# Fossil Coniferous Wood from Kerguelen Island.

BY

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**With Plate XXIII and four Figures in the Text.**

THE material described in this paper was mainly collected in 1840 in the vicinity of Christmas Harbour, Kerguelen Island (lat. 49° S.), by Surgeon R. McCormick, who accompanied Sir James Ross on the voyage of the *Erebus* and *Terror* to Antarctic regions, and who bequeathed his geological collections to the British Museum (Natural History) in 1890.

The McCormick collection of Kerguelen woods contains about forty or fifty pieces of various sizes, some of which are obviously very poorly preserved. Fourteen specimens were sectioned by Mr. J. Lomax, and though some were very different in external appearance and mode of preservation, it was rather disappointing to find that they agreed very closely in internal structure, and have all been included in a single species of *Cupressinoxylon*.

There are also a few specimens probably presented by McCormick's colleague, (Sir) J. D. Hooker, some of which were recently described by Prof. A. C. Seward as *Dadoxylon kerguelense* (Seward, 1919, p. 185). The Bryson collection of plant sections in the British Museum, which includes Nicol's specimens and others made many years ago, contains two slides (51534 and 51748) labelled 'Kerguellans Land', but there is no further information in the register. They are sections of poorly preserved dicotyledonous wood, and seem to have been cut from the same specimen. The Museum collections do not contain, however, any undoubted blocks of fossil dicotyledonous wood from Kerguelen.

*Occurrence of the wood.* The northern extremity of Kerguelen Island is largely covered with thick beds of basalt. Ross (1847, vol. i, p. 71) states that the basalt 'is upwards of 500 feet thick, and rests upon the older rocks at an elevation of 600 feet above the sea; and it was between these rocks of different ages that the fossil trees were chiefly found, and one exceeding seven feet in circumference was dug out and sent to England'. (This specimen has not been traced.) Ross says further that the wood was found

'in every stage from that of charcoal lighting and burning freely when put in the fire, to so high a degree of silicification as to scratch glass. A bed of shale, several feet in thickness, which was found overlying some of the fossil trees, had probably prevented their carbonization when the fluid lava poured over them.' McCormick gives a detailed account (McCormick, 1842, reprinted in Ross, 1847, p. 74) of the occurrence of wood, and states that it was found 'both imbedded in the basalt and in the débris below, or scattered on the surface amongst the fragments of rocks'. He refers to the shale, but says that no remains of leaves could be discovered in it. (His collection contains a few small pieces of sandy shales full of plant impressions too fragmentary for identification, and labelled 'Christmas Harbour'.) Beds of slaty coal were met with at many points under the basalt. Hooker (1847, p. 219) writes: 'Throughout many of the lava-streams are found prostrate trunks of fossil trees of no mean growth, and the incinerated remains of recent ones, so that it seems impossible to reckon the period of time that must have elapsed between the origin, growth, and destruction of the successive forests now buried in one hill.'

The fossil wood was also observed by members of later expeditions to the island, notably the voyages of the *Gazelle* (Studer, 1889, p. 61) and the *Challenger* (Murray, 1885, p. 349), and the German South Polar Expedition of 1901–3 (Philippi, 1908, p. 197). The wood brought back by the *Gazelle* from Christmas Harbour was examined microscopically by Goeppert (1881, p. 28) and by Beust (1884, p. 10). The former signalized the presence of araucarian wood, but without description or illustration, and, as Gothan (1908, p. 13) says, it is doubtful whether Goeppert's *Araucarites Schleinitzii et Hookeri* refers to one species or to two, and both are really *nomina nuda*. However, Seward (1914, p. 11) stated in 1914 that 'the examination of sections cut from a piece of petrified wood in the British Museum, obtained by Sir J. D. Hooker, enables me to confirm Goeppert's statement as to the occurrence of araucarian wood', and later these sections were named *Dadoxylon kerguelense* (Seward, 1919, p. 185). Beust in 1884 named some of the Christmas Harbour wood *Cupressinoxylon antarcticum* (Beust, 1884, p. 12), but he was only able to examine a few small fragments. He described it as having separate bordered pits in one row, abundant resin parenchyma, and uniseriate rays 1–8 cells high. The specimens here described from the same locality apparently belong to the same species.

