

XIX.—On *Lepidophloios Scottii* (a new species from the Calciferous Sandstone series at Pettycur, Fife). By Wm. T. Gordon, M.A., B.Sc., Carnegie Research Scholar in Geology, Edinburgh University. Communicated by Professor GEIKIE, D.C.L., LL.D., F.R.S., etc. (With Three Plates.)

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As Carnegie Research Scholar in Geology under Professor JAMES GEIKIE, D.C.L., LL.D., F.R.S., at Edinburgh University, I have entered upon a systematic examination of fossil plants from Pettycur, Fife. Though many plants have been described from this locality, nothing systematic, as far as I know, has ever before been attempted. The main objects of this research are to endeavour to connect the various strobili obtained at the locality in question with the stems on which they were borne; to describe any new species met with, and to give some account of the mode of occurrence of the material in which the plants are enclosed. Some of these objects have already been attained, but others will require further study to decide.

The material at my disposal was handed over to the University by Dr JOHN S. FLETT, H.M. Geological Survey, and has been further added to by my own collection.

The fossil to be described in the present paper occurred in a block lying loose on the shore at Pettycur. In my preliminary note I mentioned that the same fossil had been collected by Dr D. H. SCOTT, F.R.S., on 4th December 1899, and that that specimen seemed to have been on the outside of a block, and partially weathered away. In it the middle cortex—a tissue almost completely decayed in my specimens—is well preserved. From the general look also of the material from which it came, I conclude that my specimens were derived from quite a different block of the limestone. I have seen other specimens in Dr KIDSTON's collection, and Mr D. M. S. WATSON, B.Sc., tells me that there are specimens in Manchester Museum which may belong to this species; the fossil, therefore, is apparently not a rare one. Dr SCOTT's specimen does not show the complete circumference of the stem, but it must have been 25 mm. or thereby in diameter, with a central xylem cylinder of 4 mm. Unfortunately, the longitudinal sections cut from this stem are considerably out of the vertical, and do not show some very important points connected with the xylem.

The material in my own collection was all obtained from one block measuring roughly $2 \times 1 \times 1$ ft. This block split along two planes, one across and one parallel to the plane in which the stems were lying. Five stems were exposed longitudinally, and were clothed in parts with leaf-bases. Part of one of these stems and the whole of a sixth were in the third piece of the block, and from them complete tranverse sections were cut.

The whole block had a rudely bedded appearance, while the partial decay of the xylem and central cortex in one stem, and the subsequent penetration of the specimen by stigmarian rootlets (fig. 8, *a*), point to conditions of deposit similar to those present

in a swamp. In thickness the seven stems examined varied from 1 inch to $1\frac{1}{2}$ inch, and the total length represented a little over 3 feet of the plant. There can be no doubt that all the stems were of the same species, as each had similar leaf-bases. The other tissues were typical of many of the *Lepidodendreae*, and were therefore of no specific importance; in the case of one stem the stele had rotted away. It is not likely, however, that they all formed portions of one individual, the variation in diameter being too great for that. The region of greatest weakness in the fossil was along the inner margin of the periderm, and along this region the stems easily split; hence, as none of the specimens showed a surface view of the leaf-bases, their external form has been constructed from radial and transverse sections.

Owing to incomplete fossilization, or rather to too complete mineralisation of the tissue towards one end, the cortex was there replaced by a layer of coal from which all structure had disappeared, and the stem was useless for making sections. Most of the sections have therefore been prepared from the upper parts of the stems. I have examined nearly 180 sections of this fossil; of these 16 are from the Scott collection, Nos. 960 to 976 inclusive, and were prepared by Mr LOMAX; the rest are of my own making. The large number of my slides is due to the fact that they were cut to show certain structures, sometimes only obtained after several unsuccessful attempts. The new species described in this paper is founded on the slides mentioned in the Scott and my own collections.

The genus *Lepidophloios*, to which this plant belongs, has often been recorded from the Calciferous Sandstone series, but no example from the limestone blocks at Pettycur, showing structure, has yet been described. *Lepidophloios Scoticus*, however, was included in a list from this locality by Dr ROBERT KIDSTON, F.R.S., and Mr D. M. S. WATSON, B.Sc., has also referred to one from Burntisland.

As already mentioned in my preliminary note, I propose to call this new stem *Lepidophloios Scottii*, in honour of Dr D. H. SCOTT, F.R.S., who had collected the plant and described it in MS. some years ago. I am glad of this opportunity of showing my appreciation of Dr SCOTT's kindness in handing over to me all his material. This paper was at first intended to be a joint one with Dr SCOTT, but circumstances have led to its publication by myself earlier than was anticipated. Dr SCOTT has also acted as consultant in all matters of doubt in regard both to the present paper and to my research in general. I also desire to express my thanks to Professor JAMES GEIKIE, LL.D., D.C.L., F.R.S.; Professor I. BAYLEY BALFOUR, F.R.S.; Dr ROBERT KIDSTON, F.R.S.; and Dr HORNE, H.M. Geological Survey, for encouragement and advice in my work; to Mr ROBERT CAMPBELL, M.A., B.Sc., for aid in various matters connected with my research; and to Mr A. G. STENHOUSE, F.G.S., for assistance with the illustrative photomicrographs.

GENERAL STRUCTURE.

The plant of which the fragments formed parts must have been fairly tall, for, in these stems, there is no change in the various tissues throughout their length. There are slight differences between the individual pieces, chiefly as regards the amount of periderm developed.

