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A SPECIES OF LEPIDODENDRON FROM THE BASAL LYONS GROUP,

CARNARVON BASIN, WESTERN AUSTRALIA

by

Mary E. White and M. A. Condon

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## SUMMARY

Several impressions and petrifications from near the base of the Lyons Group in the Carnarvon Basin of Western Australia are all referred to a single species of Lepidodendron, distinct from any previously recorded from Australia and not so far referred to any extra Australian species. The age of these specimens may be Carboniferous or Permian.

## INTRODUCTION

In this paper, Mary E. White examined, described and determined the relationships of the plant fossils; M.A. Condon provided the notes on the field occurrence of the fossils.

## FIELD OCCURRENCE

Lepidodendroid plant remains were first discovered in the Carnarvon Basin by C.E. Prichard in 1949 (about 115 miles east north east of Carnarvon,  $1\frac{1}{2}$  miles north of Moogooree Homestead, Western Australia) in material then tentatively regarded as Harris Sandstone. Since then other Bureau geologists have made collections from this same locality (which is considered to be in the lowermost part of the Lyons Group) and in the lowermost Lyons Group one mile south and  $1\frac{1}{2}$  miles west of south of Williambury Homestead and 4 miles south-west of Arthur River Woolshed, and from the Harris Sandstone  $2\frac{1}{2}$  miles west of Williambury Homestead. (See Locality Map, Fig. 1).

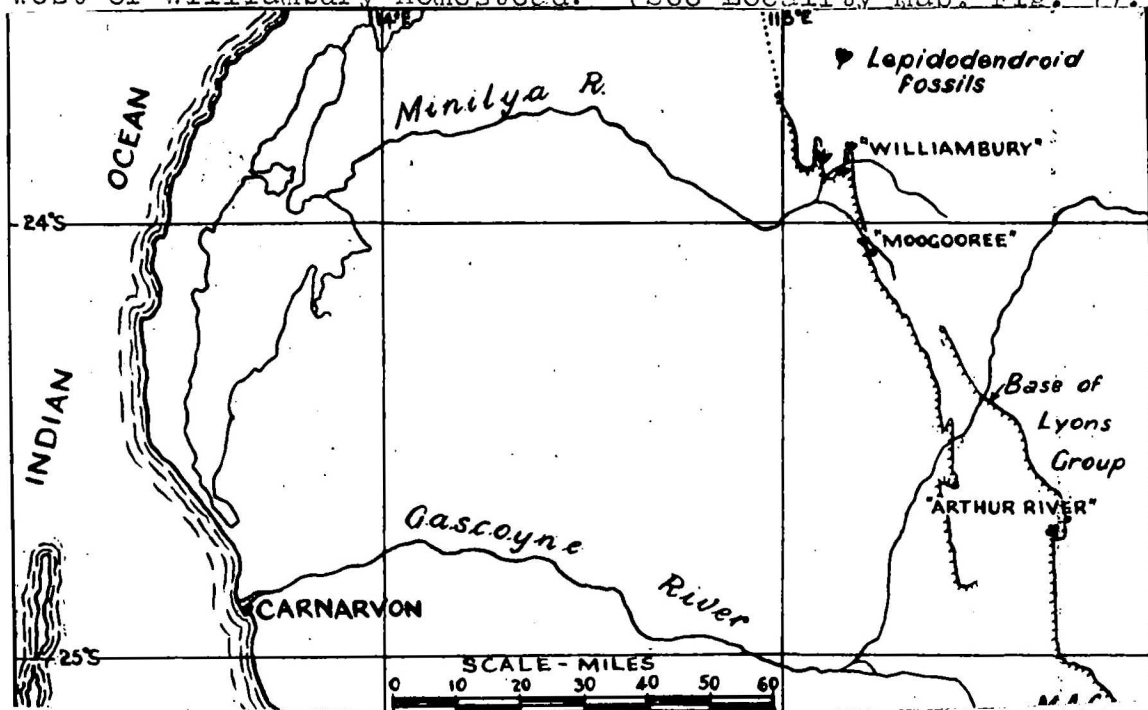


Figure 1. - Locality map showing Lepidodendron localities.

The material described here was all collected by M. A. Condon and G. A. Thomas in 1955 from the lowermost Lyons Group south of Williambury and north of Moogooree.

The sequence at the locality one mile south of Williambury Homestead, measured by M. A. Condon, is shown in Figure 2. The base of the Lyons Group is not well exposed here, although the Yindagindy Formation crops out nearby. In the type locality of the Harris Sandstone and Lyons Group,  $2\frac{1}{2}$  miles west of Williambury Homestead, the lowermost boulder bed of the