The only other paper on the internal structure of Kerguelen wood is by Crié (1889, p. 8), who described as *Cupressinoxylon kerguelense* some well-preserved pieces of silicified wood which had been sent him from London by Gardiner and Etheridge. His description is, however, wholly inadequate, and his illustrations are poor. He states that *C. kerguelense* appears to differ from all hitherto described species, and then gives a reference to Beust's paper, but does not say wherein the differences lie. According to Crié, the

secondary wood contained here and there single scattered resin cells (as seen in transverse section; his figures of longitudinal sections show no parenchyma), and the tangential walls of the tracheides are pitted, whereas in the McCormick specimens there is abundant resin parenchyma and no tangential pitting. Moreover, Crié shows the tracheide pits in contact in a single row, and it is even possible, as Kräusel (1919, p. 208) suggests, that the wood was really araucarian.

*Age of the specimens.* The Tertiary date of the basalts has generally been assumed, partly on the evidence of the fossil woods (Philippi, 1908, p. 197). Though these may well be of Tertiary age, however, they cannot be considered as absolutely definitive, nor is it possible to fix the horizon any more exactly on geological grounds. Seward (1914, p. 208) makes a comparison with the plants preserved in the Tertiary basalts of north-west Europe, and, referring to the resemblance between the basaltic hills of Kerguelen and of South Victoria Land, suggests an extensive basaltic outpouring in Tertiary times. Philippi further remarks that the weathering and changes that have taken place in the basalt point to the outflow being of earlier rather than later Tertiary date.

Kräusel's reference (1919, p. 208) to the age of *C. kerguelense*, Crié, as 'Trias? (Tertiär?)' is doubtless an error, for Crié considered the wood to be Tertiary.

*Cupressinoxylon antarcticum*, Beust.

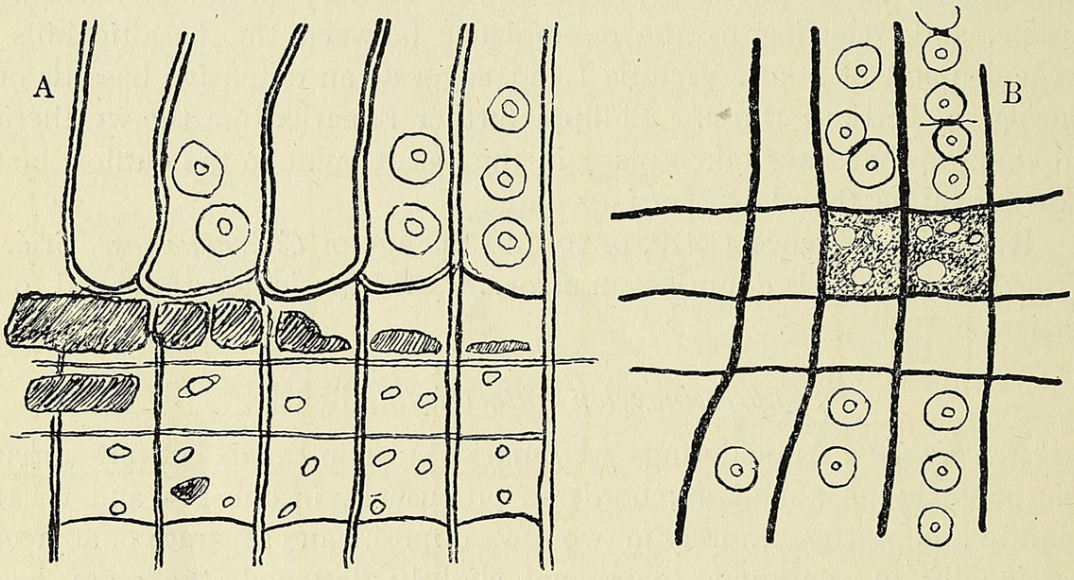
*Description*: Annual rings well marked; resin canals entirely absent; resin parenchyma abundant; bordered pits usually in one row and usually separate and scattered, rarely in two rows, opposite and separate or adjacent, occasionally in contiguous pairs and slightly flattened, the pairs being vertically or obliquely placed; rims of Sanio present, frequently attached to the margin of the pit; tangential walls of tracheides unpitted; medullary rays uniseriate, very rarely partly biseriate, 1–15 cells in height (commonly 1–6), frequently containing resin; abietinean pitting absent; field pitting not usually preserved, but occasionally 1–4 rather small and apparently simple pits present.

