FIG. 1.

FIG. 2.

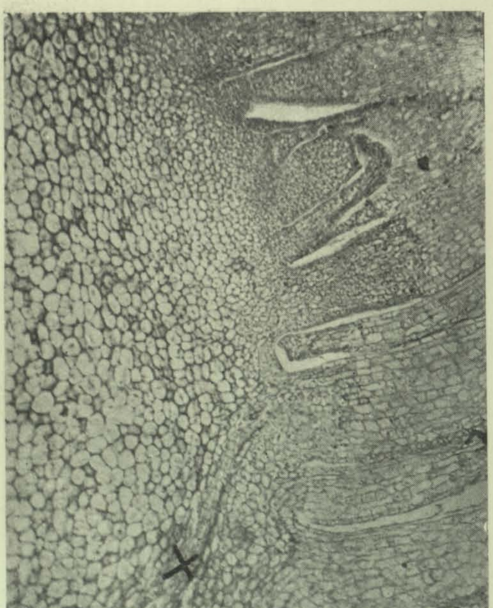

FIG. 3.

FIG. 4.

FIG. 1.—*Melicytus ramiflorus*, longitudinal section through a young stem showing a group of young buds on the side.

FIG. 2.—*Melicytus ramiflorus*, cross section through a stem similar to that in Fig. 1.

FIG. 3.—*Melicytus ramiflorus*, young bud (in June) surrounded by half-dead scale-leaves.

FIG. 4.—*Melicytus ramiflorus*, October. Three little stelar systems are seen in cross-section.

FIG. 5.

FIG. 6.

FIG. 7.

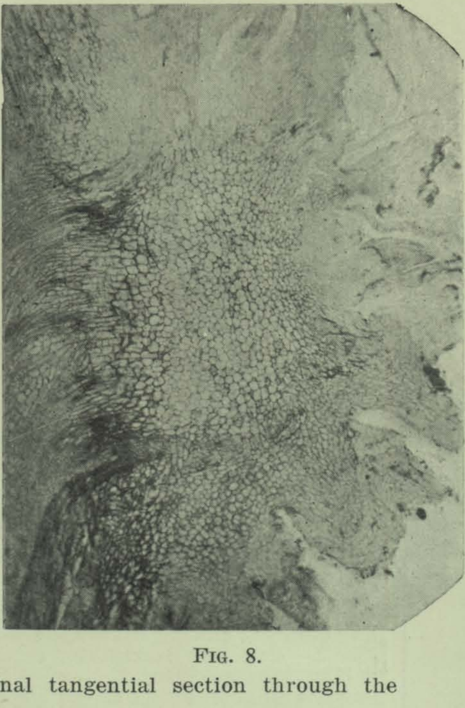

FIG. 8.

FIG. 5.—*Melicytus ramiflorus*, longitudinal tangential section through the stele of the stunted branch.

FIG. 6.—*Melicytus ramiflorus*, longitudinal section through a little branch showing its stele in longitudinal section.

FIG. 7.—*Melicytus ramiflorus*, longitudinal section through the stem showing the stele of the stunted branch.

FIG. 8.—*Melicytus ramiflorus*, young buds on old wood, separate fibro-vascular strands are seen passing in to the old stem stele.

order in their production. They appear in little groups scattered irregularly over the branches.

The most noticeable of all is *Dysoxylum spectabile* Hook. f., one of the family Meliaceae, which bears all its flowers on the trunk, far away from the leaves and younger branches. Here the flowers are formed, year after year, from the same spot on an apparently otherwise inactive trunk. The flowers are white, somewhat larger than lilies of the valley, and the ripe fruits are the size of a small walnut and very heavy, borne on a raceme about six to twelve inches long.

For work on this subject the five plants above mentioned were examined and a marked similarity in bud-production was discovered.

Taking the case of *Suttonia australis* and *Melicytus ramiflorus*, it is observed that when a leafy branch is formed no flowers are produced on that branch during the first season. By the end of the season most of the leaves have dropped off, and when growth begins in the second season little groups of flowers appear just above the scars of the fallen leaves. If this were all that happened there would be nothing so very noticeable. The little groups of flowers could very easily be accounted for as having sprung from typical meristem which had lain dormant for a season. The fact that calls for attention is that in the following season fresh groups of flowers spring from these same places which have already borne flowers.