No single section shows all the tissues in organic continuity, while some tissues, notably the phloem, are hardly to be distinguished in any section. Taken conjointly, figs. 1 and 8 give a fairly good idea of the transverse appearance, all the parts, from central xylem to the leaf-bases, being organically connected. The xylem at first sight appears solid, but careful examination reveals the presence of short, thin-walled cells distributed near the centre of the xylem, either in groups or occupying the whole of the centre (see *p*, figs. 2, 2A, and 4 respectively). Scattered through this parenchyma as detached strings of cells, or more often between the short-celled parenchyma and the long tracheides of the primary wood, are short, reticulately thickened tracheides with flat ends. In fig. 2, *t'*, the ends are shown, and in fig. 5, *t'*, these cells are cut longitudinally. These tracheides vary greatly in length, being sometimes broader than long, and occasionally they attain a length of from three to four times their width. In *Lepidophloios Scottii* the pith shows a transitionary condition between those lycopods with solid xylem and those with a true medulla. The scattered tracheides in the pith have departed less in their character from those of the primary wood than is the case in *Lepidodendron vasculare* (BINNEY, sp.).

The primary wood is composed of scalariformly thickened, centripetally developed tracheides (fig. 5, *t*). No secondary wood has been observed in any of the specimens, but other secondary tissue has been developed in successive zones, so that the stems are not of only one season's growth. The protoxylem is peripheral, occurring as blunt points round the woody axis. The leaf-traces have a mesarch xylem and rise abruptly at first, but, after crossing the middle cortex, they bend out horizontally into the leaf-bases (fig. 4, *l.t.*).

Owing to imperfect preservation, the phloem is distinguished with some difficulty, but a zone of partially disintegrated tissue surrounding the xylem probably represents it (fig. 1, *ph.*). Outside the phloem zone is a layer of cells tangentially elongated, probably marking the outside limit of the inner cortex. The middle cortex is well preserved only in Dr SCOTT's specimen (fig. 1, *m.c.*), and in one of my stems near the end, and consists of thin-walled parenchyma. There is no trace of secondary tissue in this zone. The outer cortex is separated from this middle belt by a layer of tangentially elongated cells, two or three rows deep, with thin walls, which passes gradually into the thicker-walled outer cortex. The outer cortex consists of three zones, the inner being parenchymatous, the middle prosenchymatous, and the outer parenchymatous. The elements of these zones are more or less radially arranged, but the outer zone passes into a more irregular parenchyma on which the leaf-bases abut.

While there is no distinct abscission layer in the leaf-base, it breaks away at this parenchyma, which is therefore not present in stems denuded of their leaf-bases.

HISTOLOGY.

In describing the various tissues from the centre outwards, the pith naturally comes first. The stems examined are all of approximately the same diameter, and yet the pith varies greatly in amount. One stem, with primary xylem of 3.3 mm. diameter, has only a few pith cells in patches (fig. 2, *p*); another, with xylem 4.3 mm. diameter, has a pith 2.5 mm. diameter; while yet another, with xylem 3.4 mm. diameter, has a pith 1.6 mm. diameter. But even in the same specimen the pith varies greatly; the example referred to above as showing only a few pith cells in one part (fig. 2), had, in another part (about 10 cm. further down), a pith of 2 mm. diameter, and 5 cm. further up from where the section (fig. 2) was cut, the pith was 1.4 mm. diameter. In certain sections from other individuals there does not seem to be any pith at all. The pith, then, is very variable both in extent and in occurrence; its elements are slightly elongated vertically, and are arranged in vertical rows, the ends of each element being flattened horizontally. Secondary oblique walls also occur in places. The walls of these elements are thin and soft, and do not show any secondary thickening. In fig. 2*a*, *p*—the cell with no secondary thickening, but being bounded by what is the central lamella in the tracheides—is a pith cell.

Scattered through this soft parenchyma are rows of short tracheides; they occur in greater abundance towards the periphery, but are of no greater diameter than the other parenchyma cells of that tissue. These tracheides seem to form an irregular layer between the primary wood and the soft pith. They are thickened in an irregularly scalariform manner, but in some the thickenings have a tendency to assume a reticulate arrangement, whose structure is very similar to those figured by BRONGNIART in the description of the *Sigillaria* which he in error referred to *S. elegans*.

Occasionally also long tracheides occur isolated in the pith, and are easily distinguished from the others by their length and the scalariform thickenings on their walls. The isolated and the short tracheides are somewhat similar to those found in *Lepidodendron vasculare* (BINNEY, sp.) and in *Lepidodendron Hickii* (WATSON).

The zone of primary wood surrounding the pith is seldom broken even when branches are given off. In one branch, however, a row of short tracheides passes out with the xylem, thus indicating a break in the wood ring, while in another case of branching, the soft pith has actually grown out of the gap thus formed in the xylem zone (fig. 6, *p*). Both these examples are in cases of unequal dichotomy. The pith cells average in dimensions $.18 \times .09 \times .09$ mm.

From the measurements given of the diameter of the xylem cylinder and that of the pith, it will be seen that the primary wood is in places comparatively small in amount. In a specimen 35 mm. diameter the xylem and pith are together 4.3 mm.,

and of that the xylem forms an outer ring 9 mm. thick (about 7 or 8 tracheides). Another stem with a small pith has a wood ring 13 to 14 tracheides thick and a total xylem cylinder of 3.3 mm. diameter. Generally speaking, the innermost tracheides are larger than those round the periphery, but this is not invariable, as small tracheides fill in the spaces between the larger ones, even in the innermost elements of the wood. The largest tracheides had a mean diameter of .16 mm.; the smaller ones of .07 mm. In length these tracheides vary greatly, as is shown in cases where pointed ends can be clearly seen—indicating proximity at least to the actual terminations. One of these tracheides was 5.5 mm. in length, while another was nearly 8 mm. The middle lamella can be distinctly seen in these elements both in transverse and in longitudinal sections (fig. 2, *l*, and fig. 2*a*, *l*).