*Locality*: Christmas Harbour, Kerguelen Island, lat. 49° S.

*Age*: ? Tertiary.

*General remarks*: All the specimens examined are of mature wood, some of the stems being of considerable girth, and no young twigs have been seen. The annual rings vary from 10 to 40 cells in width in different specimens, and the spring wood is usually distorted and crushed. The preservation is frequently very poor, and the tracheides often show the spiral markings which are due to decay. The occasional occurrence of contiguous and partly alternate pits is not uncommon in both living and fossil non-araucarian Conifers.

The field pitting (see Text-fig. 1) is rarely distinguishable, and when preserved is sometimes similar to that figured by Stopes in *C. luccombense* (Stopes, 1915, p. 183, Fig. 52) and by Seward in *C. orientale* (1912, Pl. V, Figs. 73, 75). In all three cases the irregular appearance of the field pitting is probably due to partial decay and enlargement of the original pits. In Slide V. 13615 *d* (see Text-fig. 1, B) from one to three small roundish or oval and apparently simple pits can be seen at one point. Some of these pits are obliquely placed and narrowly elliptical, but it is difficult to distinguish a border, perhaps owing to decay before preservation. This pitting is somewhat like the ' podocarpoid ' type (Gothan, 1905, p. 48) and perhaps the Kerguelen species may belong to *Podocarpoxylon*. It is, however, impossible to make exact comparisons with living species, or to define the



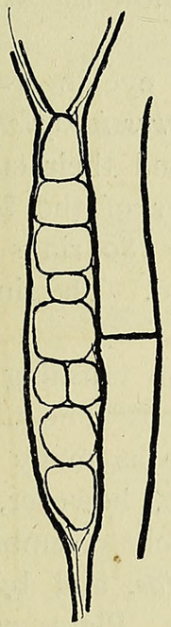

TEXT-FIG. 1. *Cupressinoxylon antarcticum*. Radial longitudinal sections, showing field pitting of the medullary rays. A, Slide V. 10291. B, Slide V. 13615 *d*.

precise position of this fossil, which is best included in the genus *Cupressinoxylon*, using the term in a wide sense.

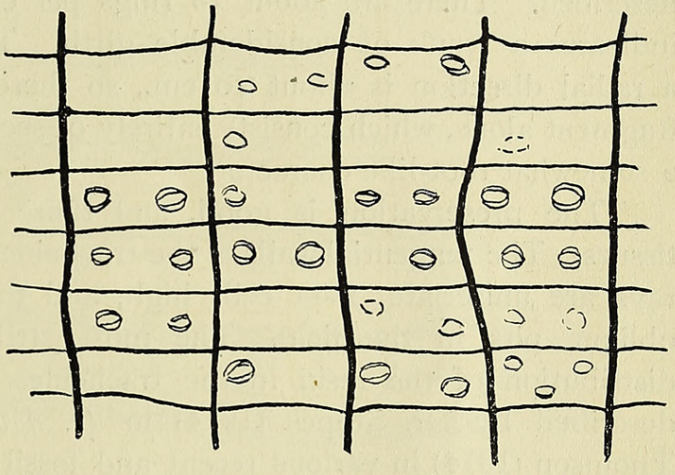
The field pitting in Beust's wood was apparently fairly well preserved, and in some of his figures (Beust, 1884, Pl. IV, Fig. 7) the pore seems to be obliquely placed, thus showing an approach to the podocarpoid type. Kräusel (1919, p. 206) thinks that it may belong to the *Juniperus* group (*Fitzroya?*), but Beust's figures scarcely warrant this conclusion. I have seen no trace of *Juniperus* pitting in the present material, though the state of the wood precludes one from being absolutely certain of its absence.