To examine the material, sections were taken through young stems of *Melicytus ramiflorus, Suttonia australis,* and also of *Melicope ternata* Forst. before the first annual ring had begun to form, that is during the first growing season. Just above the scar of a fallen leaf a little group of buds is found, four or five to each group, each little bud subtended and overarched by little scale-leaves, one or more for each bud (Figs. 1, 2). In *Melicytus ramiflorus* and in *Melicope ternata* the whole group forms an excrescence on the stem just at that spot; in *Suttonia australis* the group is flush with the surface, and the epidemis of the stem only slightly disturbed.

These groups of flower-buds remain dormant until the following spring, when they develop and open out on the stem below the crown of new leaves; except that during the first season in *Melicope ternata* flowers are borne in the leaf-axils as well.

Sections taken later in the season after flowers have dropped off will show the original leaf-scar and also the scars made by the fallen flowerstalks. The subtending scale-leaves die, and if they were not so completely submerged, but were exposed to the wind and weather, would most likely all fall off. As it is, often only the upper half of a scale-leaf falls off and sometimes not even this. At this stage, to a casual observer, in the autumn, the stem would appear to have no life in it; only the epidermis appears a little broken and uneven. All the same, meristem groups are there, mainly seen in the axils of some of the scale-leaves which have not fallen off. These groups are very small, but when the time comes, very active. If the sections are made from material gathered in late summer or very early autumn meristem cells are also found at the bases of the scale-leaves (Fig. 13, m)—their growing regions (Fig. 3). However, these cells cease to be meristematic as the season advances. Also, at the bases of fallen flower-stalks there are often found cells having all the appearance of meristem-cells; these never have been the growing point of a flower-stalk.

Melicytus ramiflorus and *Suttonia australis* often do not set any seed, but the dead flower-stalks persist as late as July. They can easily be knocked off at a slight touch, and the microscope shows, in the axils of the scales, meristem-cells already actively dividing and forming next season's buds. There seems no reason why such a pro-

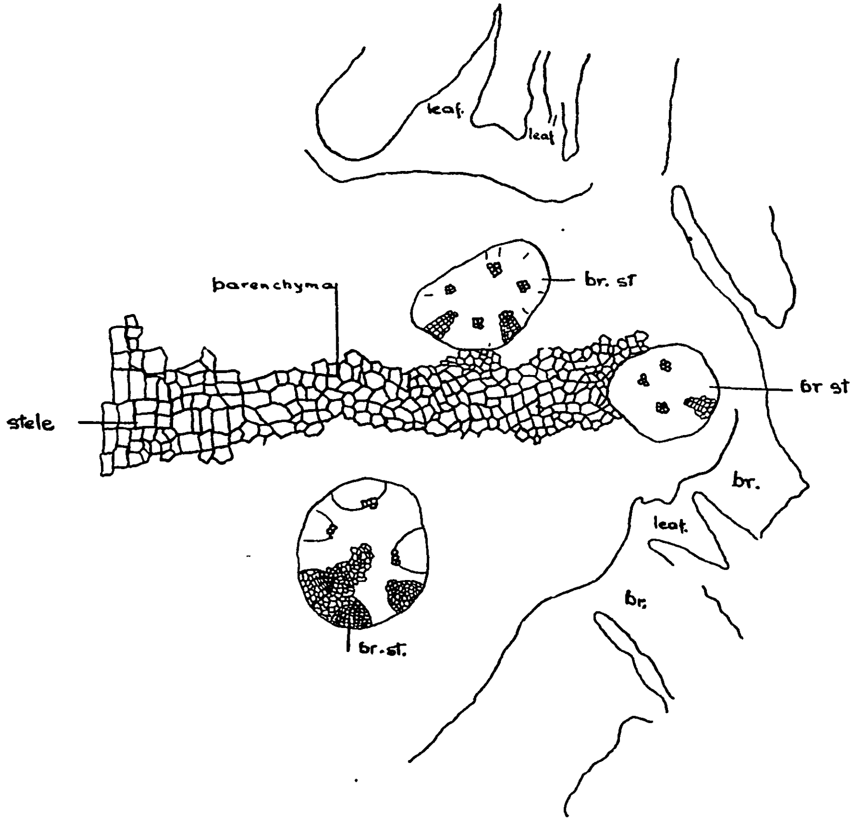

FIG. 10.—*Melicytus ramiflorus*, longitudinal section through the stem near the edge of the stunted branch, showing three steles, each belonging to a small branch.
br. st. = branch stele; l. = leaf.