The peripheral layers consist of smaller and more uniform tracheides forming a continuous ring round the whole cylinder. The contour of the wood is fairly smooth, as the protoxylem points are rounded and flat. These protoxylem teeth consist of from 9 to 10 tracheides, and the spaces between are each occupied by a leaf-trace bundle. The elements of the protoxylem are about .02 mm. diameter, and are scalariformly thickened. In no section examined can any trace of a truly spiral protoxylem element be seen. In certain sections the branching of the xylem cylinder is well shown and will be referred to later.

External to the primary wood there is in most sections a thick band of almost completely decomposed tissue, but in one specimen this tissue is fairly well preserved. A longitudinal section shows three rows of slightly elongated parenchyma abutting on the wood, and this is probably the xylem sheath. Immediately outside this sheath there is a zone of large-celled tissue showing signs of rupture in itself; physiologically this tissue probably represents the phloem, and, wherever a branch is given off, a band of the same tissue occurs on the under side, and gradually surrounds the branch bundle. The leaf-traces do not give much help in describing this tissue, for in them the phloem representatives cannot be distinguished from the ordinary parenchyma round the bundle, except that their cells are filled with dark-coloured material. On the whole, the preservation of the tissue in the phloem region is not sufficiently good to allow of any detailed description.

Outside the phloem is a zone of parenchyma in which all the cells appear similar except the outermost layers, which are elongated tangentially. The preservation here is also very poor.

Succeeding this tissue is the middle cortex, completely preserved in one specimen only (fig. 1, *m.c.*); in others merely isolated patches appear, generally surrounding the outgoing leaf-trace. This tissue consists of thin-walled parenchyma with no definite arrangement of its cells. There is no evidence of meristematic condition in any of these cells, but in certain places they are filled with dark brown substance. It is not clear in the middle cortex how these patches of cells with dark contents are arranged, but in the outer cortex it can be seen that they occupy a definite position, and probably they

occupied a definite position also in the middle cortex. The whole zone of middle cortex in a stem 25 mm. diameter is a ring 2·3 mm. in thickness, and shows no trace of secondary growth. In none of the specimens examined can any secondary growth be seen in this middle cortex.

External to the middle cortex comes a belt, two to three cells broad, of tangentially elongated elements with thin walls; these are the inner cells of the outer cortex. These innermost cells are no larger than those of the middle cortex, but they gradually give place to larger cells with thicker walls. The tissue in this region and all the more external parts is in most cases well preserved. The outer cortex can be divided into three zones, of which the inner is composed of parenchymatous elements in no definite arrangement. Here again, however, patches of tissue filled with dark brown contents may be observed. They are seen here to occur in places well removed from the outgoing vascular bundles and also from the outer and inner edges of the parenchyma. It would seem, therefore, either that the cells secreted a resinous substance, or that they acted as storage tissue and that the brown substance represents the stored food. The inner zone stops just where the radial arrangement of the outer cortex begins, *i.e.* five or six cells in from the periderm. The brown patches are therefore confined to the area where there is no secondary growth. Beyond this, in young branches and in older ones which have no periderm, the leaf-bases would be found; in all the specimens examined, however, some secondary cortex existed. Sometimes very little appears, but in other cases there is a succession of periderm layers, denoting some sort of periodic rest and active growth (fig. 8, *pd.*).

The secondary cortex is formed by the rapid division of a belt of cells, near the outside of the primitive outer cortex. The resulting tissue is arranged in radial rows, and is more regularly arranged in vertical rows than the surrounding cortical parenchyma. Passing further out they become much elongated vertically, and in this species are filled with dark material. I cannot see any trace of secretory passages in this species, though they have been observed in others.

The dark belt is succeeded externally by long clear cells, which in turn give place to another dark zone like the last. In my specimens I cannot trace more than two of such zones, but their presence seems to indicate some sort of periodic rest. Outside the last dark peridermic ring, the cells are still radially arranged and vertically elongated, while some rows are at the same time tangentially elongated. The last two or three layers of this tissue become parenchymatous, and on this third cortical zone the leaf-bases abut. There is no distinct abscission layer, but, when the leaf-bases are absent, they have torn away this parenchyma, thus exposing the elongated elements of the secondary cortex on the denuded stem. The leaf-bases persisted even after the upper portion of the leaves had decayed, and on the shape of these leaf-bases specific characters are more safely founded than on other parts of the vegetative tissue.

Dr KIDSTON has shown in *Lepidophloios* that these leaf-bases pointed upwards on young twigs, and outwards and even downwards on older ones, thus indicating that these

leaf-bases continued their growth after the foliage had decayed, and that the growth was longer continued on the upper side. In all the specimens of *Lepidophloios Scottii* the leaf-bases hang downwards, and seem to have reached the limit of their growth (fig. 3).

The leaf-trace bundles, which run from the stem through the leaf-bases to the leaves, arise from the outer surface of the stele. Their xylem is derived from the protoxylem of the stele, and though their direct passage into the protoxylem cannot be traced accurately, it can be inferred. These xylem strands of the leaf-traces contain more tracheides than each individual blunt protoxylem tooth, and are situated between two adjacent protoxylems; they are probably the result of the anastomosing of parts of the protoxylem teeth between which they occur. The number of tracheides to each leaf-trace varies from 15 to 25, and the whole xylem strand is elongated tangentially with the smaller elements in the centre, *i.e.* the xylem is mesarch. The bundle has rather a steep course at first, but passes out almost horizontally through the outer cortex. By examining successive sections it is found that the xylem does not change in shape, and, even in the leaf-base, the trace retains the same form. Before passing into the periderm, however, the xylem becomes augmented by transfusion tissue, which appears to be added chiefly on the lower side of the xylem.