Among the few known examples of *Cupressinoxylon* from the southern hemisphere, reference must be made to *C. Hookeri*, Arber (1904). On the ground of Arber's description of 'a small simple pit on the radial walls' this species was referred by Gothan (1908, p. 7) to *Podocarpoxylon*, and Seward (1919, p. 211), stating that ' in some places a single fairly large

simple pit occurs in the field', includes the species doubtfully in the comprehensive genus *Mesembrioxylon*. As far as my observations go, wherever the field pitting is preserved there are almost invariably (at any rate in the spring wood) two small pits with a broadly elliptical horizontal pore (Text-fig. 3). The type sections are rather thick in places, and bordered pits on the tracheides overlying the rays might appear to be single pits in the field, but, since the wood is very transparent, the pair of smaller pits as just described may frequently be seen by focusing up and down. The Museum collection contains many fragments from the large specimen (Slide V. 332), and, as they split up very easily, it is possible to separate out the individual medullary rays. Such rays usually show faint vertical lines marking the



TEXT-FIG. 2. *Cupressinoxylon antarcticum*. Tangential longitudinal section showing a partly biseriate ray with adjoining parenchyma. Slide V. 13616 *c*.



TEXT-FIG. 3. *Cupressinoxylon Hookeri*, from Tasmania. Radial longitudinal section to show medullary ray pitting. Slide V. 332 *b*.

lines of contact of the tracheides, and the field thus marked off usually contains two small pits in the early wood, or a single one in the late wood; the pore is more or less circular, but never vertically elongated. It therefore seems best to retain this species in the genus *Cupressinoxylon*. It differs in several respects from the Kerguelen species, notably in the height of the rays and the tangential pitting of the tracheide walls as well as in the field pitting.

*C. Hookeri* appears to resemble fairly closely *C. Patagonicum*, Conwentz (1884, p. 441), which is described as having one or two round or elliptical pits in the field. There are no other well-preserved examples of *Cupressinoxylon* from the Southern Hemisphere, for *C. latiporosum*, Conwentz, is included by Gothan in the genus *Phyllocladoxylon*.

*Dadoxylon kerguelense*, Seward.

Seward's description (1919, p. 185) is as follows: 'Annual rings narrow, often 15–20 tracheides broad, the summer wood being frequently represented by only two rows of elements. There are one or two rows of bordered pits on the radial walls of the tracheides, contiguous, alternate, and often slightly flattened.' This description is based on three old and very thick slides (V. 8388–V. 8390) which have 'Kerguellan, Ross' scratched on the glass, and the figures were made from the radial section (V. 8389). These sections were cut from a block of compact, black, silicified wood (V. 5867) bearing an old label 'Kerguellan, Sir J. Ross'. Three more sections (V. 5867 *a*, *b*, and *c*) have recently been cut from this piece which show the structural details much more clearly.

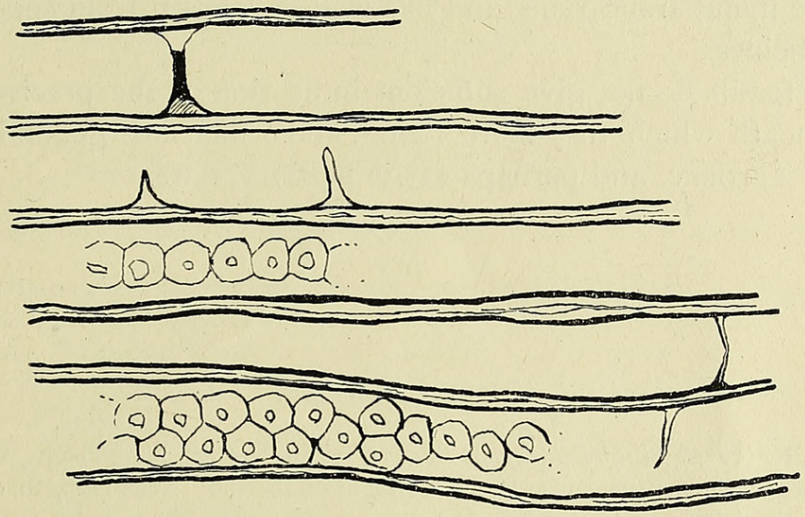
The growth rings are very distinct to the naked eye in transverse section, and are much closer together than in the *Cupressinoxylon* above described. There are about 18 rings per centimetre, and their curvature indicates a trunk of considerable girth. The diameter of the block in a radial direction is about 10 cm., so there are about 180 rings in this fragment alone, which consists entirely of secondary wood. The rings have a somewhat root-like character.