cess should not be repeated year by year, and this is apparently what actually does occur. New flower-buds are formed, and in the second season they are more in number than in the first, due to the larger number of scale-leaves possessing meristem in their axils; although possibly not all the buds formed develop as flowers that same reason. Each new flower terminates a little branch and has its own scale-leaves (Fig. 2, x), each of which may be provided with meristem capable of developing the following season. The fact that cut stumps of these and other trees are known to send out new shoot points to the fact that some of these groups of meristem in the normal life of the plant fail to develop, but may be stimulated in after years by injury.

In *Melicytus ramiflorus* and *Suttonia australis* flowers usually appear on woody branches of two or three years' growth, but not on the older branches; in *Dysoxylum spectabile* it is the rule that they appear on the trunk and not on the younger branches. In *Melicope ternata* flower-branches appear in the normal position, in the axils of the leaves of young branches, and the branches which appear regularly lower down are foliage-branches, but the explanation of their origin and development is the same for all.

ANATOMY.

First season—Consider the case of *Melicytus ramiflorus.* Sections cut through any stem will show different arrangements of the tissues according to the age of the stem. If the sections are cut during the first season there will be found a set of buds (Fig. 1) or sometimes only one (Fig 9), each overarched by scale-leaves of which there may be as many as five or six to each bud. If there is one bud

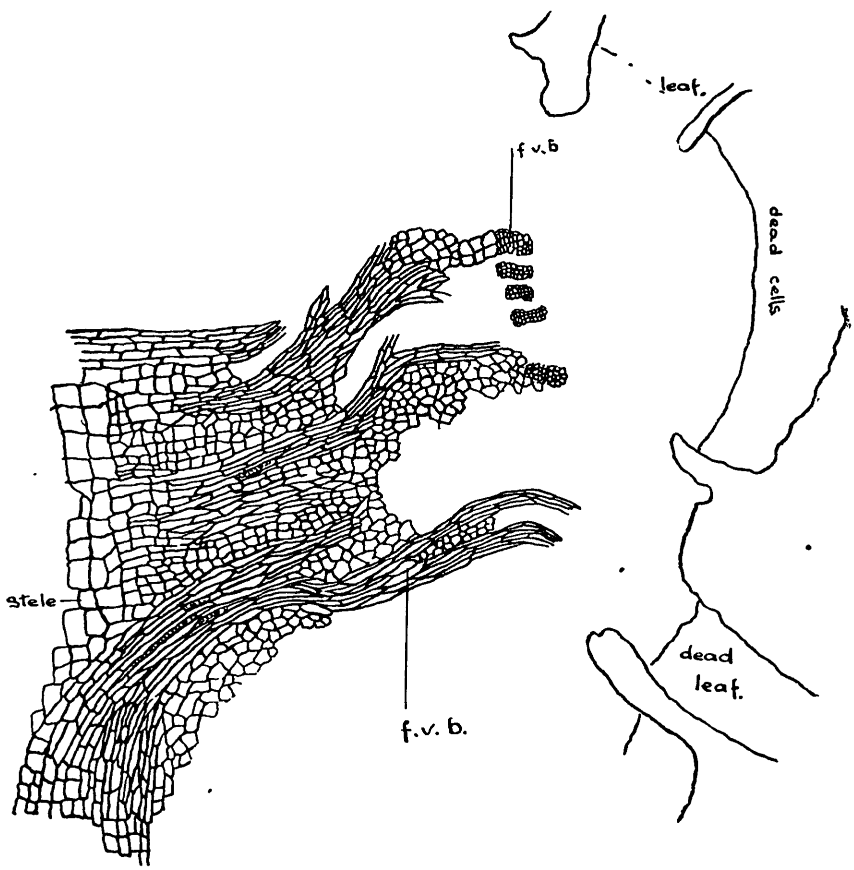

FIG. 11.—*Melicytus ramiflorus*, longitudinal section through a stem of two or three years' growth showing fibro-vascular strands (f.v.b.) from the stunted branch connecting separately with the main stele.