The phloem has mostly disappeared from the traces except in the regions of the outer cortex and the leaf-bases. In the periderm zone it is seen at its best, though even there it cannot be distinguished with certainty. It consists of slightly elongated, soft-walled tissue, but the state of preservation does not warrant further description. Passing out from the periderm, the bundle is accompanied by a parichnos strand, while round it in the leaf-base are spiral cells of the mesophyll, similar to those described in WILLIAMSON'S XIX Memoir, and representing transfusion tissue. The leaf-trace passes out of the leaf-base a little below the centre of the leaf-scar, and beyond that cannot be followed, as the foliage has all decayed in the specimens examined.

The leaf-base is of considerable size, measuring $6 \times 6 \times 3$ mm., and is composed of large-celled parenchyma. It is elongated horizontally, as the measurements indicate, and is rhomboidal in section (fig. 9). The leaf-scar is about 1.7 mm. high (figs. 10 and 14, *l.s.*), and considerably broader, though the exact width of the scar has not been fully ascertained. The leaf-base assumes its greatest width about halfway between the leaf-scar and its attachment to the stem, tapering slightly in both directions. The amount of tapering is not great, but is quite distinct. Near the leaf-scar, and especially round the vascular bundle where it emerges on the scar, the large-celled parenchyma of the leaf-base gives place to a smaller-celled and more closely packed parenchyma (figs. 10 and 14).

Within the leaf-base is the ligule pit, a bottle-shaped cavity, much elongated, and lined by a layer of palisade-like cells. This pit is placed immediately above the vascular bundle of the leaf-base, and, while long cells fill in the space between the bundle and the base of the ligule pit, no tracheides were observed among them. The ligule

arises from the base of this pit. It is tongue-shaped, and consists of uniform small-celled parenchyma. It does not quite fill the pit (figs. 10 and 14, *lg.*).

The top of the ligule pit communicates with the exterior by a short, straight canal, surrounded in places, especially near its base, by the same pallisade tissue which lines the ligule pit. This canal (fig. 10, *lg. c.*) opens far back from the leaf-scar into the space between the leaf-base and the next overlying one. In this way the opening is protected from injury and is not exposed on the outside of the plant. In all the other examples of *Lepidophloios* I have seen this canal opens near the leaf-scar and on the exposed portion of the leaf-base. The canal is oval in section, being broader than high, and the opening at the top is triangular, with the base of the triangle towards the axis of the stem.

As mentioned before, a strand of parichnos underlies the leaf-trace for the greater part of its length in the outer cortex and leaf-base. This strand is of very loosely packed, thin-walled cells; it divides into two in the leaf-base, and, rising to the level of the bundle, these two branches pass out at the leaf-scar, one on each side of the bundle. As the tissue of the parichnos is well preserved, I have been able to follow its course by both longitudinal and transverse sections. In the inner part of the periderm *no parichnos can be distinguished*, nor in any case has it been seen further in than the periderm. Fig. 11 shows the bundle *v.b.*, and on the *upper* side there is parenchyma. This section is cut near a branch, so that the traces can be seen both in the periderm and in the inner part of the outer cortex. Those in the periderm have the parichnos on the opposite side of the trace from that of fig. 11. The parenchyma above this trace belongs to the middle cortex. Passing into the periderm the parenchyma above the bundle gets less, but, a little way in, a distinct elongated portion below the bundle becomes visible (fig. 12, 2 *par.*), and this I take to be the true parichnos. As the exterior is approached this tissue increases in amount, until, just outside the periderm, it occupies the lower two-thirds of the leaf-trace (fig. 12, 1 *par.* and 3 *par.*; fig. 13, *par.*). The parichnos then communicates with the inside of the stem through the parenchymatous bundle sheath and not directly.

On entering the leaf-base the parichnos is still long and narrow, but quickly shortens and broadens into the typical kidney-shaped strand. Fig. 12 shows three leaf-traces; of these, two (Nos. 1 and 3) are near the outside of the periderm and just going to pass into the leaf-base, the third (No. 2) is further into the stem; the increase in the parichnos is well seen in these three traces.

In the leaf-base this strand can be traced quite a long distance before it forks (fig. 14, *par.*); the forking takes place just beyond a plane drawn through the opening of the ligule canal and parallel to the main axis. Sections which show any portion of either ligule or ligule canal invariably also show a single parichnos strand. Such a long stretch of unbranched parichnos is unusual. Fig. 9 shows a leaf-base beyond the region where the single strand is got, so the parichnos is represented by two masses of tissue, one on each side of the leaf-trace (fig. 9, *par.*, *par.*).

This tissue does not seem to have had any communication with the exterior other than on the leaf-scar. The examination of a large number of leaf-bases cut in all directions has failed to show any such connection either directly or by pits, as in the *Lepidodendrons*; indeed, the parichnos is much the same distance from the exterior at all parts of its course in the leaf-base, until it emerges on the leaf-scar.

Fig. 14 shows a radial section of a leaf-base, with parichnos strand (*par.*), leaf-scar (*l.s.*), ligule pit and ligule (*lg*). The section just misses the ligule canal, which was probably slightly bent to one side in this case, as all other radial sections show the canal as well. The point where the leaf-base ceases to be keeled and becomes round is well shown in this figure, as also in fig. 10, *c.d.*, while in fig. 7 the difference in transverse section is well marked. Fig. 7 is part of a section cut sloping outwards, so that the difference might be seen; in the lower part of the figure the leaf-bases are keeled; in the upper part they are rounded. As the lower part is nearer the stem than the upper, the leaf-bases are keeled near the stem and rounded near the leaf-scar.