The preservation is good, and there has been no crushing of the tissues. The tangential walls of the tracheides are unpitted. The medullary rays are uniseriate, 1–11 cells high, and there may be as many as nine oblique pits in the field. The most striking feature, however, is the distribution of the resin in the tracheides, which closely resembles that described by Dr. Stopes (1914) in *D. novae-Zeelandiae*, and by R. B. Thomson (1914) in various recent and fossil araucarians. Plates or spools of resin may be seen in both radial and tangential sections in the tracheides adjacent to the rays, and in some cases these tracheides appear to have thickened walls. The transverse section has a striking appearance: in parts of the wood the resin seems to be absent, and while in some patches the resin is confined to the tracheides next to the rays, in other regions practically every tracheide is filled with a dark brown, presumably resinous substance (see Pl. XXIII, Figs. 4 and 5). In the longitudinal sections isolated tracheides are to be seen entirely filled with resin, which is found also in the medullary ray cells.

The spools in the tracheides are sometimes so reduced as to give the appearance of septa (Text-fig. 4), and in fact it is very difficult to say whether or not actual septa or trabeculae were present. In one or two cases these apparent septa are arranged to some extent in radial rows, and it seems possible that the septa described by Gothan (1908, p. 10) in *Dadoxylon pseudoparenchymatosum* from Seymour Island (lat. 64° S.) were reduced resin plates, for they occur in the same position, in connexion with

the rays. Gothan discusses in detail the significance of the supposed septate tracheides, though without reaching any definite conclusion. He does not consider that they are resin parenchyma because of the absence of any resin content, though resin is often present as a dark mass in the ray cells. The appearance of the transverse section, however, as described by Gothan ('eine Anzahl von Zellen, die scheinbar mit dunklerem, bräunlichem Inhalt erfüllt scheinen'), supports the idea that the septa are really resin plates. The fact that the resin was so reduced in the tracheides and not in the ray cells is not surprising when one considers the variation in the amount and distribution of the resin in *D. kerguelense* and other araucarians.

Though the non-committal name *Dadoxylon* is used for the Kerguelen species, it agrees closely in structure with living araucarians, and among



TEXT-FIG. 4. *Dadoxylon kerguelense.* Radial longitudinal section, showing thin plates and projections of resin. Slide V. 5867 *b*.

fossil species from the Southern Hemisphere it is very near to those already mentioned from New Zealand and Seymour Island. Gothan indeed calls his wood *D.* (*Araucaria*) *pseudoparenchymatosum*, thus indicating its close affinity with living types, though since there seems to be no method of deciding whether any fossil araucarian wood belonged to *Araucaria* or to *Agathis*, it seems better to use the name *Dadoxylon* alone.

Gothan's species differs from *D. kerguelense* chiefly in the point of resin distribution. It is of Tertiary or perhaps Upper Cretaceous age, while *D. novae-Zeelandiae* is supposed to be mid-Cretaceous. The latter and *D. kerguelense* agree in most characters, including the presence of resin spools, but in *D. novae-Zeelandiae* the growth rings are better marked, and the late wood is several cells broad; the medullary rays are also only 1–7 cells high instead of 1–11, and the field pits, according to Dr. Stopes, are 5 or 6 in number, while there are frequently more in *D. kerguelense*.

These, however, are probably not constant specific characters. Another Tertiary species, *Dadoxylon Doeringii* (Conwentz), from the Oligocene of Patagonia (Conwentz, 1884, p. 448), is not so closely related, for it has much higher and occasionally biseriate rays.

## Summary.

An examination of fossil wood from Kerguelen Island in the British Museum (Natural History) has revealed the presence of only two species (apart from some rather doubtful dicotyledonous wood), the anatomy of which is described in detail. In the case of *Cupressinoxylon antarcticum*, Beust, the preservation of the minuter features does not permit of an exact comparison with recent genera.

The other species, *Dadoxylon kerguelense*, Seward, closely resembles the wood of living araucarians, and has well-developed resin spools or plates in the tracheides.