it forms certainly the apex of the excrescence. If there are more the two largest scale-leaves are connected by vascular tissue with the stele of the stem (Fig. 3), and in some cases this vascular tissue is very feebly developed indeed, consisting of a row of two or three weak vessels and a few other ill-defined thin-walled elongated cells. None of the other scale-leaves show any vascular tissue whatever, nor as yet do the little buds. This whole group of buds and scale-leaves is seated on a cushion of parenchymatous cells, small in size, which has evidently been formed from the meristem, so that the group is very slightly beyond the level of the epidermis. (In *Suttonia australis* this cushion is absent).

As growth continues the buds develop; each one forms a little branch, terminated in a flower, and bearing more scale-leaves. Each branch develops a vascular system containing from four to seven little bundles (Figs. 10 and 4) and the cells of the vascular system are often so weakly developed that careful staining is necessary in order to see them at all. The bundles strike obliquely across the parenchymatous cushion at its base and bend downwards to the stem-stele (Figs. 11 and 5). Longitudinal sections at this stage will also show the bundles from the two largest scale-leaves striking inwards and downwards towards the stele of the stem.

There appears to be only one strand from each leaf. The strands from the scale-leaves and some of the bundles from the little branch, that is, those that are on the same side, join one another or nearly do so at their bases just where they are inserted on the stele.

Cross-sections of stems of similar age taken about the same time, that is in June or at any time before the spring, will show the vascular system of the little branches striking immediately in to the stem-stele. If there is only one little branch the arrangement is simple. If there are several branches the little branch nearest the outside, that is the lowest, sends part of its stele to the main stele, and part to an adjacent little branch and so on all around the excrescence (Figs. 12 and 6). The little branches nearer the centre of the excrescence send their strands to one another. The scale-leaves are so small that it is difficult to detect their vascular bundles, and it is certain that many of them never possess any.

The whole group of little flower-branches with their subtending scales is to be regarded as constituting one branch, very much stunted, so much so that it rises very little above the epidermis of the stem. (In *Suttonia australis* it does not rise at all, but is flush with the surface.) It consists for the most part of small parenchymatous cells, which develop from the meristem of the buds (Figs. 9 and 8) and of the leaf bases. It is traversed near its circumference by vascular bundles from the little flower-branches, and these bundles follow a very irregular and uneven course. Each little flower-stalk has its own stele consisting of from four to seven bundles with very little medulla (Fig. 4), which unite further in to form the stele of the stunted branch; (Figs. 13 and 7) this therefore contains a large number of bundles, twenty or more, which although they lie close together, side by side, do not unite. In other words there is no interfascicular cambium. This stele forms in cross-section a wide ring with a very large pith, and the bundles insert themselves separately on the old stem stele (Figs. 8 and 11).

Second season. The little flowers drop off, and the apex of the stunted branch has disappeared. However, new growing-points arise in the axils of some of the scale-leaves. By the activity of some of these groups of meristem the stunted branch increases in size, but instead of elongating, it spreads, forming on the surface of the old stem an irregularly-shaped excrescence. It seems certain that these meristem-cells together with the meristem-cells at the bases of the scale-

