

have settled any time between March and September or early October of that year.

The average size of adult specimens from Chichester Harbour during the period 1945-49, 5-6 mm., agrees well with that recorded for Australian³ and New Zealand⁴ specimens, and this size in Chichester Harbour is reached apparently in about two months in the summer. The maximum size so far recorded, 9 mm., is well below the 12.5-13 mm. recorded for these areas. In July, the surface-water temperature in Chichester Harbour may reach 21° C. for a short time only, comparing favourably with the published average figure of 24° C. for January in parts of Sydney Harbour. As, however, winter temperatures drop to 6-7° C. or lower, compared with 15° C. in Sydney Harbour, and average temperatures for all seasons are lower, this may account for the failure of the species to reach the upper limit of size recorded for Australian and New Zealand specimens.

In conclusion, it appears that *E. modestus* was fairly common in the Portsmouth-Isle of Wight area in the summer of 1944 and that the species was already established in 1943, though to what extent is unknown. Growth of the species in British waters is probably limited by the lower water temperature compared with that of the original habitat.

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⁴ Moore, L. B., *Trans. Proc. Roy. Soc., N.Z.*, **73**, 329 (1944).

Extension and Radial Growth in Trees

Chowdhury and Tandan¹ report that, in certain Indian woody species, radial growth does not commence until the first period of extension growth has ceased, and they contrast this behaviour with that in European and North American species, where both extension and radial growth normally proceed simultaneously, and in which an obligate dependence of radial on extension growth is generally held² to occur in both diffuse-porous and ring-porous types. The results of recent experiments of mine, however, indicate that some modification of this generally accepted view is necessary so far as the initiation of radial growth in ring-porous European species is concerned.

As Priestley and Scott³ have shown, whereas in diffuse-porous trees the resumption of radial growth in the trunk progresses basipetally from the expanding buds comparatively slowly, so that there may be a considerable delay between the initiation of radial growth in the twigs and that in the base of the trunk, in ring-porous trees there is a rapid resumption of secondary growth throughout the trunk at an early stage of development of the buds. Indeed, the initiation of cambial activity in such trees, for example, *Fraxinus excelsior*, has been reported^{4,5} actually to precede swelling of the buds; but nevertheless Priestley² maintained that even in *Fraxinus excelsior* there is an obligate connexion between cambial activity and bursting of the buds. The crucial experiment of testing the effect of debudding on cambial activity in *Fraxinus excelsior* does not appear to have been previously carried out, although this was done for larch by Th. Hartig⁶ many years ago, and it was

found that secondary growth occurred in the trunk, even in debudded trees.

Three ten- to twelve-year old trees of ash were decapitated on April 3 at 10 ft. above the ground, and all branches and buds were removed from the trunks. (All adventitious buds which appeared later were similarly removed.) At this date there was no sign of renewal of secondary growth and there was no indication of swelling of the buds. Observations on the cambium were made at intervals of seven to ten days by removing small blocks and sectioning. Similar observations were carried out on intact trees of comparable age. By April 27 a well-developed ring of wide vessels had been formed in both decapitated and normal trees. Further secondary growth occurred in both series at an equal rate up to May 15; but by the end of May the width of the new annual ring in the decapitated specimens was falling behind that of the normal trees. Thus in *Fraxinus excelsior* the initiation of cambial activity can occur in the trunks even in the absence of buds.

In a further experiment, the buds were removed individually from three- to four-year old trees of ash on March 30; but the twigs themselves were allowed to remain. In these trees wide-vessel formation afterwards occurred throughout the plant; it was greatest at the base of the main stem, and was restricted in the twigs to a few isolated small vessels. The direction of this gradient in cambial activity not only provides strong evidence against the possibility of some 'influence' having travelled from the buds in a basipetal direction before debudding had been carried out, but also precludes the possibility that the renewal of cambial activity was a wound reaction resulting from the debudding operation. Similar results were obtained with seven-year debudded trees of *Quercus robur*. In comparable experiments with the diffuse-porous types, *Acer pseudoplatanus* and *Tilia europæa*, however, no signs of cambial activity were obtained in decapitated or debudded trees.

These results would seem to indicate a fundamental difference between ring-porous and diffuse-porous types of temperate regions with regard to the initiation of cambial activity, which is apparently dependent upon extension growth in the latter, but not in the trunks of ring-porous trees. Normal vessel development is, however, very restricted in the tips of the branches in debudded ring-porous trees and appears normally to be dependent mainly upon extension growth. In view of the demonstration that renewal of cambial activity in woody species can be stimulated by the application of auxin^{7,8}, it appears that whereas in diffuse-porous types the cambium is entirely dependent upon an exogenous supply of auxin from the extending shoot⁹, in ring-porous types another source of auxin is available in the initial stages of secondary growth.

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