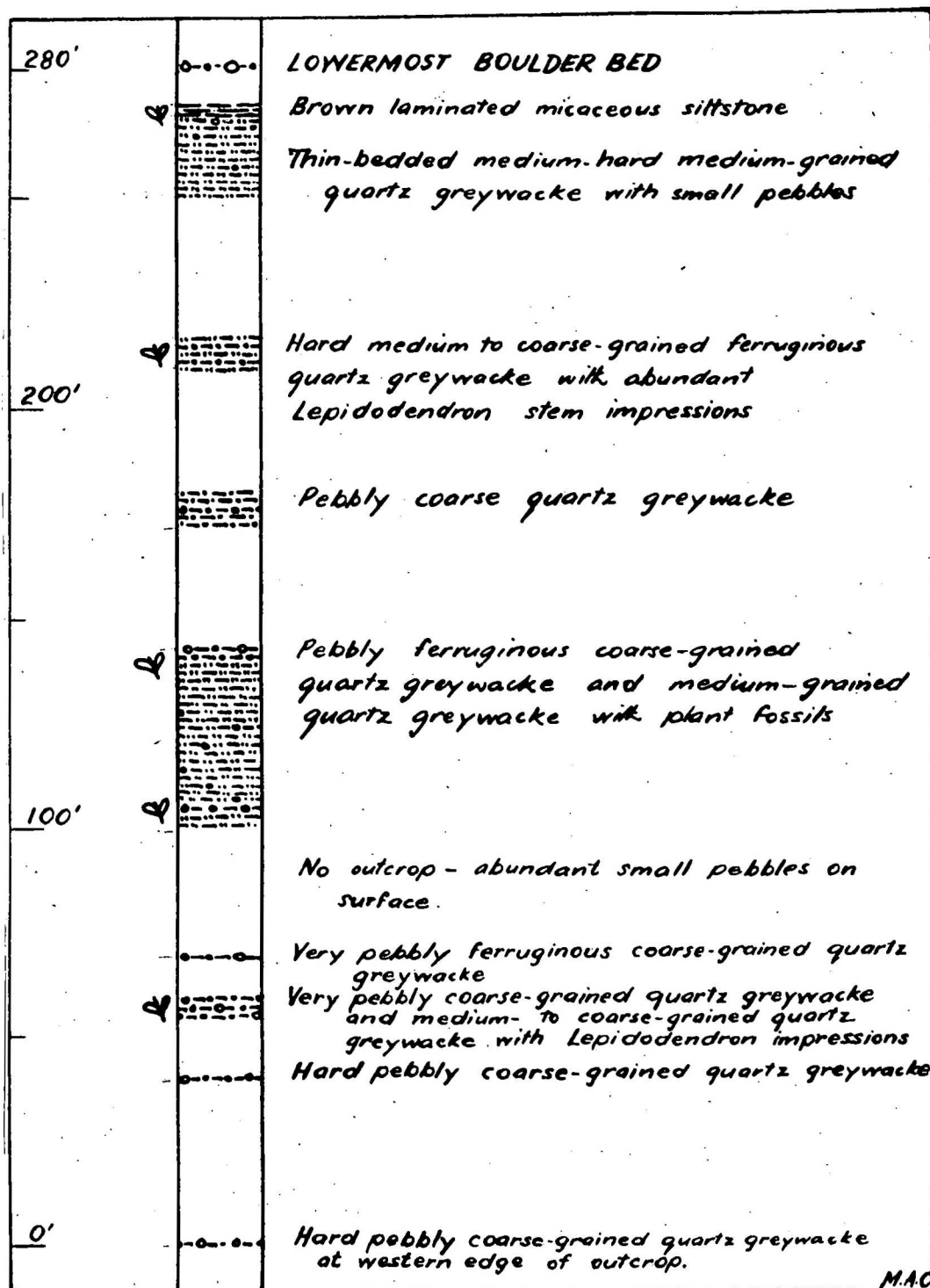


Figure 2. - Measured section showing position of *Lepidodendron* fossils relative to lowermost boulder bed of Lyons Group.

Lyons Group is 90 feet above the base of the Lyons Group, and 370 feet above the base of the Harris Sandstone; lepidodendroid fossils are present in the lowermost 36 feet of the Harris Sandstone. In the area one to two miles south of Williambury Homestead, the stratigraphic relationships are not clear because of poor exposures, but the Lyons Group sediments apparently rest on a dissected surface of unconformity cutting Lower Carboniferous Yindagindy Formation and Williambury Formation, Devonian Gneudna Formation and Nannyarra Greywacke, and Precambrian schist. The lowermost boulder bed appears to be about 500 feet above the lowest part of this unconformity, although it also abuts against a higher part of the unconformity.