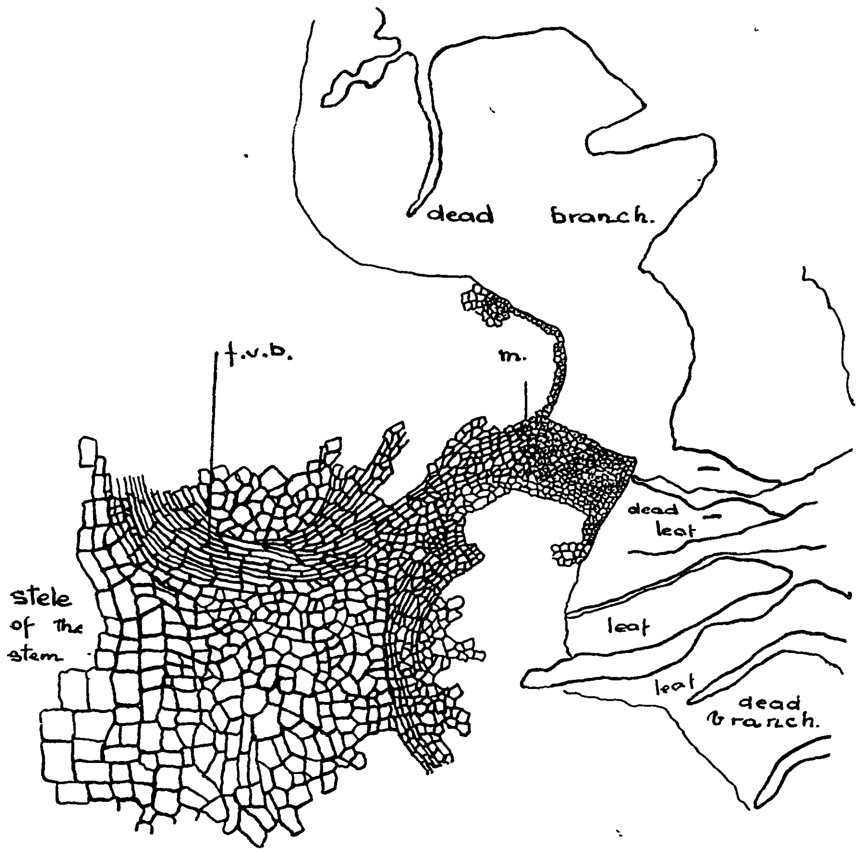

FIG. 12.—*Melicytus ramiflorus,* longitudinal section through the stem showing stele of a small branch, also in longitudinal section; one side (f.v.b.) connecting with main stele and the other side running to stele of the adjacent small branch.
l. = leaf. m. = meristem.

leaves help to increase the bulk of the parenchymatous cushion found in *Melicytus ramiflorus.* Of course the meristem of the leaf-bases is most active while the leaves are young. New flower-branches arise, each with its own set of scale-leaves, and each with it own stele. The scale-leaves seem to have no vascular tissue and the new branch-stele joins up with the stele of the stunted branch. If the stunted branch were allowed to increase in size in this way and there were no other factor to be considered it would form an excrescence gradually increasing in size on the side of the stem. In *Melicytus ramiflorus* this almost seems to take place, but in such a tree as *Dysoxylum spectabile* rapid growth in thickness and increase in diameter of the trunk takes place, and tends to keep the short lateral branch submerged.

After it has been originated, further growth of such a stunted branch may in the first place be accounted for by the weak development of vascular tissue, both of the scale-leaves and of the first little bud-rudiment or rudiments, the cells of the xylem and phloem being