These fossils do not give sufficient indication of the precise age of the basalts beneath which they were found, and which are generally regarded as being of Tertiary, and perhaps early Tertiary, date.

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## EXPLANATION OF PLATE XXIII.

Illustrating Mr. W. N. Edwards's paper on Fossil Coniferous Wood from Kerguelen Island.

Fig. 1. *Cupressinoxylon antarcticum.* Transverse section of wood. × 50. Slide V. 13616 *a*.

Fig. 2. Same. Radial longitudinal section. × 50. V. 13615 *d*.

Fig. 3. Same. Tangential section. × 50. V. 13612 *c*.

Fig. 4. *Dadoxylon kerguelense.* Transverse section, showing resin in tracheides adjoining the rays. × 30. V. 5867 *a*.

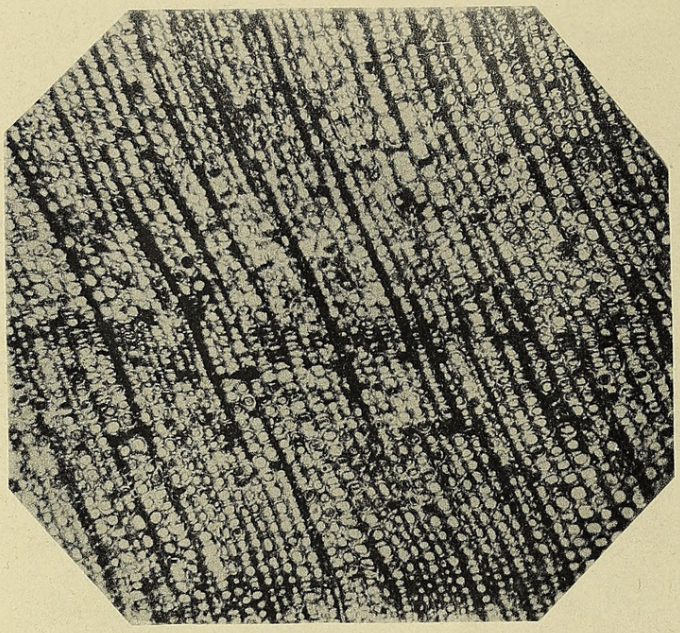
Fig. 5. Same, showing resin-filled area on the right and clear area on the left. × 30. V. 5867 *a*.

Fig. 6. Same. Radial longitudinal section, showing bordered pits in one and two rows, and a medullary ray with 3–7 pits in the field. × 150. V. 5867 *b*.

Fig. 7. Same. Radial section, showing semicircular blobs of resin in tracheides adjoining the rays. × 50. V. 5867 *b*.

Fig. 8. Same. Tangential section, showing resin plates and blobs. × 50. V. 5867 *c*.

All the slides are in the Geological Department of the British Museum (Natural History). The photographs were taken by Mr. F. W. Edwards.



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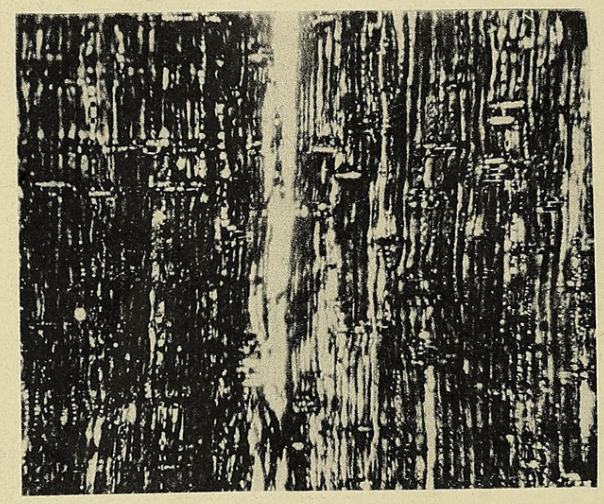