M. A. Condon's interpretation of the relationships is shown in section in Figure 3.

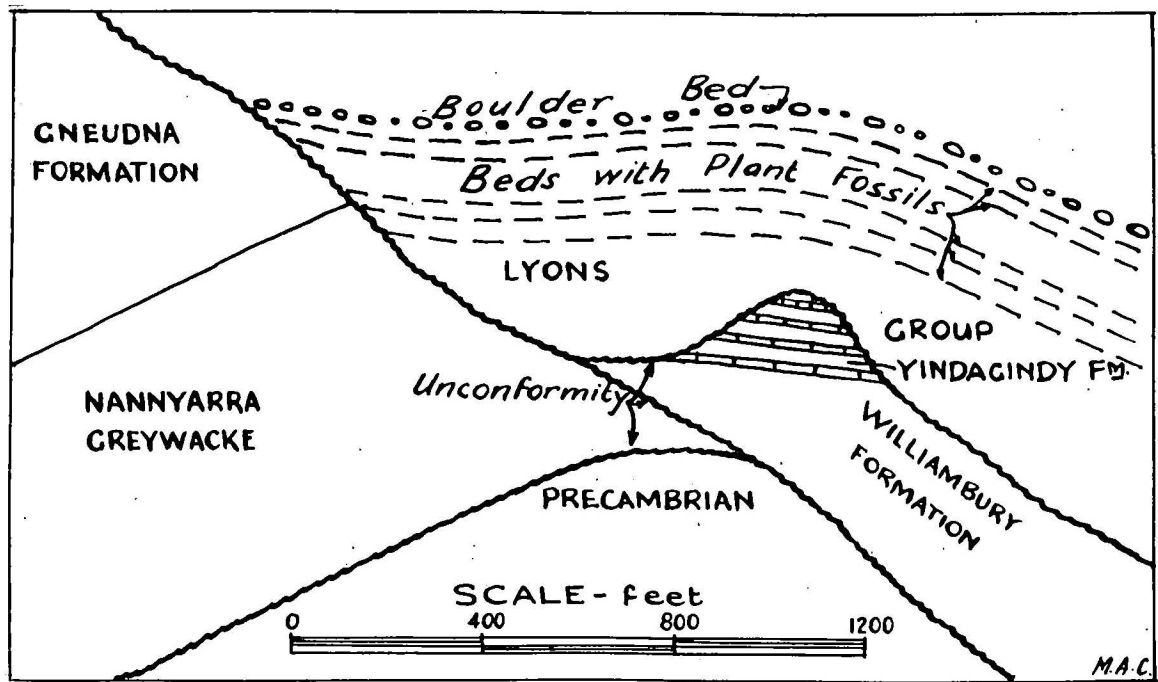


Figure 3. - Diagrammatic section of relationships 1 to 2 miles south of Williambury Homestead.

In the area  $1\frac{1}{2}$  miles north of Moogooree Homestead, the Lepidodendron material is found in the basal 35 feet of the Lyons Group unconformably overlying Carboniferous Yindagindy Formation. About 1.7 miles west of north of the plant fossil locality, the lowermost boulder bed of the Lyons Group, there containing marine fossils (bryozoa, brachiopods and pelecypods) of Permian character (G. A. Thomas, personal communication), overlies 275 feet of quartz greywacke, the base of which is not exposed. Half a mile south of Moogooree Homestead, the lowermost boulder bed is only 55 feet above the base. The unconformity at the base of the Lyons Group is known to have marked relief and the relationships in this Moogooree area are indicated in Figure 4.

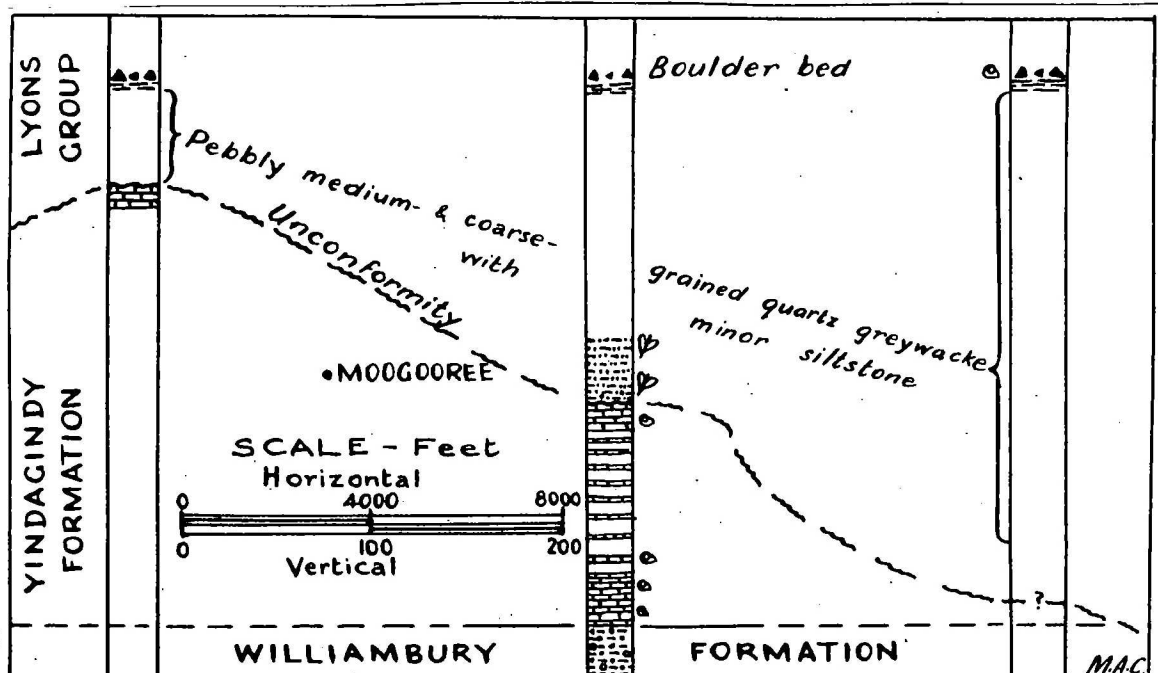


Figure 4. - Relationships at base of Lyons Group, Moogooree area.

Although the sediments containing the plant fossils are not of the strongly tillitic texture of the boulder beds of the Lyons Group, they are of the lithology (silty quartz greywacke) very common in the non-tillitic parts of the group including the lowermost part of the type section (Condon, 1954) between the top of the Harris Sandstone and the lowermost boulder bed. In the area north of Moogooree Homestead, the plant-bearing sediments, resting directly on the Yindagindy Formation, are not of the clean quartz sandstone lithology of the Harris Sandstone which is not present in that area.

Lycopod fossils, not necessarily of the same species as that here described, were found by M.A.C. in the Harris Sandstone  $2\frac{1}{2}$  miles west of Williambury Homestead (about 30 feet above the base of the formation) and near the base of the Lyons Group four miles south west of Arthur River Woolshed, where the Lyons Group rests unconformably on a strongly dissected surface of Precambrian schist. The Harris Sandstone fossils have not been examined by M.E.W.; she tentatively determines Lycopodiopsis pedroanus Carr in the poorly preserved material from Arthur River (White, 1957) suggesting a Lower Permian age.