The leaf-scar is slightly hollow, due probably to contraction of the tissue after the foliage had rotted away, and the leaf-trace shows as a low papilla in this hollow, about one-third of the height of the scar from the bottom.

The branching in all the cases examined was of unequal dichotomy, but apparently of two types. In most cases the wood ring is not broken, only the outer elements passing off to form the branch; but in fig. 6 the ring is ruptured, and the pith cells are seen growing out through the gap. This last type is also seen in transverse section in specimens in my own and in Dr KIDSTON's collections. The branches, however, are all alike devoid of a pith, and are representative of the "halonial" type of branch.*

In my specimens the branches project very slightly beyond the covering of leaf-bases, where they are broken over, and they seem to have been quincuncially arranged. In one series of longitudinal sections 1 inch long, there are four of these branches, so that they are set somewhat closely together; they are not in vertical rows. In all cases they are sharply broken off outside the leaf-bases, and they taper quickly to this truncation. The leaf-bases do not form rosettes round these tubercles, as is characteristic of *Lepidophloios Scoticus* (KIDSTON).

This new species has points in common with other species. The occurrence, for example, of short tracheides in and round the pith suggests comparison with *Lepidodendron vasculare* (BINNEY, sp.) and *L. Hickii* (WATSON), but the leaf-bases in these species at once differentiate them from *Lepidophloios*. The only species with which more careful comparison is necessary is *Lepidophloios Scoticus* (KIDSTON), and *Lepidodendron Pettycureense* (KIDSTON). The latter was described from the woody axis only, and the complete absence of any pith in that species is sufficient to distinguish it from *Lepidophloios Scottii*. *Lepidophloios Scoticus* is very common through the whole Calceiferous Sandstone series in carbonised impressions, and, from the similarity of leaf-base, *L. Scottii* might easily be mistaken for *L. Scoticus*. Comparison is therefore very

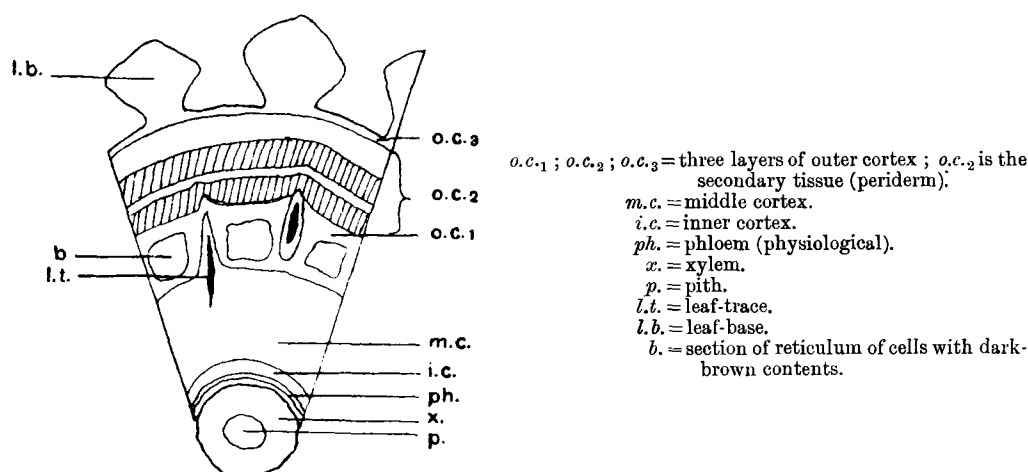
* Mr LOMAX, who prepared the sections of Dr SCOTT's specimen, referred to it as a halonia-like stem.

necessary, and I have based my comparison on the author's description. It was described from impressions, so that the specific characters depend on the leaf-bases. (Only halonial branches can be compared, as my stems are all in that condition.) In *L. Scoticus* there is a bending back of the leaf-bases round the halonial tubercules into a rosette, and the leaf-bases themselves are smooth, rounded, elongated; in *L. Scottii*, no rosettes have been observed at the base of the cone stalks, and the leaf-bases are smooth, keeled, elongated. Towards the scar the keel disappears, and from that point to the scar the leaf-base is rounded, getting flatter and flatter as the scar is approached. On the under surface of the leaf-base the ridge is more prominent than in *L. Scoticus*.

SUMMARY.

Lepidophloios Scottii occurs in the Pettycur limestone in the Calciferous Sandstone series of Fife. The species is named in honour of Dr D. H. SCOTT, F.R.S., and is founded on sections 960 to 976 in the Scott collection and about 180 sections in the Gordon collection. It is a true *Lepidophloios*, having all the characters of that genus. The stem is typical of the *Lepidodendrea*, is in this case "halonial," and is clothed with leaf-bases. The leaf-trace is collateral, the xylem mesarch, and a parichnos strand occurs beneath the bundle. The cone branches have no pith, are typically halonial, and are quincuncially arranged. The main stem has a pith with short tracheides and sometimes long tracheides scattered in it. The specific characters derived from the leaf-bases, and irrespective of those derived from the structure of the stele, are as follows:—

1. The leaf-base is keeled for three-quarters of its length, and then slopes suddenly down to the leaf-scar with an unkeeled, concave surface.
2. The ligule canal is short, straight, and has its orifice covered by the overlying leaf-bases.
3. There is a pallisade-like layer round the ligule pit.
4. The parichnos only forks a short distance below the leaf-scar.



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EXPLANATION OF PLATES.

Figs. 1-14. Photomicrographs by A. G. Stenhouse, F.G.S., and the author.

