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The Hunt Institute for Botanical Documentation, a research division of Carnegie Mellon University, specializes in the history of botany and all aspects of plant science and serves the international scientific community through research and documentation. To this end, the Institute acquires and maintains authoritative collections of books, plant images, manuscripts, portraits and data files, and provides publications and other modes of information service. The Institute meets the reference needs of botanists, biologists, historians, conservationists, librarians, bibliographers and the public at large, especially those concerned with any aspect of the North American flora.

Hunt Institute was dedicated in 1961 as the Rachel McMasters Miller Hunt Botanical Library, an international center for bibliographical research and service in the interests of botany and horticulture, as well as a center for the study of all aspects of the history of the plant sciences. By 1971 the Library's activities had so diversified that the name was changed to Hunt Institute for Botanical Documentation. Growth in collections and research projects led to the establishment of four programmatic departments: Archives, Art, Bibliography and the Library.

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Pteridophyta
Vasc. Crypt.

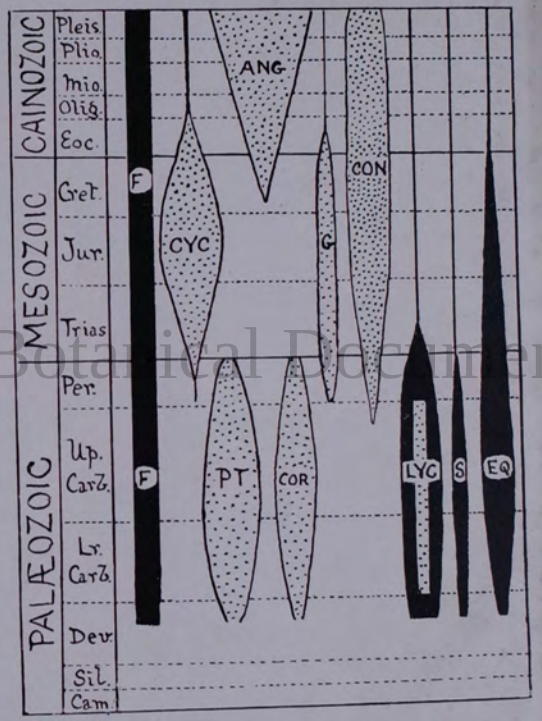
- Filicales
  - Filices
    - Ophioglossaceae
    - Marattiaceae
    - Polypodiaceae
    - Hymenophyllaceae
    - Cyatheaceae
    - Gleicheniaceae
    - Schizaeaceae
    - Osmundaceae
  - Hydropteridaceae
    - Salviniaceae
    - Marsileaceae
- Equisetales
  - Equisetineae
    - Equisetum
    - EQUISETITES
    - CALAMITES
    - ARCHAEOCALAMITES
    - PHYLLOTHECA
    - SCHIZONEURA
  - Equisetineae
    - SPHENOPHYLLUM
- Sphenophyllales
- Lycopodiales
  - Lycopodiaceae
  - Psilotaceae
  - Isoetaceae
  - Selaginellaceae
  - LEPIDODENDREAE
  - SIGILLARIEAE
  - LYCOPODIOPSIS
  - HETERANGIUM
  - MEDULLOSEAE

CYCADOFILICES

Spermophyta

- Cycadales
  - Cycadaceae
  - BENNETTITEAE
- Cordaitales
  - CORDAITEAE
- Coniferales
  - Pinoideae
    - Araucariaceae
    - Abietaceae
    - Taxodiaceae
    - Cupressaceae
  - Taxoideae
    - Taxeae
    - Podocarpeae
    - Ginkgo
    - BAIERA
- Ginkgoales
- Gnetales
  - Gnetum
  - Welwitschia
  - Ephedra
- Amygdalaceae

Monocots
Dicots



Sil
Cam.

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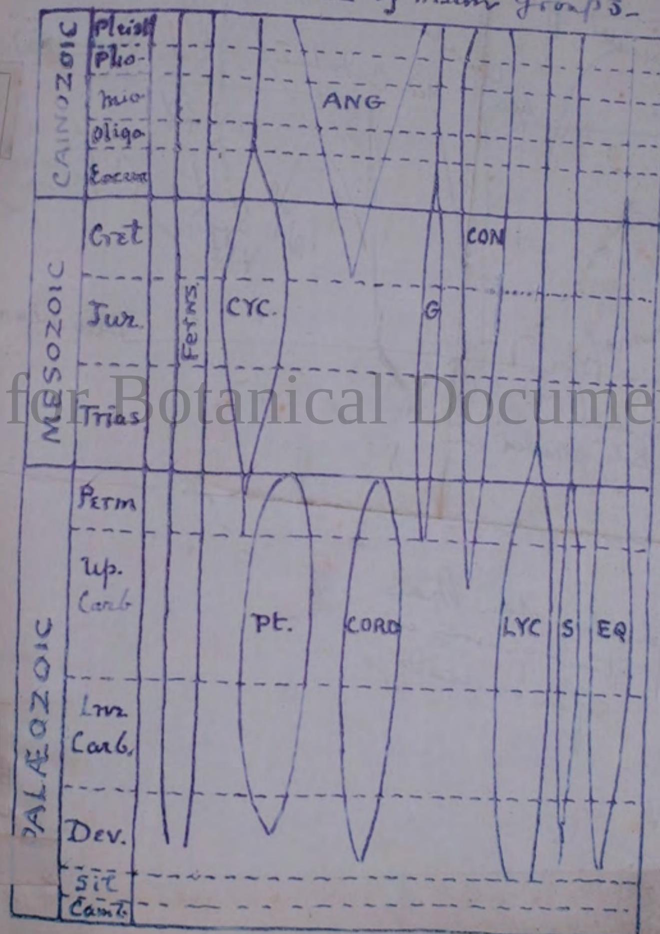
Ophioglossaceae
Marattiaceae
Polypodiaceae

Pl...
Va...

Angiospermae
Monocot
Dicot
Ephedra

Distribution in Time of main Groups.



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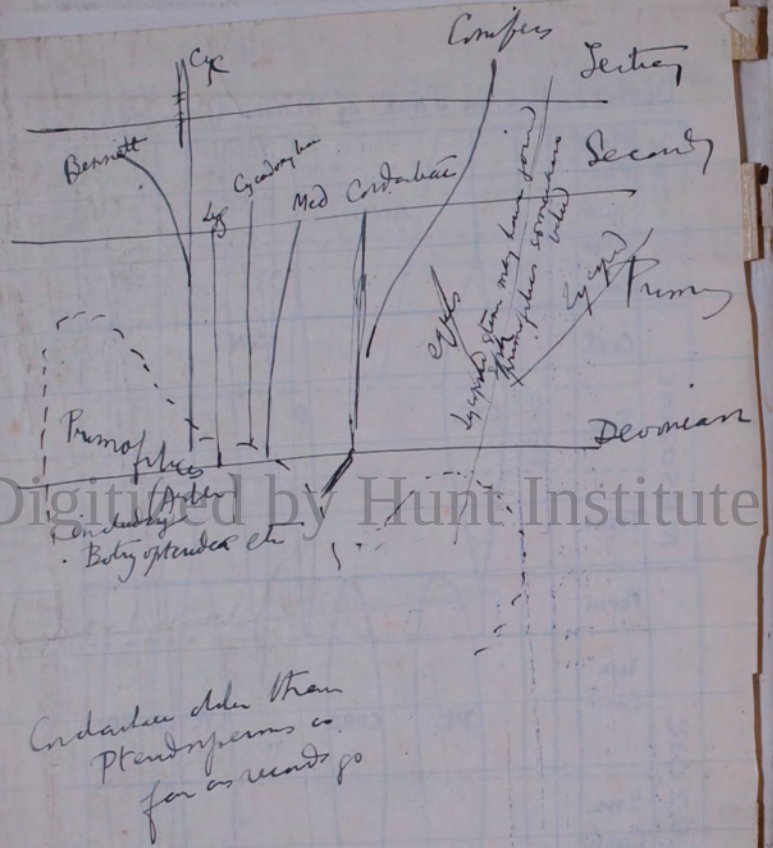

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Text books

Seward Fossil Plants Vol I (Libr. A. 5. 126)

Zeiller Éléments de Palaeobotanique (Libr A 5 128)

The following may also be consulted

Patonié Lehrbuch der Pflanzen Palaeontologie (Libr. A. 5. 127)

Scott Studies in Fossil Botany (Libr A 5. 129)

Read first 6 chapters in Seward Fossil Plants especially

Chapters I + II. Historical Sketch

IV Preservation of Plants as fossils

V, VI Nomenclature

On the various divisions of the British Carboniferous rocks + their flora.