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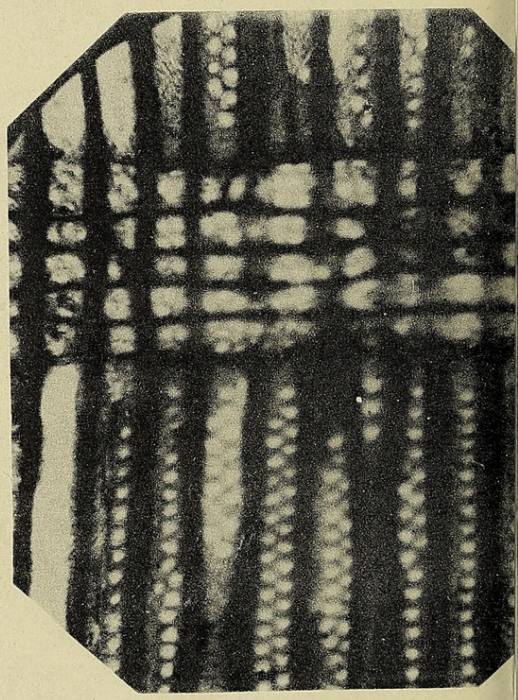

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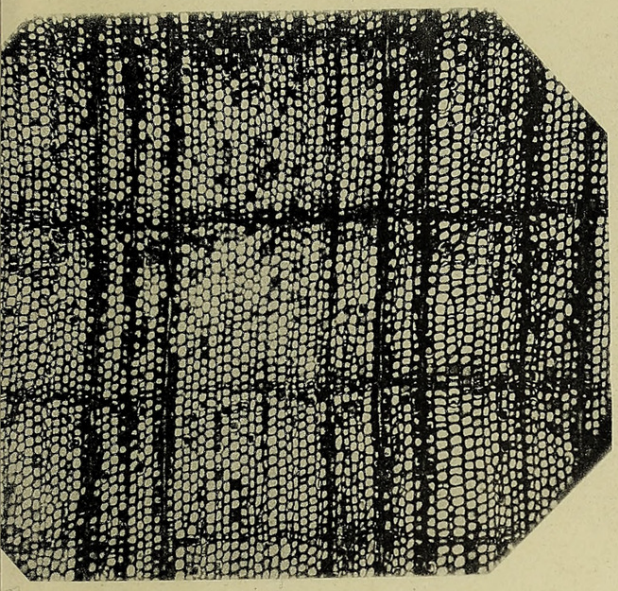

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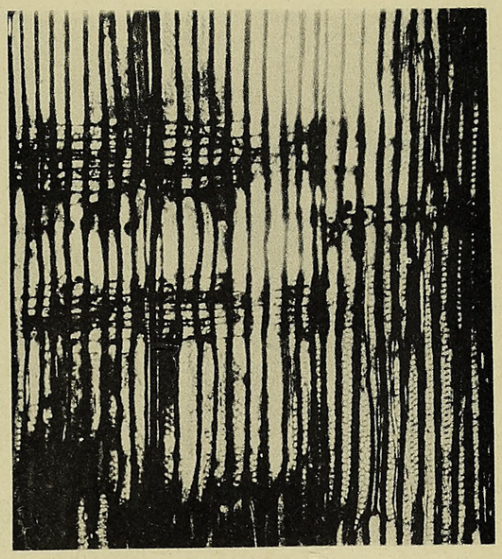

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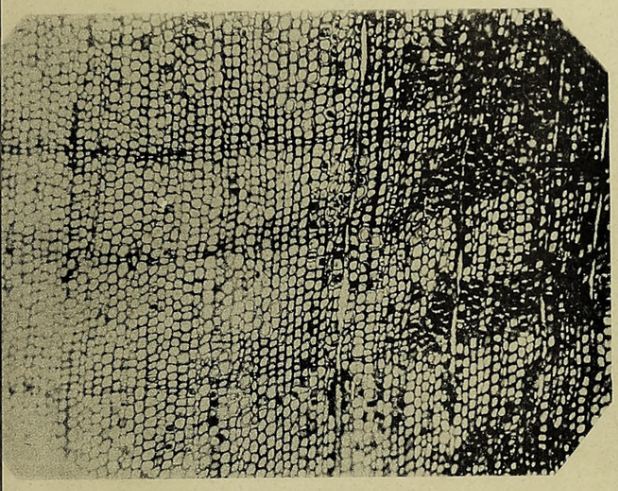