Fig. 2a. Camera Lucida drawing by the author.

Fig. 1. Transverse section of *Lepidophloios Scottii*. *x*=xylem; *ph*=phloem; *m.c.*=middle cortex; *o.c.*=outer cortex; *pd.*=periderm; *br.*=branch. Scott Collection 965. $\times 5$.

Fig. 2. Transverse section of central xylem cylinder. *p*=pith; *l*=central lamella; *t'*=end of short tracheide. Gordon Collection 176. $\times 36$.

Fig. 2a. Enlarged drawing of tracheides to show central lamella (*l*).

Fig. 3. Longitudinal section of stem. *x*=xylem; *m.c.*=middle cortex; *o.c.*=outer cortex; *pd.*=periderm. Gordon Collection 173. $\times 2$.

Fig. 4. Longitudinal section of xylem cylinder. *lt.*=leaf-trace bundle; *t*=tracheides of xylem (scalariformly thickened); *p*=pith. Gordon Collection 228. $\times 14$.

Fig. 5. Longitudinal section of xylem. *t*=tracheide (scalariformly thickened); *t'*=short tracheide (reticulately thickened). Gordon Collection 223. $\times 36$.

Fig. 6. Longitudinal section through a branch. *x*=xylem of main stele; *x'*=xylem of branch; *p*=pith cells growing out through gap. Gordon Collection 228. $\times 36$.

Fig. 7. Transverse section of leaf-bases, showing keeled and unkeeled region of leaf-bases, but sloping out from the stem. Gordon Collection 216. $\times 2$.

Fig. 8. Transverse section of stem with leaf-bases attached. *a*=stigmarian rootlet; *o.c.*=outer cortex; *pd. 1* and *pd. 2*=layers of periderm; *l.b.*=leaf-base. Gordon Collection 152. $\times 3$.

Fig. 9. Transverse section of leaf-base. *v.b.*=vascular bundle; *par.*=parichnos. Gordon Collection 215. $\times 12$.

Fig. 10. Longitudinal radial section of leaf-base. *l.s.*=leaf-scar; *c.d.*=concave depression; *lg.c.*=ligular canal; *lg.p.*=ligular pit. Gordon Collection 223. $\times 12$.

Fig. 11. Transverse section of leaf-trace bundle in inner part of outer cortex. *m.c.*=middle cortex coming out with the bundle; *v.b.*=vascular bundle. Gordon Collection 196. $\times 36$.

Fig. 12. Transverse sections of leaf-trace bundles in the periderm. *par.*=parichnos. Gordon Collection 194. $\times 12$.

Fig. 13. Part of fig 12. *x*=xylem; *b.s.*=bundle sheath; *par.*=parichnos. $\times 48$.

Fig. 14. Longitudinal radial section of leaf-base. *l.s.*=leaf-scar; *lg.*=ligule; *par.*=parichnos; *c.d.*=concave depression. Gordon Collection 173. $\times 12$.

Mr WM. T. GORDON on *Lepidophloios Scottii*.—PLATE I.

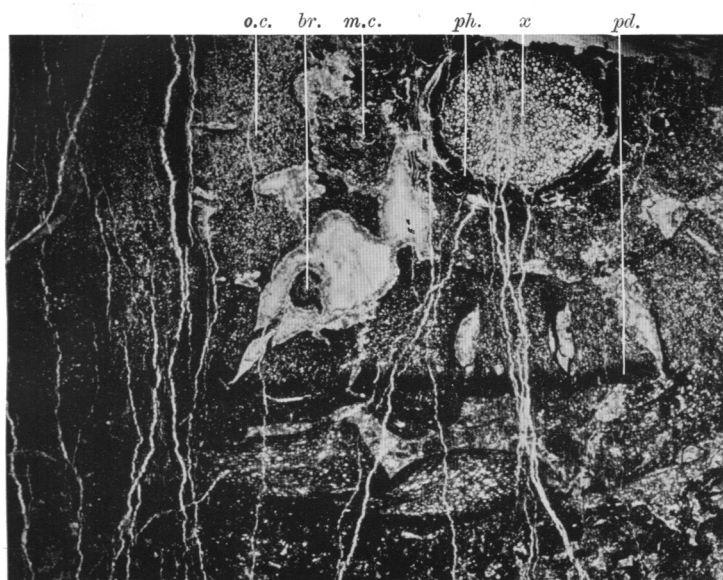


FIG. 1.

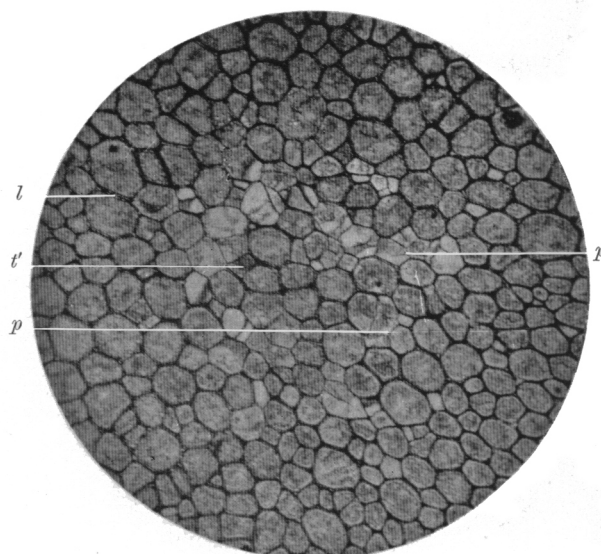


FIG. 2.