(Proc. Phys. Soc. Edin. 1894) Kidston. Esp. pp 223–231

On Geological Floras generally the following may be consulted

Zeiller. Elements pp 324 – 360

Patonié Lehrbuch 361 – 391

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Palæobotany [Mr Arber]

Agnes Robertson
U.H.
Newn. C.U.

May Term 1901

Oldest figures of fossil plants are coal measure ferns drawn by Edward Lhwyd 1760

1804 Schlotheim

1820–1838 Sternberg, Brongniart

1833 Witham

Preservation

1. incrustation – cast
2. petrifaction. (a) replacement by $CaCO_3$ – (England)
   (b) " " H_4SiO_4 (France)
   (c) " " $CaSO_4$, $Ca_3(PO_4)_2$, Amber

Genera + Species

Rarely find parts of plants in connection : have an artificial classⁿ:

e.g. certain stem = Lepidodendron
root = Stigmaria
leaves = Lepidophyllum
Cones = Lepidostrobus.

All belong to certain Lepidodendron.

e.g. Sphenopteris stands for fern fronds having a particular habit & form of segment + venation, & : includes representatives of various divisions & genera of the filices

Ferns of present day

Leptosporangiateae		3000 sp
Fil	7 gen	350 sp
Equisetum	1	20
Lycopodiaceae	3	100
Selaginellaceae	1	300

Spermaphytae of present day

Coniferales	34 gen	350 sp
Cycadales	9	75
Ginkgo	alive only in Cultivation	
Dicotyledones		78000 sp
Mono		20000

No Gymnosperms, Cycads & Coniferae in Carboniferous times; most abundant then were the Sphaenophyllaceae & Araucariaceae.

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SOCIETIES AND ACADEMIES.

LONDON.

1904

Royal Society, May 9.—"The Fossil Flora of the Culm Measures of North-west Devon, and the Palæobotanical Evidence with regard to the Age of the Beds." By E. A. Newell **Arber**. Communicated by Prof. McKenny Hughes, F.R.S.

The Carboniferous rocks of Devonshire, generally known as the Culm Measures, are divided into an Upper and a Lower division. The Upper Culm Measures, which are of Upper Carboniferous age, form by far the thickest portion of this Carboniferous series. Plant remains, although abundant in these beds, are rarely sufficiently well preserved to admit of identification. A number of species have, however, been obtained, some of which are new to Britain, from the one horizon in the Upper Culm Measures in which coal, known locally as culm, is found. This flora is identical with that of the Middle Coal Measures elsewhere in England, and consequently the horizon on which the coal or culm occurs in the Bideford district is the equivalent of the Middle Coal Measures, a higher horizon than has been previously assigned to these beds.

There is also evidence that the Culm Measures at Instow, which occupy a lower horizon than the Culm Measures of the Bideford district, are probably the equivalents of the Lower Coal Measures. Thus both the Lower and Middle Coal Measures are represented in Devonshire, and, as the higher beds of the Culm Measures are as yet unexplored, possibly even higher horizons may eventually be found to be represented.

It is pointed out that the Culm Measures of Devon, which have been regarded by several geologists as essentially a Lower Carboniferous formation, are in reality chiefly, but not entirely, of Upper Carboniferous age. Consequently, the term "culm" or "kulm" generally applied to certain deposits in Germany, Austria, and elsewhere on the Continent, which are entirely of Lower Carboniferous age, is peculiarly unfortunate, for these beds are not of the same age as the great bulk of the Devonshire Culm Measures.

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Coal measure Flora

Richest carb. flora middle supra coal measures
Several types are confined to U. coal measures
Middle coal measures have certain types which do not occur in U. coal measures.
Types of fern etc common to middle & lower:-

- Neuropteris heterophylla
- Alethopteris lonchitica
- Sphenopteris obtusiloba

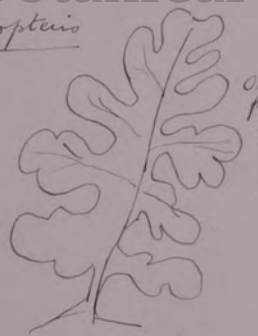
Lepidodendron ophiurus
Calamites { Sackowi / ramosus

I Middle coal measures

Fructification unknown in Carboniferous fern like plants
Fern class? by form of frond & pinnules & course & texture of
The veins

Sphenopteris

The lobes of some Sphen. may be very narrow



Outline of pinnule of Sphen. obtusiloba

Median nerve giving off branches out the lobes. These branches dichotomise
Pinnules much divided
At base pinnule is contract

S. obtusiloba has alternate pinnules, orbicular & blunted & decurrent

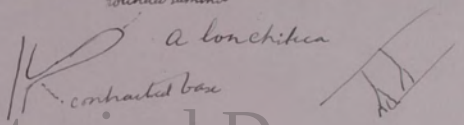
eg some dawsiana & hoffmanni

many recent ferns might come under Sphenopteris
S. hifoliata is a char? midd. Coal measure type

Osmunda regalis

Aletheopteris

Pinnules narrow & decurrent, attached by entire base.



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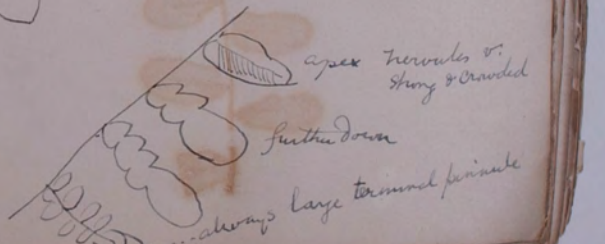
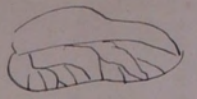
Neuropteris [Osmunda has this type of foliage]

N. heterophylla

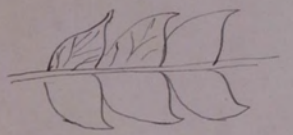


N. obliqua. Mid. coal measures.



Nervation open

Odontopteris [middle, not lower]



No median nerve; all nerves arise direct from the rachis

O. Rheichiana

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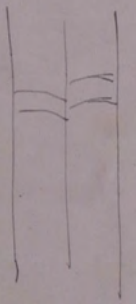
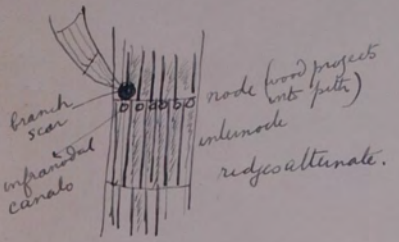
Taeniopteris



Calamites

Forest trees; second. thickening

Casts of inside. The material which filled the stem projected in between the bundles as the medullary rays decayed.



Pith casts of rhizome very much same

3 groups

I Eucalamites — C. cruciatus [M. Ch.]

Branch scars on every node

II Stylocalamites — C. Suckowi

Branch scars — Whorls adjacent or few far between

III Calamitina — Periodic recurrence of branch scars

C. approximatus. — Internods v. short

C. ramosus

Palaeobotany III

Demonstration.