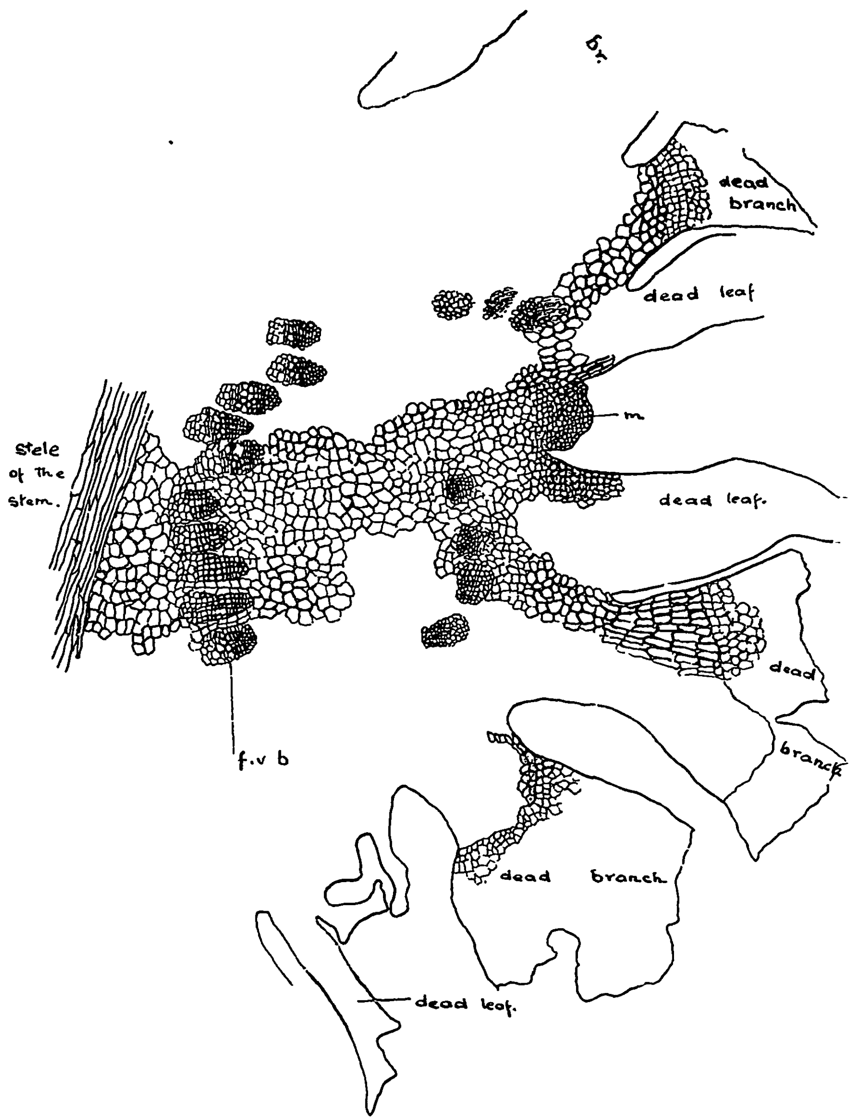

FIG. 13.—*Melicytus ramiflorus*, longitudinal section through a stem of several years' growth showing the stele of the stunted branch.

too small to carry food-material sufficient for the construction of a strong branch. Also, the absence of interfascicular cambium and the very doubtful presence of fascicular cambium prevents any growth in thickness of the stunted branch or any increase in the number of xylem and phloem cells.

The fully-developed stele of a stunted branch is very unusual in shape. It never forms a cylinder such as is found in any elongated stem, but it has instead the form of an incomplete disc, following the contour of the excrescence. Since there is no interfascicular cambium, secondary growth does not take place. The identity of the original bundles can be easily recognized; in some places they are closer together than in other places; and if, half way down the stunted branch they seem almost to be united, they are seen to widen out again lower down.

Cork forms at the bases of the scale-leaves and flower-stalks as they die or drop off, so that there is also a disc-shaped region of cork, incomplete, just outside the stele.

LEAF-GAP.

The original leaf-gap made in the stele is very wide. It is occupied during the first season by large almost square parenchymatous cells, four or five times as large as the parenchymatous cells of the cushion outside it. These cells are thin-walled, with obvious nuclei and much protoplasm. During the growth of the stem they thicken and harden but do not alter much in shape. Thus it is always easy to tell where the leaf-gap was originally formed, for the wood-cells adjacent are long narrow cells. The cortex of the main stem just outside a leaf-gap consists of large cells like all other cortical cells of the plant except the very small cells of the parenchymatous cushion of the stunted branch. These, as was stated above, have arisen from the very small meristem-cells at the several growing-points of the stunted branch, and correspond to the medulla and cortex of the stem. It is therefore very easy to tell where the cortex of the main stem ends and the parenchyma of the lateral stunted branch begins.

In a stem of three or four years' growth the cells filling the gap are not quite so square in outline. Their longer axes are at right angles to the long axes of the wood-cells, and when they are thickened equally with the wood-cells the whole mass filling the gap can be pulled out, giving at first a false idea that they may be a foundation for the whole lateral stunted branch.

For valuable help and advice in the preparation and arrangement of this paper I wish to thank Professor Kirk.