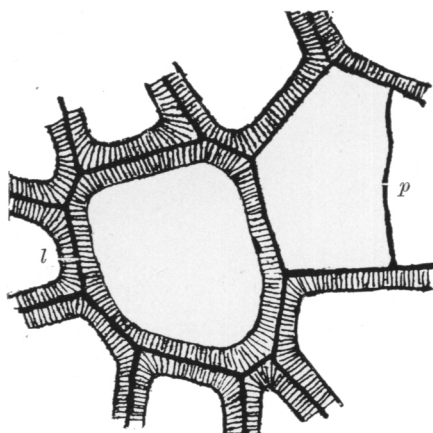


FIG. 2A.

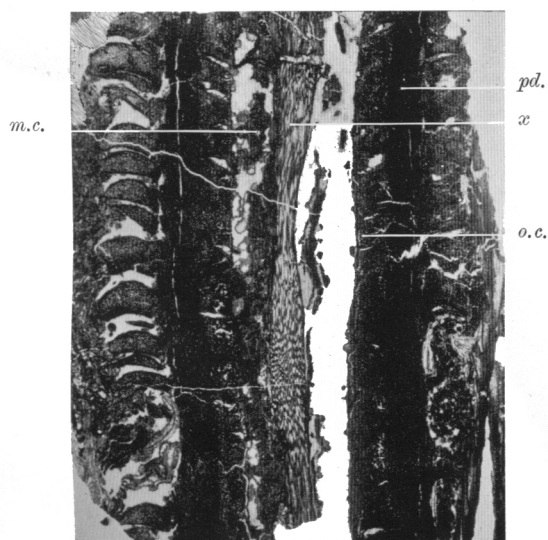


FIG. 3.

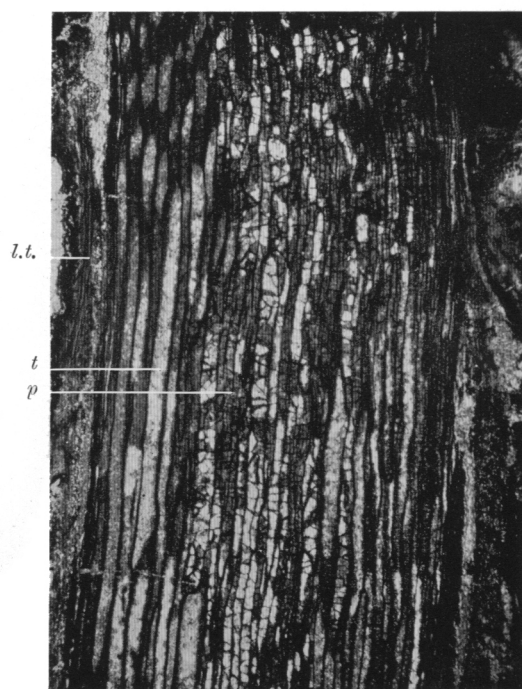


FIG. 4.

Mr WM. T. GORDON ON *Lepidophloios Scottii*.—PLATE II.

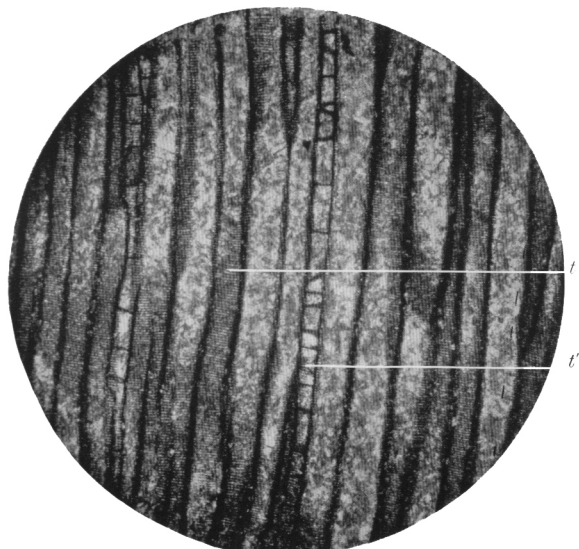


FIG. 5.

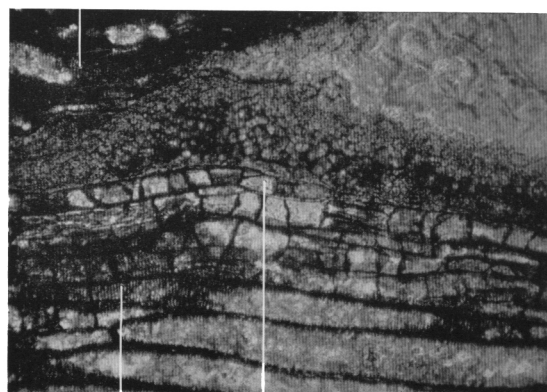
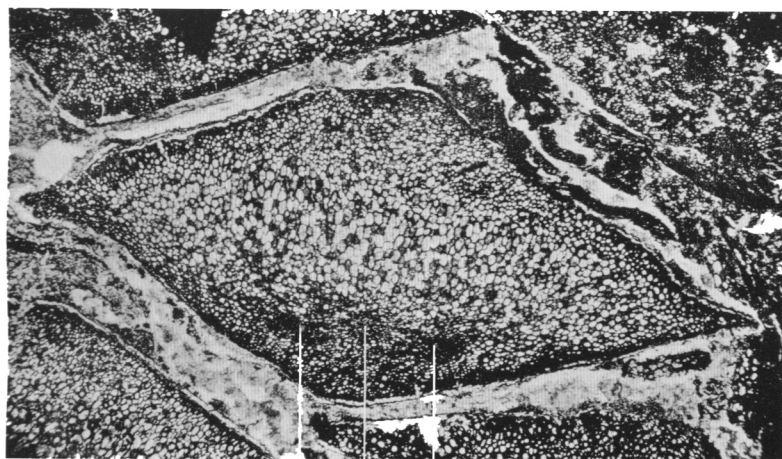


FIG. 6.