Calamites

1 Annularia stellata
2 Calamocladus equisetiformis
3 Pinnularia
4 Palaeostachya pedunculata
5 Paracalamostachys

Lepidodendrae

1 Lepidodendron (External Surface)
2 " (parichnos)
3 " (Bergeria type)
4 " (Aspidiaria type)
5 " (Knorria type)
6 " Ophiurus
7 Lycopodioides
8 Lepidophloios
9 Stigmaria ficoides

Lepidodendrae (cont

10 Lepidodendrae (Cones)
11 Lepidostrobus variabilis
12 Ulodendron
13 Halonia

Sigillariae

1 Sigillaria (External Surface)
2 " (Syringodendron Type)
3 S. mamillaris
4 S. scutellata
5 S. tesselata
6 S. camptotaenia
7 Sigillariostrobus

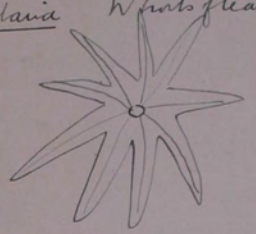
References

Calamites. Seward "Fossil plants" Chap X
Lepidodendron. Scott ("Studies etc) p115, -123
Stigmaria Scott " p 161-4
 p 214
Williamson Monograph on Stigmaria (Libr F.1.61)
Ulodendron & Halonia Scott p 153
Sigillaria " p 185-195

Foliage

Different Types

I Annularia Whorls of leaves occur as detached fossils

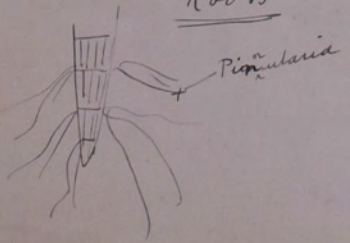


Eg. A. stellata. U. Coal measures.
Narrow typical leaves 16–32 segts

II Calamocladus (Asterophyllites) (i) Leaves equal (ii) No basal collar

Equisetiformis M. Coal measures.

Roots



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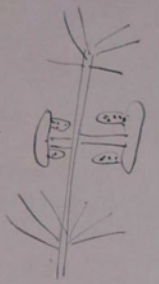
Fructification

Essentially like modern Equisetums

I Calamostachys

Whorls of sterile bracts w. sporangiophores between sticking out at right



II Palaeostachya

sporangia in axils of sterile bract

often difficult to distinguish I + II. Then call it Paracalamostachys

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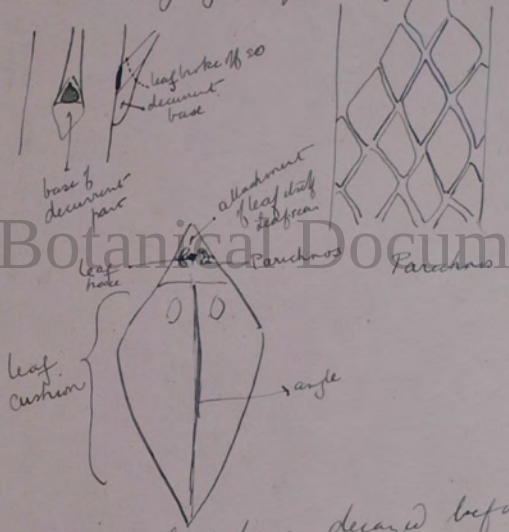
Lepidodendrea

Lepidodendron Trunk tree. Sec. thickening. Branches rather confined to upper part.

Stem Pith solid so no internal casts

Impressions of real external surfaces — so rare among calamites

Covered w. lozenge shaped leaf areas



Often epidermis & leaf bases decayed before the cast was taken. It is then called a Bergeria cast

When all outer cortex goes too, the type is called Aspidiaria

Finally all cortex goes, type called Knorria

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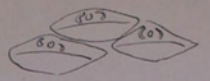
Lepidophloios



Leaf bases prominent

Lepidodendron ophiurus - Much branched stem; short curved leaves; leaf base prominent & elongate & closely set
Ridge has no transverse ridges.
Leaf scar near apex

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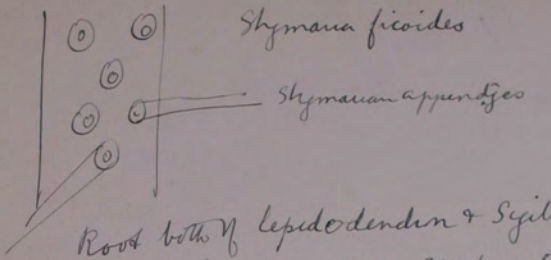
Lepidodendron lycopodioides Dana & Cranston. Recognized from ophiuras by leaf bases which are quite a different type
Leaf scar far from apex
Transverse ridges

Root of Lepidodendron - Stygmaria



Root both of Lepidodendron & Sigillaria -
Has been found in organic continuity with both.
Stygmaria often in seten in underclays
It must have grown in a thick humus of vegetable
debris judging by occurrence of the rootlets in seten
among all sorts of other things

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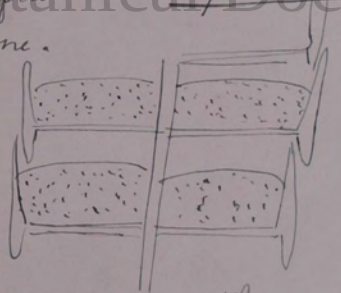
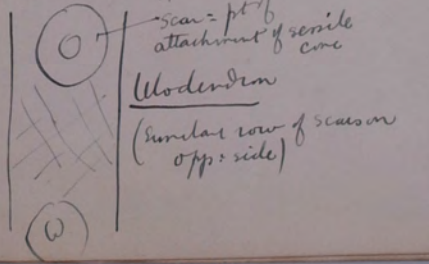
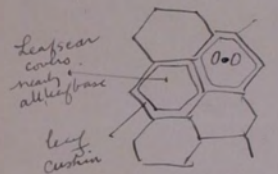
Fructification. Lepidostrobus
A cone.





Sigillaria Essentially Middle Coal Measure Gen.

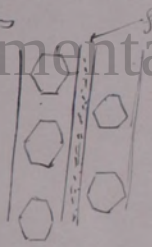
Leaves like those of Lepidodendron
Cones imperfectly known
Large trees. 70 ft long in French coal measures.
slender. Only branched towards top. External
surface of stem covered with leaf bases
Imperfect casts [of Bergen etc] = Syringodendron
Leaf bases differ in form & arr't from Lepidodendron
Arranged in rows & not spirals



In some cases leaf cushions close
together & fuse into long ribs

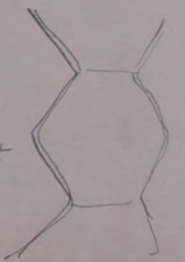
(a) Eusigillaria
(a) Rhytidolepis

Ribbed stem



(b) Favularia
Rib separately
Zigzag lines

Sometimes both types
occur on same plant



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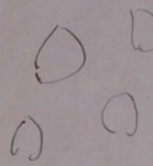
II Sub-syllaricæ

no ribs

(a) Clathraria

(b) Leiodictyaria



no leaf cushions

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Palaeobotany IV

References

Swedish & Lower Coal Measures

Cordaitaceae } Scott "Studies" } A 409
Cycadofilices } A 307

Upper Coal Measures.

Rhodea "On the fossil flora of the Radstock Series" (Trans. R. Soc. Edinb.) XLI Q.3

Annularia Stewart A 341

Sphenophyllum " A 407

Lower Carboniferous.

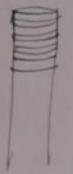
Archaeocalamites Seward A 383

Cordaitales (As abundant as lepidodendrons & calamites in coal measure times)

Cordaites. All diff. parts are known. Pith casts & leaves common.