The marine fossils of the Lyons Group, found in beds from near the base (above the plant fossils) to near the top, indicate a Sakmarian age (Thomas and Dickins, 1954). The Yindagindy Formation, now regarded as of Lower Carboniferous age (G.A. Thomas, personal communication), is unconformably below the plant bearing beds.

#### PALAEOBOTANY

An examination of the large number of specimens collected shows Lepidodendroid plant remains only. The fossils are in the form of impressions of stems of different sizes, with rare examples of petrifications of portions of stems. As is usual in Lepidodendroid fossils, the varying degrees of decortication and decay of the stems prior to fossilisation and the different methods of preservation have resulted in a wide range of forms. While nearly all the specimens can be assigned with little doubt to the genus Lepidodendron a large number show no characters of positive value in specific identification. It is possible that the forms present represent more than one species, but such specimens as show specific characters appear to be all referable to one species only.

While many of the forms of the species to which all determinate specimens are provisionally assigned resemble forms of several known species of Lepidodendron, this species from the Basal Lyons Group appears to be distinct from any described species recorded from Australia, and has not as yet been matched to any extra Australian species. With the available material, and at the present state of knowledge, it is not possible to state whether it is a new species. A revision of Lepidodendroid plants collected in Australia is needed to clarify the position.

The described species which most closely resembles that under discussion is Lepidodendron scutatum Lx. which occurs in "Meso-Carboniferous" Coal Measures in Missouri. The species is also similar to some forms which have been attributed to Lepidodendron veltheimianum Stbg. (Lower Carboniferous) but does not in any instance show the features regarded as diagnostic in European examples. There is the same general resemblance to a specimen referred to Lepidodendron pedroanum

from the Ecca series in South Africa, and to an undetermined species figured by Jack and Etheridge from the Drummond range in Queensland. Specific names such as Lepidodendron veltheimianum have too often been loosely used to include any impression of the same general type on insufficient evidence.

A diagrammatic comparison of forms of the species with similar forms of other described species is given in Figure 5.

A representative selection of specimens showing the range of forms in the species is described and illustrated below.

#### DESCRIPTION OF PLANT REMAINS

##### A. Impressions and Casts.

Figure 5 (Plate 1) shows a surface impression of an immature stem. This specimen (Registered No. F21581) is from near the base of the Lyons Group, 1.4 miles west of north of Moogooree Homestead (Lat.  $24^{\circ}03'45''$ S., Long.  $115^{\circ}12'10''$ E.). The leaf cushions decrease in size upwards on the stem from 7 mm near the base of the specimen to 4 mm at the top, over a distance of five inches. This rapid tapering suggests that the stem was a lateral rather than a main axis. The leaf cushions have a rounded top and taper steeply to a point at the bottom. Each cushion has a medium linear depression and resembles an inverted bract or scale leaf with midrib.

Specimen F21582 (Figure 6, Plate 1) is from near the base of the Lyons Group, 1.1 miles south-south-west of Williamsbury Homestead (Lat.  $23^{\circ}52\frac{1}{2}'$ S., Long.  $115^{\circ}08'20''$ E.). It shows a layered series of bark impressions with surface and near-surface ("Aspidiaria") views of leaf cushions. The mature cushions are 14 mm long and have a maximum width of 3 mm (at 2 mm from the top of each cushion). The "Aspidiaria" casts are internal casts of shells of bark which had been shed prior to embedding. The bark impressions are fragmentary and there is no indication of the size of the parent trunk.

Specimen F21583 (Figure 7, Plate 1) is from near the base of the Lyons Group 1.4 miles west of north of Moogooree Homestead (Lat.  $24^{\circ}03'45''$ S., long.  $115^{\circ}12'10''$ E.). It shows an "Aspidiaria" type cast. The leaf cushions of the trunk from which the bark came were larger and more separated than in Figure 6.

Specimen F21584 (Figure 8, Plate 2) is from near the base of the Lyons Group 1.4 miles west of north of Moogooree Homestead (Lat.  $24^{\circ}03'45''$ S., Long.  $115^{\circ}12'10''$ E.). It shows an impression of a slightly decorticated stem with leaf trace scars near the apices of the cushions.

Specimen F21585 (Figure 9, Plate 2) is from near the base of the Lyons Group 0.8 miles south of Williamsbury (Lat.  $23^{\circ}52'16''$ S., Long.  $115^{\circ}08'55''$ E.). It shows an impression of a young stem which had undergone decortication to a deep level, resulting in obliteration of the leaf cushions, and the leaf trace bundles are represented by vertical slits. This is a "Bergeria" condition.