Mr WM. T. GORDON on *Lepidophloios Scottii*.—PLATE III.



par. *v.b.* *par.*
FIG. 9.

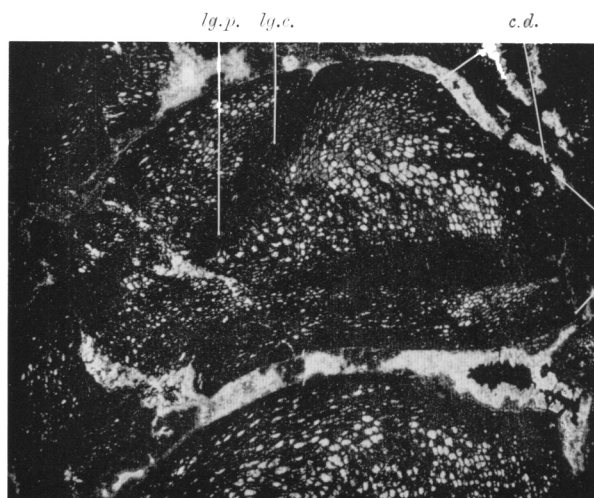


FIG. 10.

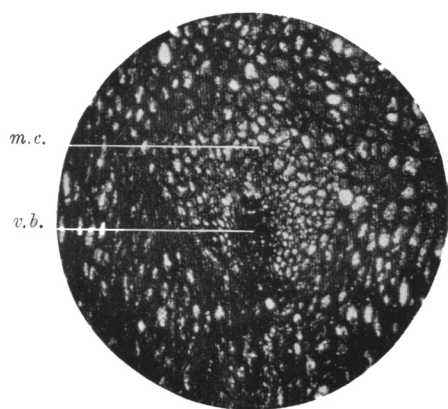


FIG. 11.

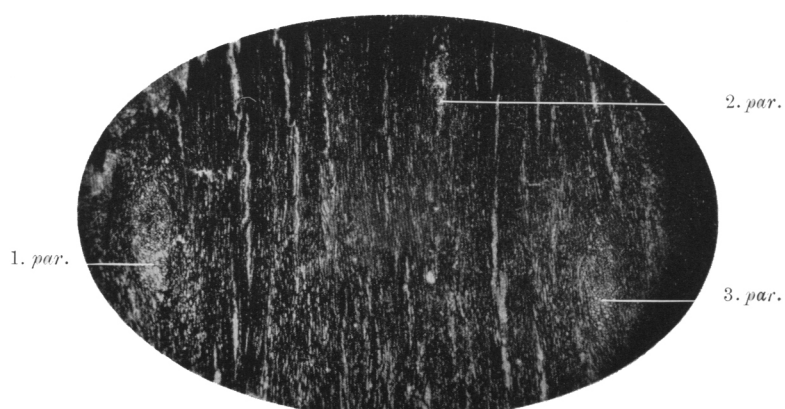


FIG. 12.

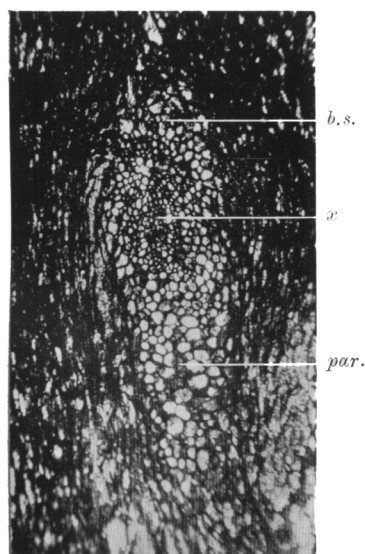


FIG. 13.

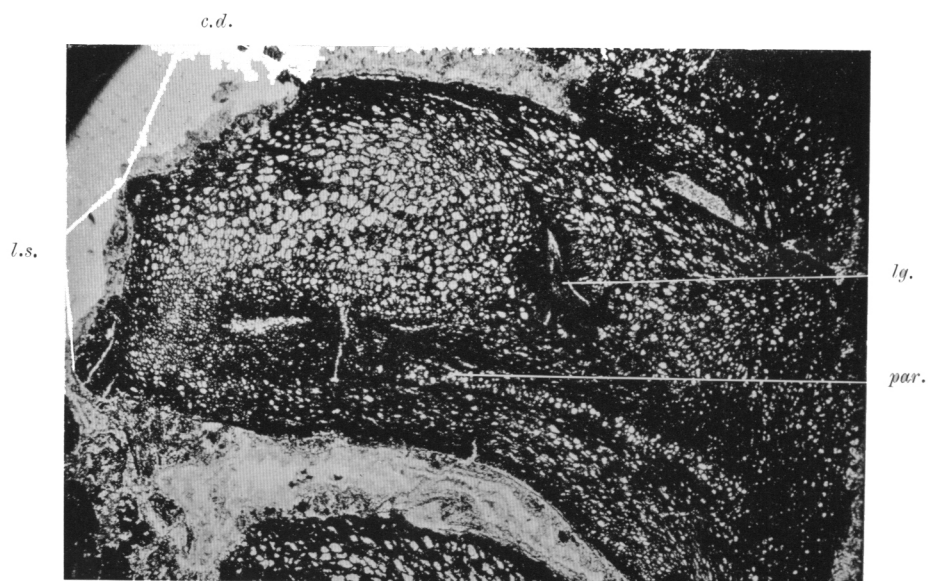


FIG. 14.