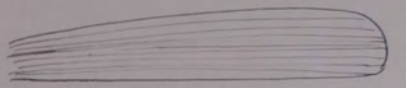
Tall slender tree, branched in upper part with long slender detached leaves. Stem had a hollow medullary cavity.

Pith casts known as Artisia [= Sternbergia]

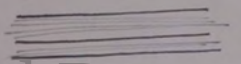


Pith was bridged at short intervals by diaphragms of tissue [cf walnut tree]

The wood is similar in structure to Araucaria



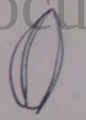
C. principalis

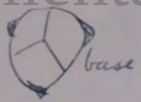


1-5 finer veins between layer ones

Trigonocarpus seed

elliptical w. 3 ridges





base

T. Parkinsoni

This seed is doubtfully referred to Cordaites

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Sphenophyllales

Cuneiform leaves
not united at base
Usually of same size
Superposed on those of whorl
below.
6, 9, or 12 leaves in whorl

Older palaeobotanists thought it
aquatic. Probably it was a climber
of the "scrambler" type.

Dist. Mid. Coal measures.

S. cuneifolium. Apex of leaf broad + denticulate. Single nerve
at base of leaf. Tubercles [illegible] the leaf.

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Cycadofilices Synthetic group.

Anatomical structure only known.

Foliage belongs to some sp of sphenopteris, alethopteris neuropteris [though others were undoubted ferns]

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Pecopteris

Pecopteris arborescens

P. Mantoni

P. unita
U. Carb & Dr Dev.

P. dentata

Mariopteris

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II Upper Coal measures

Radstock is best place.

Alethopteris Serlii. Very char[c] of U. Coal measures.
Pinnules v. long & pointed
venation v. close

Sphenopteris comparatively rare.

Pecopteris. Short pinnules attached by entire base
Pinnules very parallel sided
P. arborescens
might be taken as a type of the genus
venation dichotomous & not

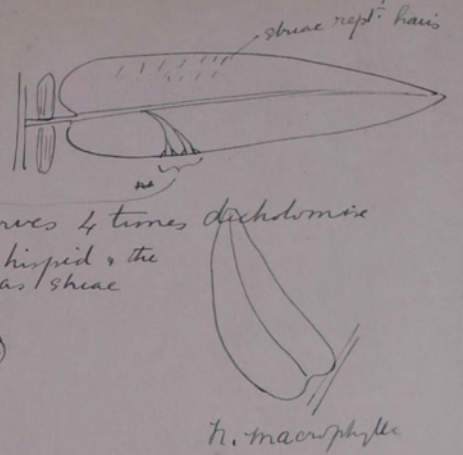
P. Mantoni
Pinnules not divided to base
venation always dichotomous

P. (Dactylotheca) dentata
Dactylotheca is the natural genus to which both fruit & leaf are referred

Mariopteris muricata
Peculiar repeated dichotomy of frond

Pinnules attached by whole base & generally decurrent

Neuropteris Scheuchzeri ‖ Neuropteris = Pecopteris char.ⁱˢ of upper coal meas
Sphenopteris ——— middle " "



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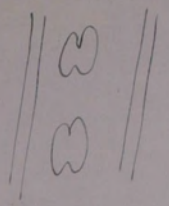
‖ Calamites apparently dying out. ‖
annularia still common, especially A. sphenophylloides

Sphenophyllum. S. emarginatum v. common.
Edges of many leaves, blunted rounded teeth.
‖ Lepidodendron becomes rare ‖
L. Worthenii.
Simmsonthic, the leaf base longer than broad

Sigillaria S tessellata the only common form
S. reniformis, Rhytidolepis type



Cordaites. Pith casts & leaves of C. angulostriatus
The latter perhaps most char.c U. coal measure fossil.
All veins same size

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Archaeocalamites . Seward P 383

Cone described by Renault as belonging to Archaeocalamites differs from Calamites agrees with equisetum in the absence of sterile bracts between the whorls of sporangiophores sometimes the grooves on the pith cast shew the same alternation at the node as in Calamites ; & also the Calamites do not constantly possess this char:

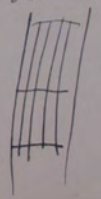
Millstone grit & associated shales, very barren of plants. What there are are like those of L: Coal measures.

Carb L^re Series

I Culm sandstone of Scotland, esp. Burdie House L^re
II Culm of Germany repts L: Carb. of England & contains same flora as I

Lepidodendron Veltheimianum
Leaf bases separated by undulating bands

Sigillaria much less common than in U Carb
Calamites become extremely rare. Their place is taken by {Archaeocalamites / Asterocalamites
One British sp only, also occurs in Continent
A. Scrobiculatus



Ribs do not alternate at nods

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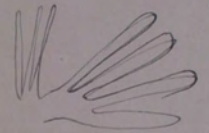
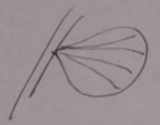
Sphenopteris different in type from U. Carb.
They are placed in another genus Calymmatotheca. This
a natural genus – fruit also known
Common type S (Calymmatotheca) affinis



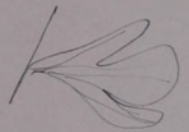
Delicate fern, pinnules broadest at apex

Adiantites



Undivided pinnules w. no
median nerve
Oval in contour with
contracted wedge shaped base

Rhacopteris. Frond usually deeply divided. Otherwise
like Adiantites



Sphenophyllum
Cordaitaceae
Cycadofilices
} also occur

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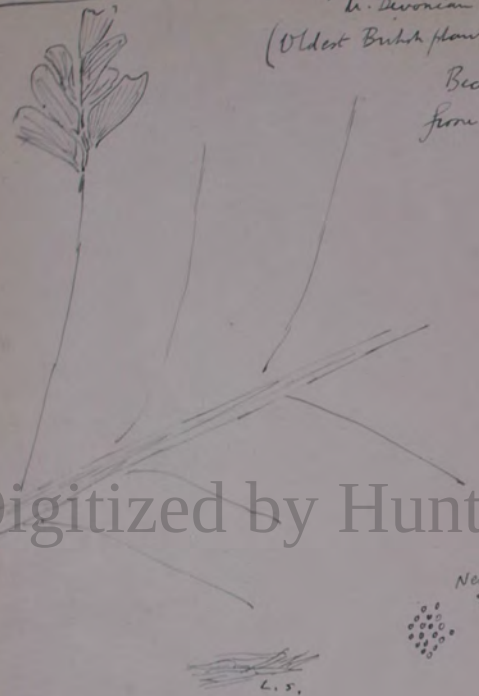
Devonian

Archaeopteris hibernica
U. Devonian
(Oldest British plant not an alga)

Beautifully preserved spec.
from Killorcan S Ireland.



Neuropteris
U.S. Europe

L.S.

Silurian

No case made out for occurrence of any plant remains other than algae in any part of the world.

Many contradictions of this – plants higher than algae in Stur Etage H-h, Bohemia. Rocks used to be referred to Silurian but now known to be U. Dev or L. Carb.

Annularia & Sigillaria have been stated to occur in Silurian of Canada. But these were not rightly determined

Nematophycus Observed 1856 in M & U Silurian of Canada in Gaspé sandstone. (Dawson) Since then in Wenlock of Cardiff at Tymawr near Corwen in N. Wales.