Specimen F21586 (Figure 10, Plate 2) is from the lowermost part of the Lyons Group, about 50 feet above the base, 1.4 miles west of north of Moogooree Homestead. (Lat.  $24^{\circ}03'55''$ S., Long.  $115^{\circ}12'05''$ E.). It shows a cast of a flattened cylinder with deep level decortication at the surface. No internal structure has

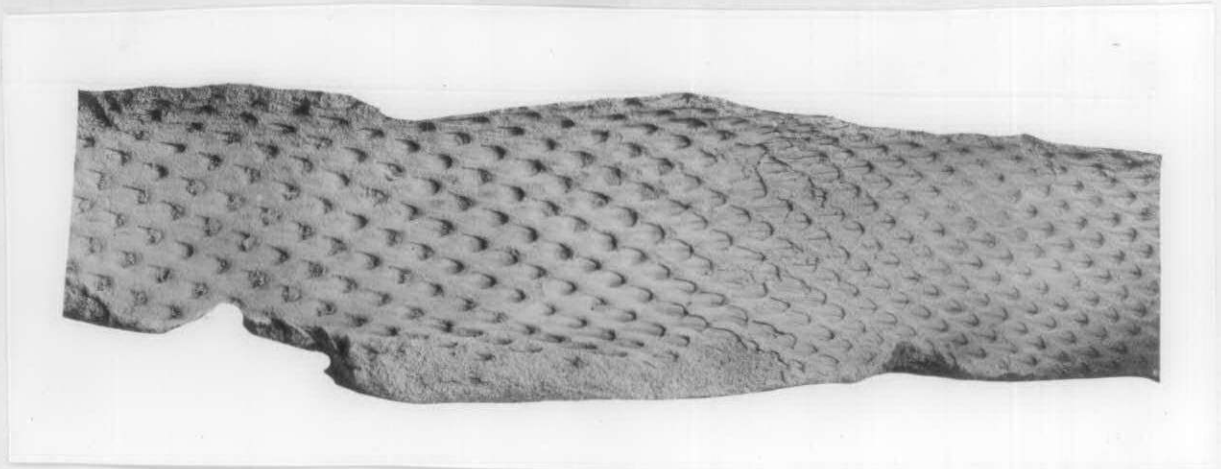
PLATE I

Figure 5: Regd. No. F21581



Figure 6: Regd. No. F21582

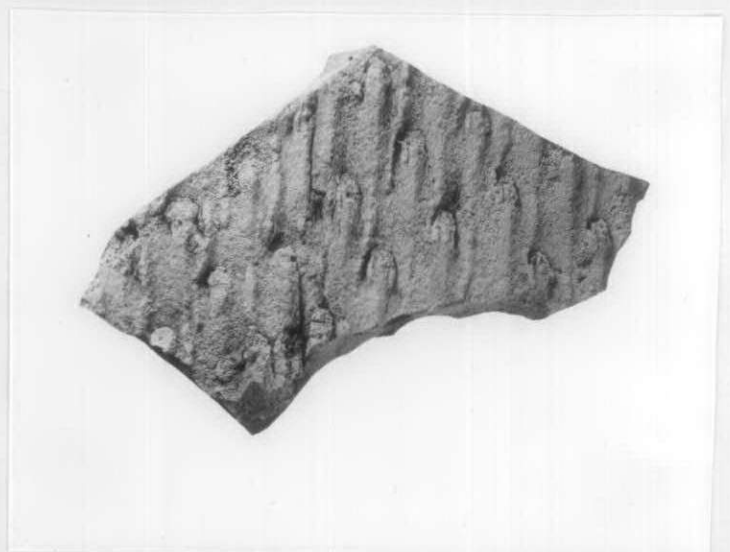


Figure 7: Regd. No. F21583

PLATE 2

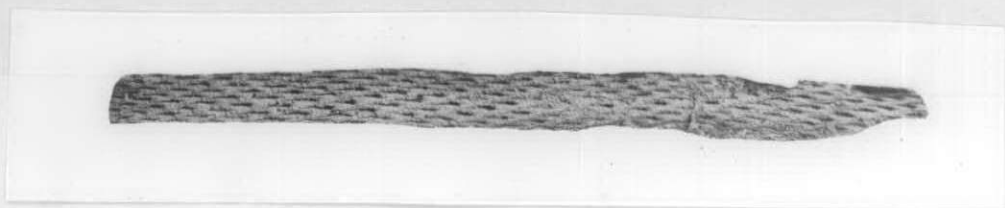


Figure 9: Regd. No. F21585



Figure 8:  
Regd. No. F21584

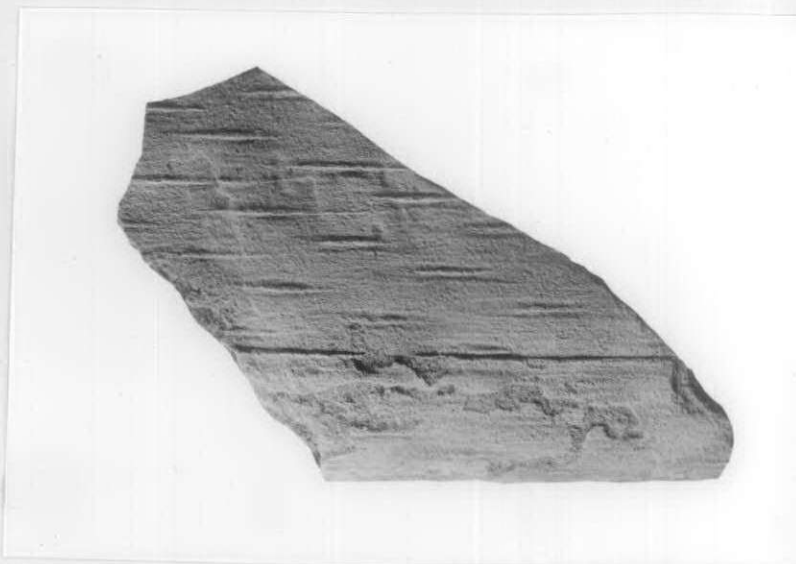


Figure 10:  
Regd. No. F21586



Figure 11:  
Regd. No. F21587



Figure 12:  
Regd. No. F21588



been preserved in this cast or in any of the others of which this is a representative example.

