance between sieve-tubes and other elements of the phloem. Between the sieve-tubes and their companion cells (as Gardiner and Hill had already observed) threads are very numerous and very short, for the cell-walls are furnished with a great number of deep pits elongated in the horizontal direction.

Sieve-tubes are placed in communication with adjacent bast-parenchyma cells by threads, which are in some cases fairly numerous and are usually short and occur in small and deep pits.

Cells comparable in the structure of their threads to the albuminous cells of *Pinus sylvestris*, &c., apparently occur in the phloem of *Vitis vinifera*.

In the cases just cited the groups of threads are covered in winter by callus-pads, which however are formed only on the sieve-tube side of the groups, and the connecting threads can usually be seen to traverse the callus-masses.

It is interesting in this connexion to notice that sieve-tubes appear to be the only elements of the bast in which callus is formed.

The development of the terminal sieve-plates is very difficult to investigate, owing to the thinness and delicacy of the pit-closing membrane, but the history of the lateral sieves can be more easily followed. The development of the sieves in the radial and tangential walls appears to be analogous to the development of the sieves in the radial walls of the sieve-tubes of species of *Pinus*, and the sieves in the radial and tangential walls of most Angiospermous sieve-tubes appear to pass through similar developmental stages to those which have been described for such Gymnosperms as *Pinus*. Groups of fine threads can be seen in the lateral walls of the youngest sieve-tubes, which by the action of ferments (as it would appear) are bored out and converted into slime-strings, the cellulose membrane in the immediate vicinity being at the same time altered into callus.

In this way the callus-rod enclosing a small group of slime-strings is produced.

All stages in the process have been seen. The precise mode of development of the end-wall sieve-plates has not yet been seen very

clearly. In the youngest stages there appear first to be small groups of threads in little secondary pits; very soon little rounded and bason-shaped masses of callus arise in the little depressions on either side of the thin membrane, and these finally unite to form a short callus-rod. In *Wistaria chinensis* and in *Vitis vinifera* three to five threads apparently of the nature of slime-strings have been seen in each callus-rod in sieve-plates of this age, but more detailed and careful examination is demanded before any conclusive statement can be made.

In the next older tube the boring out of these strings has proceeded further, and given rise to the single slime-string in each callus-rod so characteristic of the mature terminal sieve-plates of Angiosperms.

The views put forward to explain the origin of the callus in species of *Pinus* seem to apply with equal force in the present case: for the callus-rods appear to be formed by local alteration of the cell-wall, and to arise at first as cylindrical rods, which subsequently become hexagonal owing to growth and mutual pressure in the confined area of a pit.

As to the further production of callus towards the end of the season, it would appear that the protoplasm of the sieve-tube commences to form callus, which not only builds up the callus-pads on the callus-rods of the terminal and lateral sieve-plates, but also deposits callus-substance around all the groups of threads which connect the sieve-tubes with other elements of the phloem.

It has become clear during the progress of these researches that it is the slime-strings which are of primary importance to the sieve-tubes, and that the callus, though no doubt also playing an important rôle in the life-history of the sieve-tube, must be regarded as of altogether secondary importance, being for the most part subservient to the slime-strings and active or living sieve-tube contents, of which the slime-string itself is merely a continuation.

ARTHUR W. HILL.

KING'S COLLEGE, CAMBRIDGE,
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NOTE ON THE DISPERSAL OF MANGROVE SEEDLINGS.—

During the year 1901 and for three months of the present year I was engaged in marine biological work for Sir Charles Eliot, K.C.M.G., H.B.M. Consul-General at Zanzibar and Commissioner for British East Africa. During all this time I was interested in, and at first much