Large silicified trunks, sometimes 2 or 3 feet in diameter. Consist of longitudinally loosely arranged tubes with undulate somewhat in their course

Dawson thought it was a Conifer allied to the Yews called it Prototaxites. All palaeobotanists call it an alga now. It is like Lessonia of the Arctic regions

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Nematophycus } Seward Foss. Plants p 192
Pachytheca } p 202

<u>Devonian</u>

Zeiller p 336 Potonié p 364

Dawson Fossil Plants of the Devonian & Upper Silurian Canada (A.5.48)

<u>Lower Permian</u>

Zeiller p 338-340 Potonié p 376-9

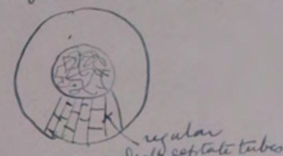
Göppert Die Foss. Flora der Permischen Formation (Libr. A.3.35)

Zeiller & Renault Permien d'Autun (Libr. A2.64-65)

Ginkgo See Seward Annals of Botany 1900.
(Libr. [illegible]

Pachytheca

Occurs as small globular bodies abt ·5 cm diameter.
Sometimes occur in association w. Nematophycus e.g. at Corwen.
In Ludlow bone bed & Woolhope & May Hill Sandstone occur without Nematophycus.
It is silicified & can be sectioned



Dawson thought it the seed of Nematophycus. Now thought to be an independent alga.

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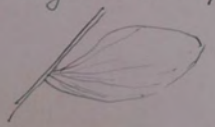
Devonian

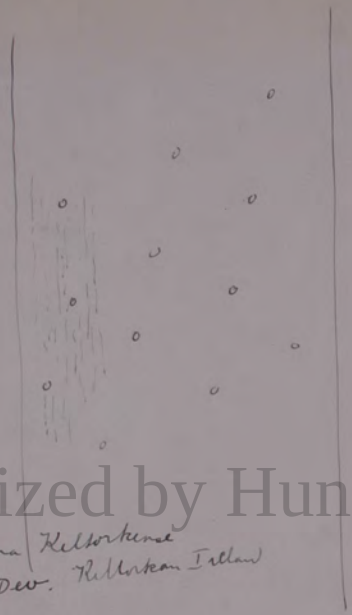
Oldest fossil flora. European Devonian v. poor. U Devonian of Ireland + Belgium, + Bohemia yes best European examples. Also U Devonian of Russia, E. Australia, + some localities in Arctic yes some of best material. But best of all comes from Canada + U.S. Dawson first described this flora as "Erian."

British Examples:- Fragments in ORS of Scotland. + Devonian of Devonshire. Not good enough to give much information. Waterford + Cork, especially Kiltorkan Hill, Kilkenny. Discovered by Forbes in 1850. Grey micaceous flagstone, commonly beautifully preserved. Best known is Archaeopteris Hibernica. Occurs also in Belgium + Sp. from Canada + S. Australia are almost indistinguishable from British form. Closely resembles Adiantites of Lr Carb. Archae: has much larger pinnules forming lanceolate pinnae, + a much larger frond. A. hibernica is a tripinnate fern with large delicately toothed pinnules, unsymmetrical



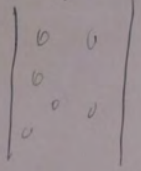
fructification is preserved, but not well enough to make out systematic posn. Probably marattiaceae

In associate with this fern get a Sphenopteris + narrow leaved type, + another new



Cyclostigma Kiltorkense
U. Dev. Kiltorkan Island

plant Cyclostigma Kiltorkense. (This occurs in same beds as Lepidodendrids, OKs fish etc.)
Sometimes leaves are preserved, but commonly only leaf scars separated by spaces of smooth bark



Probably it is a Lycopod.

//

In Gaspé sandstone, & the Hamilton Shales of U.S. have best known Dev. flora.
Sphenopteris not uncommon, but Pecopteris & Alethopteris rare. Alethopteris also occurs.
Equisetales: Archaeocalamites radiatus, scrobiculatus, as occurs in U. Carb, occurs in these Devonians. Stylocalamites Suckowi is v. abundant, as it is throughout Palaeozoic. It's so far the only Calamite.
Bythesea. Knorria (Lepidodendron) occurs.
(No Sigillaria)
Cordaites
Algae, Nematophycus etc.
Flora as a whole of same type as U. Carboniferous.
No cycadofilices so far discovered in Devonian.
But we only know anatomy of these, & don't get anatomy much preserved in Devonian.

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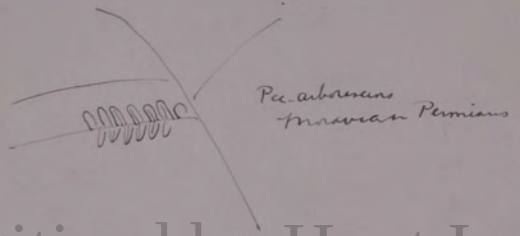

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Palaeophytic Floras [Devonian
Carb
L. Permian

U. Permian wh is included in Palaeozoic, is not Palaeophytic, so terms are not synonymous]

Permian Zechstein
Rothliegende

Most which do occur are found in marl slate. Better examples in Germany & France. Thüringen, Dresden, Autun, Epinac, Brive.

Flora of Zechstein very different from Rothliegende. Zechstein v. like Trias in Flora.

Flora of Rothliegende

Chiefly survivors of Carb. types especially U. Coalmeasures.

Several species of Pecopteris common to U. Coal measures & Rothliegende e.g.

P. arborescens

P. unita  stalk

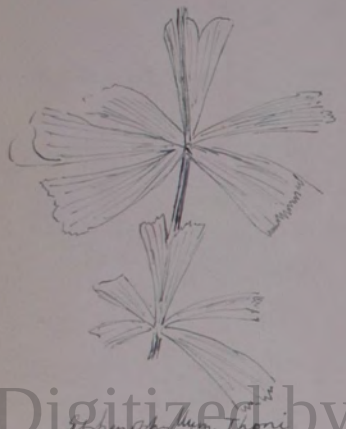
Alethopteris & Odontopteris

Neuropteris Scheuchzeri.

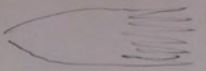
Calamites Stylo Calamites
Calamites
Eucalamites

Lepidodendron

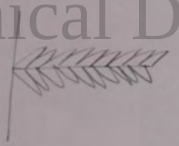
Sigillaria



Sphenophyllum occurs as char.c large-leaved form



Cordaites
Cycadofilices
Maddition to these typical carboniferous types, get others which are char.c of mesozoic.
Cycadales & Coniferae appear.
Ginkgoales
Cycads get very important in Jurassic.
Walchia is one earliest conifers. Happears in L.c Permian. W. piniformis.



imbricate leaves & much like those of Araucaria

Ginkgoales
Ginkgo. Maidenhair Tree. Sacred tree in Temple gardens of far east. G. bilobata = Salisburia
Tall tree, comparatively hardy
Leaves may have an entire apex, or be much cut up
Leaves very similar to those in L.c Permian, G. Primigenia.
Abundant in trias, prob max in Wealden.
Fructification of G. Primigena is unknown.

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Baiera - Same as Ginkgo but leaf divided into a number of segments - [also some diffs. in fructification]

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Trias Zeiller p 345 – Potonié p 382
Equisetites arenaceus Seward p 268
Voltzia Schimper & Mougeot Plant Foss.
du Grès Bigarré 1840
Libr A. 1.54

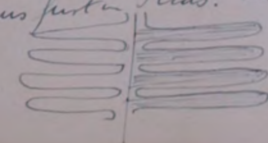
Jurassic
(1) Lower Oolite of Yorkshire Coast.
Seward Brit. Mus. Catal
Libr. A. 5.131
espec. pp 302–312 & pp 1–42
Seward, Structure & affinities of
Matonia pectinata Phil Trans vol 191
1899
Libr A. 3.
2 Upper Jurassic
Seward 'on a Cycadean stem from
Portland
Q. J. Geol. Soc 1897 (Libr A. 5.13

Mesozoic Floras

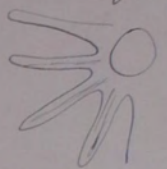
Plants scarce in Trias.
In Palaeophytic times Pteridophyta are dominant.
Zechstein flora closely related to Trias
Zechstein Bunter & Keuper
form transition from palaeophytic to mesophytic.
Rhaetic Jurassic Wealden together form mesophytic type
to mesophytic is of much smaller extent than mesozoic,
as it does not include Cretaceous above Wealden, or
Mesozoic below Rhaetic.
Neophytic flora wh has survived to present day
begins in Cretaceous.