Specimen F21587 (Figure 11, Plate 2) is from near the base of the Lyons Group 1.4 miles west of north of Moogooree Homestead (at Lat.  $24^{\circ}03'45''$ S., Long.  $115^{\circ}12'10''$ E). It shows a cast of a branching stem in "Knorria" condition.

Specimen F21588 (Figure 12, Plate 2) is from about 50 feet above the base of the Lyons Group, 1.4 miles west of north of Moogooree Homestead (Lat.  $24^{\circ}03'55''$ S., Long.  $115^{\circ}12'05''$ E). It shows a cast of a laterally compressed young stem in "Knorria" state of decortication. No internal structure is preserved.

Other specimens (F21590 to F21601) not figured show intermediate degrees of decortication. There are also medullary casts which have vertically ribbed surfaces. These casts are consistent with medullary casts of Lepidodendroid stems but are not of diagnostic value.

#### B. Petrifactions.

##### Small stem:

Specimen F21589 is from about 50 feet above the base of the Lyons Group, 1.4 miles west of north of Moogooree Homestead (Lat.  $24^{\circ}03'55''$ S., Long.  $115^{\circ}12'05''$ E).

This somewhat compressed stem less than an inch long, with diameter varying from a half to a third of an inch, and a Knorria condition of decortication at the surface, was sectioned at four levels. A considerable degree of preservation of internal tissues was revealed. Semi-diagrammatic radial transverse sections were drawn from portions of the sections showing the least disorganisation by mineralisation and compression. Ferruginous solutions have replaced and stained many of the tissues.

Details of tissues from the leaf cushions to the inner cortex are illustrated in Figure 13. Figure 14 is a continuation of the radial section and shows the tissues from the inner cortex to the central medulla.

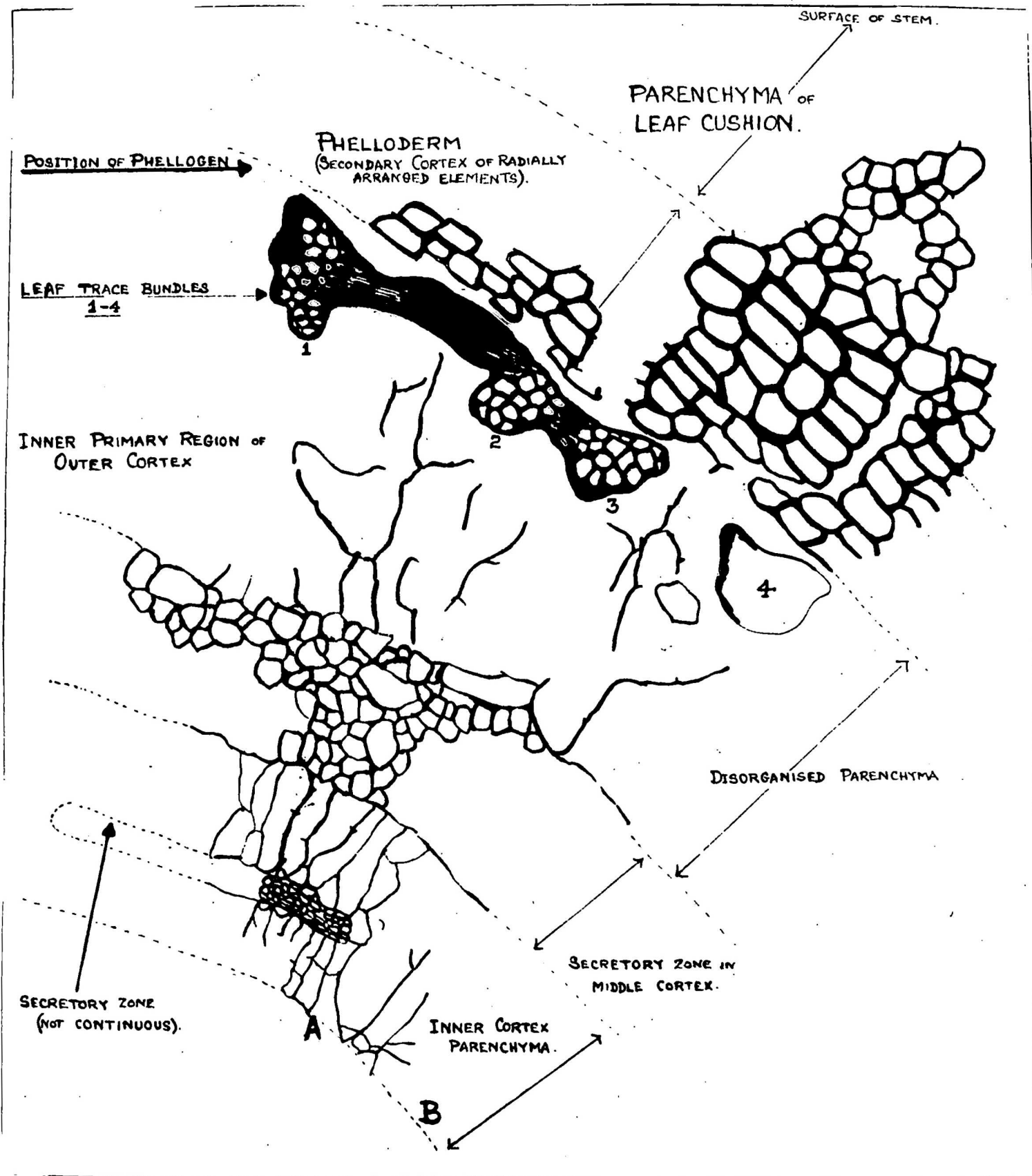


Figure 13: - Sequence of Tissues from Outside to Stele. Semi-diagrammatic radial transverse section. Camera lucida drawing. Magnification X 135.