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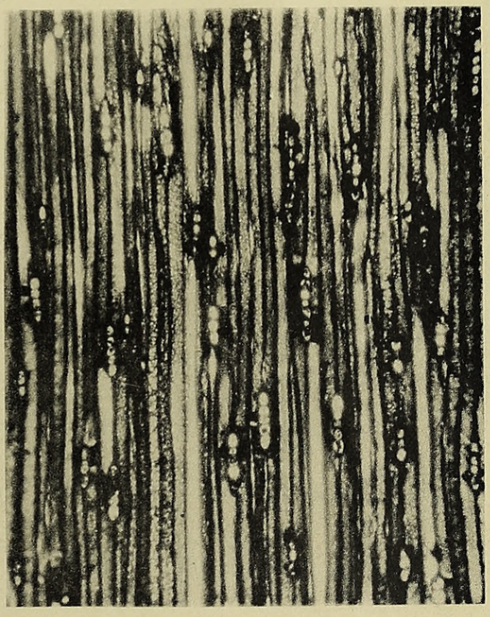

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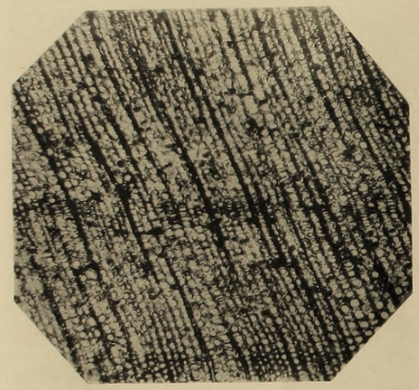

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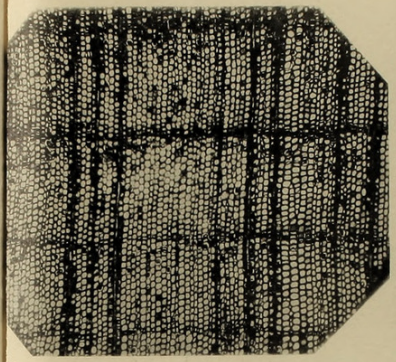

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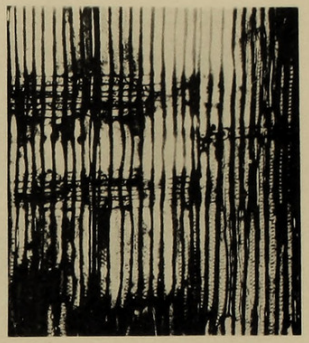

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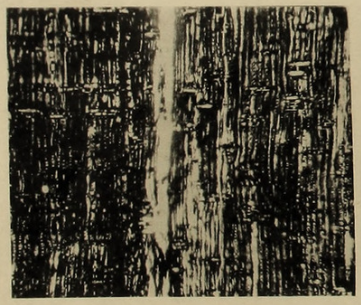

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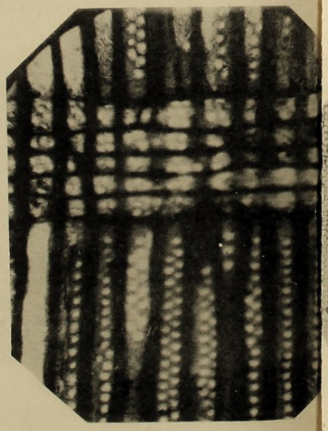

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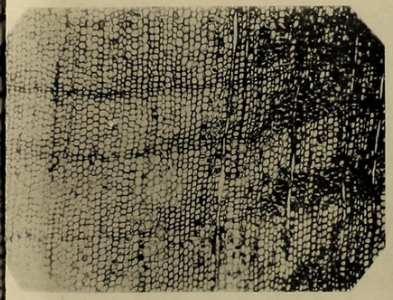

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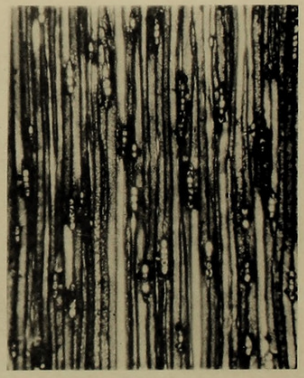

8.

Ruth coll.

EDWARDS — CUPRESSINOXYLON & DADOXYLON.