Transition Group

Scanty evidence from British rocks. Keuper of
Continent gives best results. (Muschelkalk hardly
any)
Calamite is replaced by Equisetites.
Lepidodendra & Sigillarias give way to Cycadales &
Coniferales.
Ferns more closely allied to recent ferns than those
of coal measures.
Bennettiteae – Of great importance in Jurassic
times – First appears in Trias
Pterophyllum. Occurs first in Trias. Also Jur. & Wealden
P. longifolium
Cycadean leaf.



Equisetites arenaceus Perhaps best known of all Trassic fossils. Differs from calamite in basal portions of leaves being fused into a collar as in modern equisetum



Not put in equisetum because anatomy is unknown.

This was a large tree with probably secondary thickening.

Pith casts are the commonest. Alternating ribs & grooves. External impressions of stem bear at nodes whorls of branches & leaves united in a basal collar.

Coniferales

Voltzia - generally looked upon as a fossil member of Taxodineae

V. heterophylla often spoken of as the only British Trassic plants.

Leaves spirally arr.d, imbricate, linear & linear lanceolate, decurrent.

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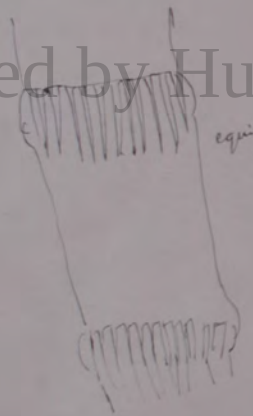

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Mesophytic Flora Proper

Take best known flora first, as we did in Palaeozoic.

Jurassic

Plants recorded from all over the place. English Jurassics are perhaps the richest. L^r. Oolites of Yorkshire have yielded a most abundant flora. Stonesfield Slate & Purbeck etc also give plant remains. Purbeck beds of Isle of Portland contain an example of old surface soil, Purbeck dirt bed. Numerous silicified stumps of conifers & cycads occur. "Fossil Crow's nest." The persistent leaf bases give char^c appearance. Purbeck contains little else

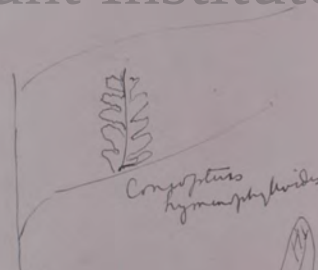
L^r. Oolites of Yorkshire. Alternating estuarine & marine:-

- Upper Calc. Grit
- U Estuarine
- Scarborough L^s
- M. Estuarine [esp: Gristhorpe Bay]
- Millepore beds
- L^r. Estuarine [esp Ribin Hood Bay]
- Dogger

all section exposed along Yorkshire coast between Whitby & Filey, Adest in N & Dipping S

Equisetites columnaris [replaces E. Arenaceus of Trassitic] External casts, turnid nodes, leaf sheaths of 70-80 long narrow segments. Leaf sheath closely appressed to stem. Tips of leaves often broken. Fairly large & thick, but not so thick as Equisetites of Trias. Genus even more slender in Wealden.

Dicksonia Antarctica



Asplenium lucidum

Jurassic ferns

In many cases specimens have been found with good fructifications, so can be referred to natural genera

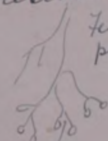
Matonineae

Matonia pectinata } ex recent examples
sarmentosa }

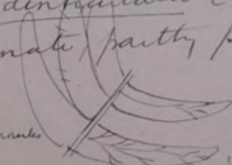
Only occur in Malay archipelago

Matonidium Göpperti. Frond fan shaped or pedate
If we did not know its fruct[n] we could not put it in this genus. But the fruct is known & is almost identical with Matonia pectinata

Coniopteris hymenophylloides [Cyatheaceae]
Cf. Dicksonia antarctica specimen
Fructification resembles bunch of immature grapes



Cladophlebis denticulata [Polypodiaceae]
Fronds pinnate partly pecopteris & partly neuropteris type.



Specific character:-
Pted sickle shaped pinnules attached by whole base
nerve breaks up before it gets to apex
Dichotomously forked nerves given off at acute angle
"Cladophlebis type of neuration"
c.f. spec. Asplenium lucidum

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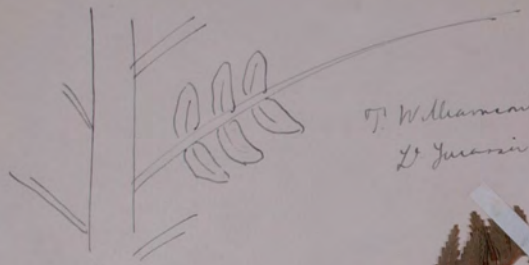
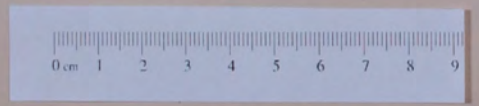


T. Williamsoni
L. Jurassic

Todea Barbara



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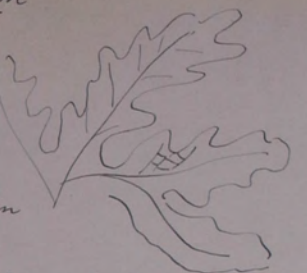
Todites Williamsoni [Osmundaceæ]

Habit very much like Todea
Cf Todea Barbara spec, very stout rachis
Cladophlebian nervation

Dictyophyllum rugosum

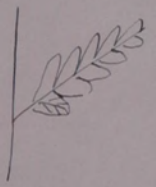
[cf modern Dipteris now confined to Indo-Malay district.
Dictyon is removed from polypodiaceae + now given an order to itself]



Detached portions of the large palmate fronds might be taken for distinct leaves
Anastomosing secondary veins form a network

Klukia

Exilis occurs in Yorkshire. Frond of Pecopteris type
It represents Ochlea ~~species~~. Sporangium apical annulus.
Frond of type of cladophlebis



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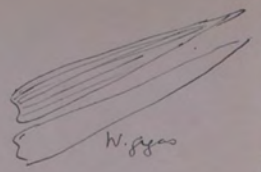

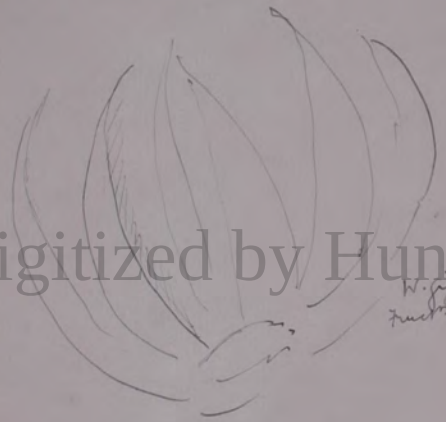

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Cycadales

Stem rarely branched. Covered w. armour of persistent leaf bases. Leaves commonly leathery perennial. Veins chiefly parallel.

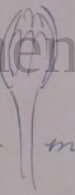
Fert. by motile spermatozoids

Bennettiteae Fructification totally distinct from anything known in recent cycads.

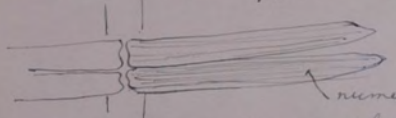
Bennettites. [Wealden.] is the type genus. Tho' it has not been found in Jurassic it is best to take it first.

small short fructifications branch wedged between leaf bases [C.S. Scott's studies in fossil Bot.]

In Jurassic [wh. also occurs in Wealden] genus **Williamsonia** fructifications borne terminally on long branches



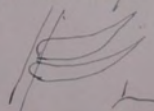
W. gyas is commonest sp. in Yorkshire. Leaves not attached to rachis but upper surface



numerous ||el veins, sometimes forking.