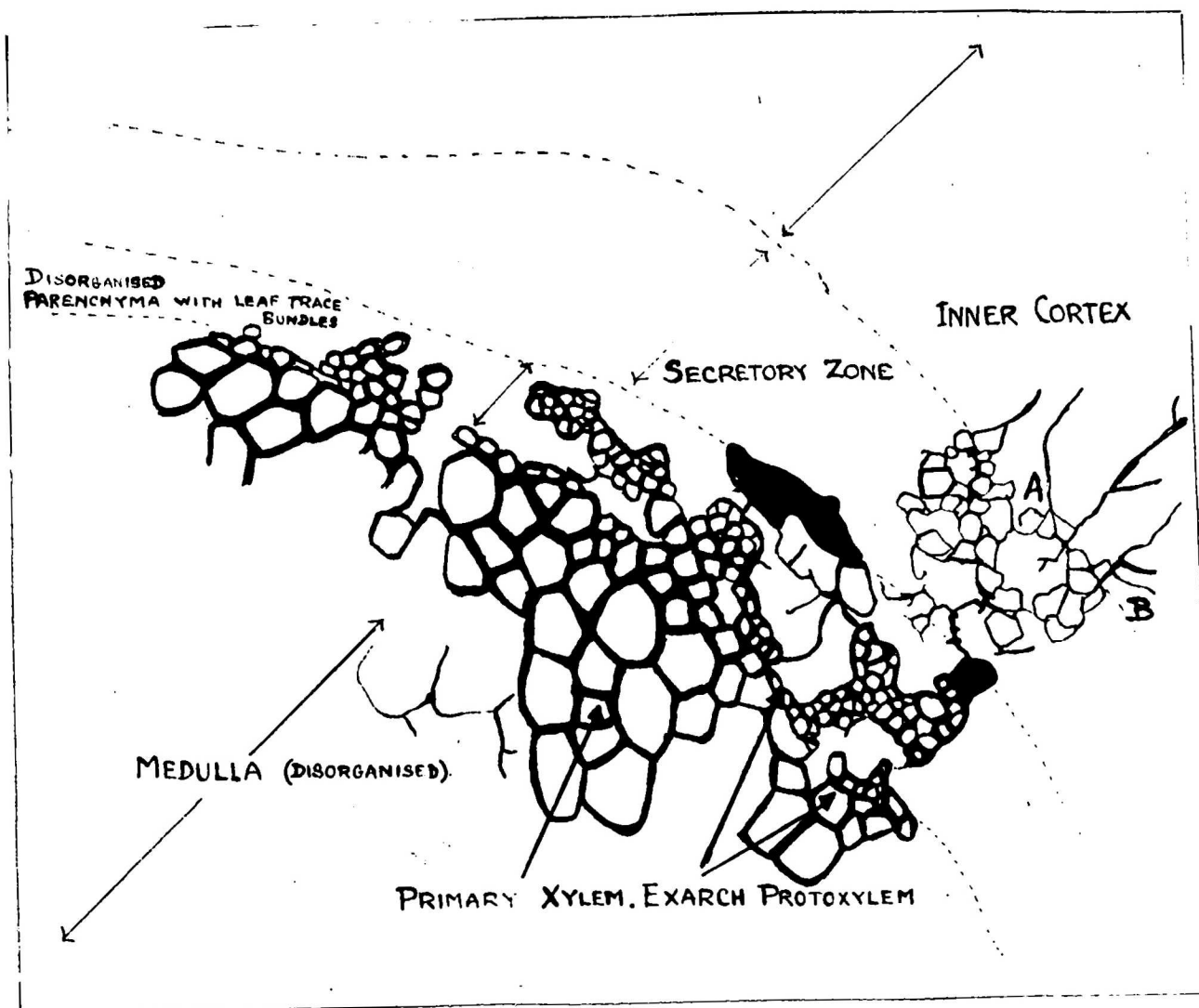


Figure 14. - Semi-diagrammatic transverse section of Stele.  
Camera lucida drawing x 135. A.B. correspond  
in Figs. 13 and 14.

Explanation of Radial Transverse Sections:

The leaf cushions are composed of unspecialised (parenchyma) cells. The cortex comprises that region of the stem external to the central conducting strand. There are three zones in the primary cortex. The inner and outer primary cortex were formed of large thin-walled cells unsuited to preservation and these regions are largely disorganised and replaced by mineral matter. The middle cortex is composed of small, irregularly shaped and sized parenchyma cells, and this zone may have a secretory nature. The vascular (conducting) cylinder in the centre has a medulla of large thin-walled cells, largely disorganised. The xylem (wood) elements comprising the conducting tissue have the smallest and first formed elements external (an exarch protoxylem arrangement). Groups of small xylem elements lie in a ring external to the protoxylem and these are the vascular strands to supply the leaf cushions. A secretory zone external to the ring of leaf traces completes the stelar regions of the stem.

The stem is young and there is no secondary xylom. There is, however, secondary cortical tissue in the form of the phelloderm. The cells of this region are radially arranged and similar to cork cells in present day plants. There are small



secretory zones tangentially arranged in the cortex, but unlike the larger secretory zone which forms the middle cortex, these are not continuous.