Outer involucre of bracts which covered the fructification is known only.

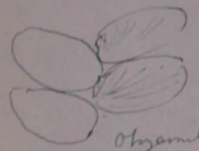
W. specten is another Yorkshire species. Pinnae are at a slightly acute ∠ to rachis



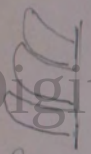
Base has same breadth as rest of pinna

Obliq. attach.ⁿ is chief char.ᶜ

occ: upper margin slightly expanded.



Otozamites Beani

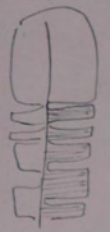


Nilssonia compta

Anomozamites

A. Nilssoni - fructification unknown from British specs, but known from Sweden

Linear leaf divided in lower part into truncated segments of various breadths

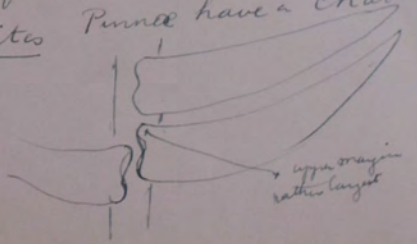


Besides the Bennettitae we have various Cycadean leaves which are put into four genera

Nilssonia one of most char.e & abundant of Yorkshire Lower Oolite

N. compta, commonest Jurassic sp, has truncate segs. of unequal breadth.

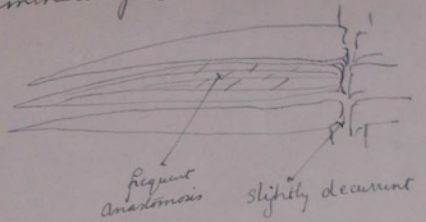
Otozamites Pinnae have a char.e auriculate base



O. Beani, shape & size of pinnae very considerably

Veins numerous, repeatedly forked, & spreading from the rachis

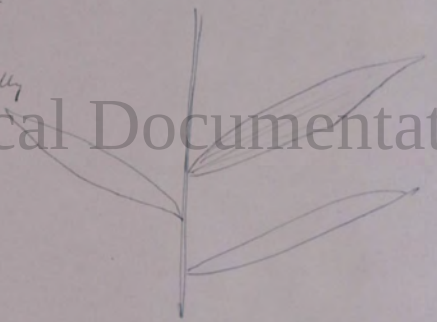
Ctenis falcata Long pinnae tapering gradually to an acuminate apex



Podozamites Leaf v. like zamia.

P. Lanceolatus

linear lanceolate tapering leaves, basally



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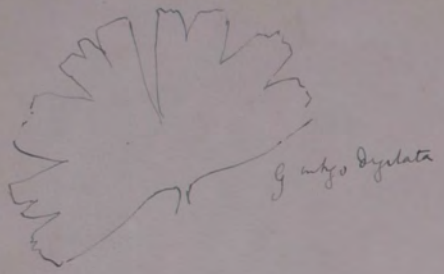

Ginkgo digitata

Baiera gracilis

Coniferæ not so abundant in Jurassic as Cycads + Ferns.
Perhaps they occupied areas far inland, away from estuary
where Wealden deposits were laid down
Such as do occur chiefly allied to Araucaria + Podocarpus.
No Abietineae in L. Oolite times, but in succeeding Wealden
they are much in evidence
Ginkgo + Baiera v. abundant in L. Oolite

L. Oolite Flora as whole :—
Cycads, Ferns + less numerous Coniferae
Total absence of angiosperms ; + also of palaeophytic
types. Cycads partly Jeehnit types. Ferns some of
which are closely allied to modern ferns. eg Matonidium,
very close to Matonia

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Rhaetic Flora

A Robertson

SOLLAS, 1901.

IGERNA B. J. SOLLAS.

NAIADITA LANCEOLATA.

[Quart. Journ. Geol. Soc., vol. lvii, 1901,
pp. 307–312 & pl. xiii.]

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Palaeobotany 98

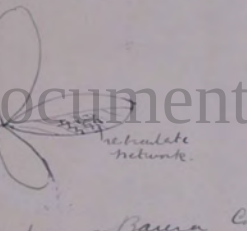
References

Rhaetic Flora

Rhaetic rocks essentially allied to Jurassic rather than Trias.
British Rhaetic has yielded little; Continent supplies examples.

Equisetites - eg E. Munsteri
Matoniaceae probably reached maximum in Rhaetic.
Cladophlebis - C. Roesserti [= C. denticulata practically]
Dictyophyllum repd. by closely allied genera.
But the Jurassic Klukia & Coniopteris do not occur.
Acrostichites [closely allied to Todites] Göppertianus
Sagenopteris rhoifolia does not occur in Jurassic

Doubtfully referred to
Marsilea [Saportaea]



Many cycadean leaves, Ginkgo + Baiera common.
Coniferae if anything less abundant than Jurassic
Altogether close similarity. Most plants specifically
Distinct, but one + two sps go on
eg. Podozamites lanceolatus
Sphenopteris princeps

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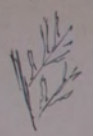
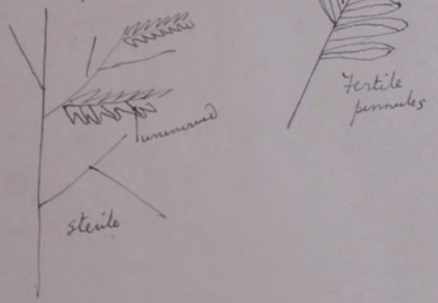


Wealden { Weald Clay / Hastings sand

Fairly hot clay gives specially good flora.
Portugal & N. America (Potomac beds) are v. important
Wealden flora seems to have been v. uniform & independent of latitude
Continuation of Jurassic type of flora.
Equisetites with more slender stems than the earlier species
E. Lyelli — commonest
E. Burchardti. Tubers occur attached to stem as in recent members e.g. equisetum tuberosum. This is another indication of closeness of equisetum & equisetites

Ferns

Onychiopsis mantelli - Closely resembles recent polypodiaceous genus Onychium. Tripinnate frond w. slender rachis. Lanceolate alternate pinnae & narrow acute pinnules



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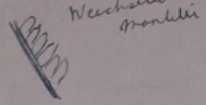
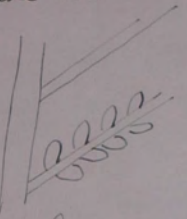


Weichselia Mantelli

Bipinnate frond, broad rachis, small entire pinnules inserted by whole base



rebuilate nervation

Matonidium Göppeti is common to Jur & Wealden
Ruffordia Göppeti " " " "
Ginkyo digitata " " " "

Ruffordia is essentially a Wealden fern [Schizaeaceae]
Pinnules deltate, dimorphic on rachis, nerves spreading & repeatedly forked

Cladophlebis
Dictyophyllum
No Wealden representative of Osmundaceae

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Cycadales

Bennettitaceae

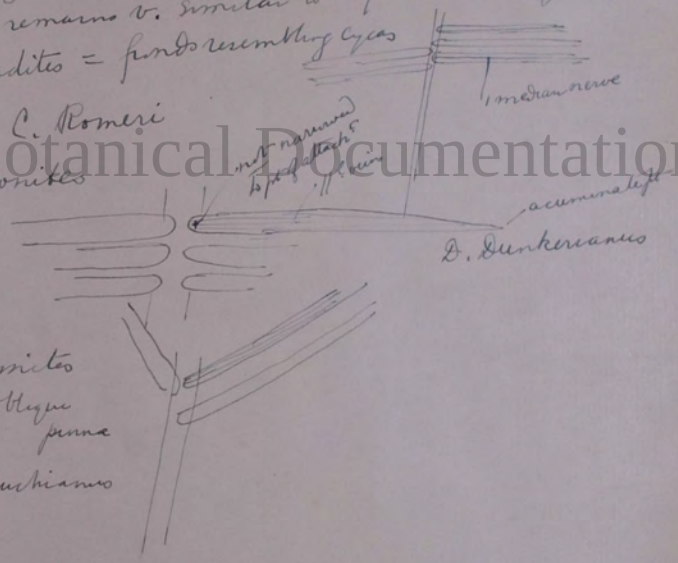
{ Bennettites
{ Williamsonia

Bennettites. Stems only. anatomical structure preserved.
Correlation of stem & leaf is still to be desired