Fragments of petrified wood showing "annual rings" to the naked eye were sectioned and found to have bands of tissue of radially arranged elements alternating with denser zones in which the cells are less regularly arranged. The denser zones may be secretory zones such as occur in the outer tissues of old Lepidodendroid stems. Other fragments of wood showed radially arranged xylem vessels of secondary xylem tissue.

### CONCLUSIONS

A species of Lepidodendron is present in rocks of the lowermost part of the Lyons Group, but this species does not determine the precise age of that part of the group.

The genus Lepidodendron is to a great extent a form genus and does not lend itself to precise definition. The species under discussion is referred to the genus on grounds of its internal anatomy as well as on superficial resemblances. It is not referable to the related genera Leptophloeum or Lycopodiopsis. The range of the genus Lepidodendron is from Devonian to Permian. Edwards (1952) is of the opinion that the only lepidophytes occurring in Permian horizons in the southern hemisphere are referable to Lycopodiopsis, but this has yet to be proved conclusively. The internal structure of a stem of the species under discussion shows a medullated stele, and for this reason as well as on the grounds of the dissimilarity of the species from known Devonian species, an age younger than Devonian is probable.

The age of the lowermost part of the Lyons Group based on the presence of the species of Lepidodendron alone could be Carboniferous or Permian. As the material occurs above an unconformity developed on marine Lower Carboniferous rocks, and conformably below marine Permian (Sakmarian) beds, its age is most probably Sakmarian although it is possible that it is uppermost Carboniferous.

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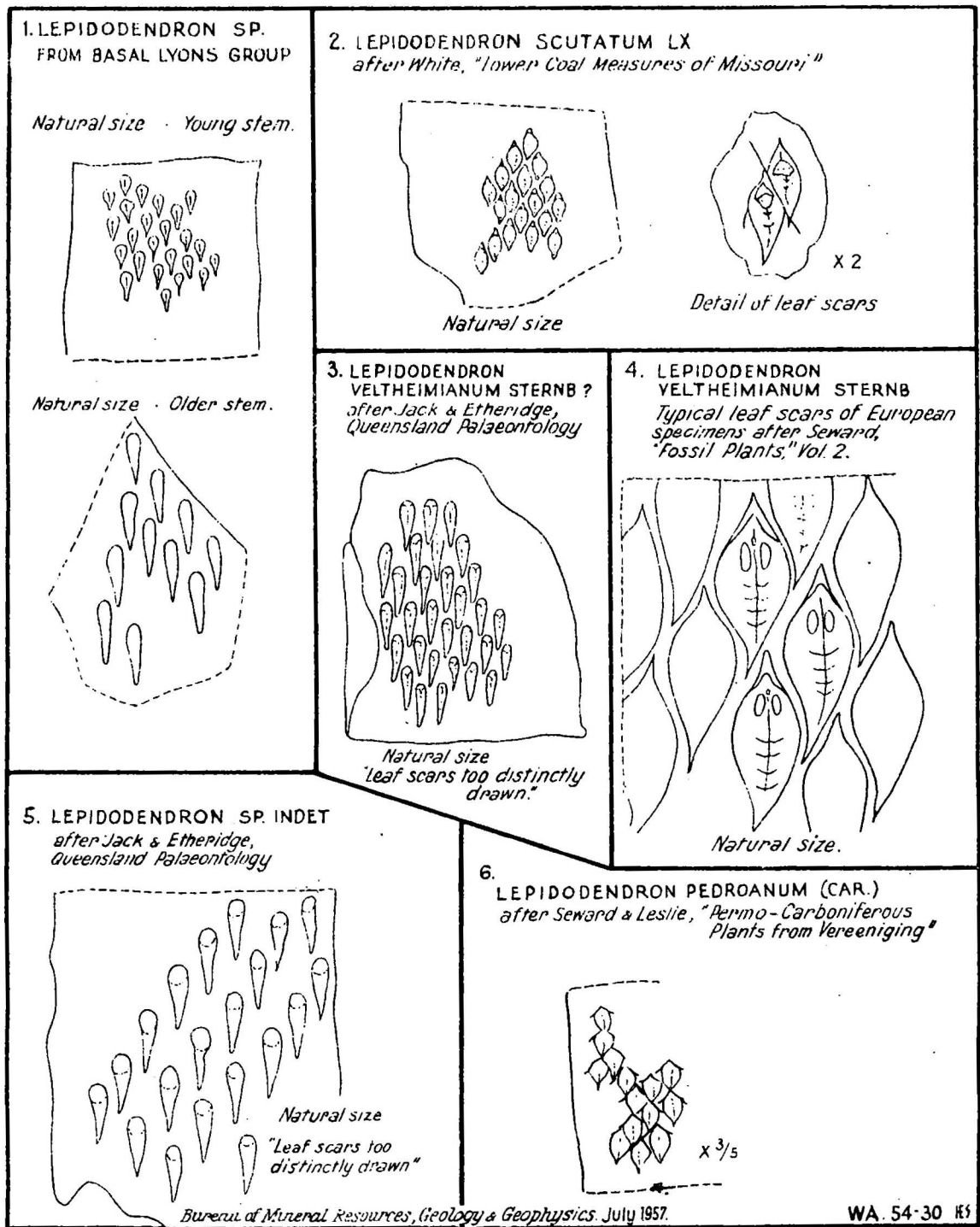


Figure 15.