[Point now cleared up by Wieland's discovery of a number of young leaves still folded in the terminal bud see Scott's Studies. Fossil Botany p. 468)

Nilssonia
Otozamites.
Anomozamites

Also remains v. similar to Cycas, Dioon & Zamia
Cycadites = fronds resembling Cycas



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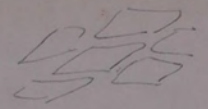

Pinales

Coniferæ

more important than in Dicots

Abietaceæ Cones like those of pines = Pinales

Taxodiaceæ

Cupressaceæ

Not a single monocot or dicot in England

But in Neocomian of U S Portugal first definite appearance of Angiosperms

This impossible to say monocots older than dicots & vice versa. They seem to arise somultaneously

Among earliest dicots fossil leaves of Salix Populus Laurus,

This sudden origin of Angiosperms is utterly puzzling.

Our knowledge of the early angiosperms depends almost entirely on leaves.

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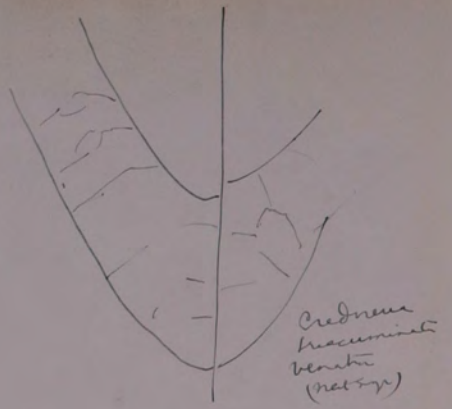
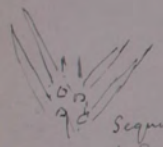


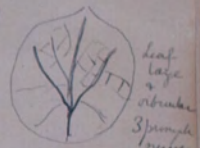


Post Wealden Floras

Nearly always detached leaves & fossil fruits & seeds
Considerable variation in shape due to age of leaf, position on tree etc! How are they to be distd specifically?
Clement Reid – Pleistocene & Late
Starkie Gardiner Eocene & Miocene

U Cretaceous of Britain. Plants very rare – Aix la Chapelle, Saxony, Westphalia, shallow water littoral type of strata. The flora is predominantly Angiospermous

Credneria [a form resembling Platanus]



C. Triacuminata Cenomian Blankenburg

Sequoia [illegible] U. Cretaceous

Beech, Birch, oak
The tropical forms are mostly those now confined to Australia (e.g. Eucalyptus) Leptospermum; Dendrobium (Miocene)
Monocots fewer than dicots even from these early times
Podozamites Zamites & Baiera appear for last time

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Tertiary Floras

...coast cats between Chalk + Eocene which separates Eocene ...it - Very unique + ...cene.

Cladophlebis, Pterophyllum, and Otozamites are given.

Some form of fossil plant was found by the geologist of the *Discovery* as far south as lat. 78°, but it has been found quite impossible to identify it on account of the imperfect nature of the specimen.

The second part of the book makes some thrilling reading, but adds very little to our knowledge. The attempt of Dr. Andersson, Lieut. Duse and seaman Grunden to reach Nordenskjöld across the ice from the *Antarctic* in the summer of 1902–3, their failure either to reach the winter quarters or to regain the ship, and subsequent lonely winter in Hope Bay, is given in detail. The *Antarctic* foundered on February 12, 1903, as the result of a severe ice "nip," and the crew succeeded in reaching Paulet Island across the ice, where they spent the winter under extremely trying conditions. Fortunately, both Dr. Andersson and Captain Larsen and their parties succeeded in reaching Nordenskjöld's winter quarters in the following summer, and, with the exception of a sailor who died on Paulet Island, all were rescued by the Argentine ship *Uruguay* in November, 1903.

The book consists of about 600 pages, and there are a large number of illustrations, some of which are from crude drawings and are indifferently reproduced. The coloured plates might have been advantageously omitted, as they give no idea of the extreme delicacy and beauty of Antarctic colour. Here and there are slight slips, such, for instance, as appears on p. 119, where the velocity of the wind is given as forty-five miles per second! However, there are no serious blemishes. The field of operations was, geographically, a limited one, and well outside the Antarctic Circle. Scientifically we may look forward to more interesting results. No attempt has been made to give an account of the scientific work, and Dr. Nordenskjöld hints that several years must elapse before the results of the voyage of the *Antarctic* can be published in full. L. C. B.

A NEW BRITISH MARINE EXPEDITION.

THE hydrographical and biological investigation of the central and western parts of the Indian Ocean will this year be the object of a special cruise of H.M.S. *Sealark*, which is fixed to leave Colombo for the purpose about April 20. This yacht, which is the latest addition to the survey vessels of the Navy, is under the command of Captain Boyle Somerville, who will be accompanied by two scientific civilians, Mr. J. Stanley Gardiner and Mr. C. Forster Cooper.

It will be remembered that the Indian Ocean was not visited by the *Challenger* Expedition in the famous cruise around the world, the course then taken lying further to the south, almost within the Antarctic circle. Meantime, however, knowledge of the

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Palaeobotany 9-10

[Ref]erences

Eocene & Oligocene	Gardner & Ettingshausen	"Eocene Flora", Vol 1 & 2 (Libr 7 1.47 & 48)
Eocene	Gardner	The Flora of Alum Bay p 104. (Libr G-3.18)
"		Lower Bagshot beds of the Hampshire Basin (Libr. D.4.10)
Miocene	Zeiller p 353	
Pliocene & Pleistocene	C. Reid	Origin of the British Flora Chap IV p 33 & Ch VI p 48 (Botanical Library
Pliocene	"	Pliocene Deposits of Britain Libr (G.3.19) p 231 etc
Pleistocene	"	Pleistocene of Sussex Coast. Q.J.G.S 18~~9~~2 p 3~~4~~4 (Libr 7.4.52)

Glossopteris Flora

Seward Science Progress Vol 6, p 178 (Libr ~~A~~ I.3.30)

Seward Fossil plants as Tests of Climate p 110 Libr A.5.118)

Tertiary Floras

[...]hat separates Eocene [...]y unique &

[...]falis

[...]val of Delbert [...]h appeared in [...] of Australian & [...] plane, hazel, [...]ua, Liriodendron

[...]nost entirely [...]mmon in Isle

[...]' now largely

[...]F

[...]a belong [...]na, Cactus, ~~[illegible]~~

...ying further to the south, almost within the Antarctic circle. Meantime, however, knowledge of the

the return of the *Antarctic*, important fossil finds were made on Seymour Island. The first were bones belonging to a species of penguin considerably larger than the largest now living—the Emperor penguin. This demonstrates that even at such a distant epoch—probably the beginning of the Tertiary period—the penguin was an inhabitant of the Antarctic regions. The other was that of numerous large and quite distinct leaves in a brown, coarse, hard, tuff-like rock, belonging to different forms of exogenous trees, firs, and ferns. The leaves are small and narrow, and call to mind similar fossils from the Tertiary form-

NO. 1850, VOL. 71]

region has been steadily increased by the exertions of individual explorers and by special Admiralty surveys. To the east there has been continuous progress, culminating in the Dutch *Siboga* Expedition of 1899–1900 through the East Indies, while other explorers have investigated Keeling Atoll, Christmas Island, and parts of Torres Straits and Western Australia. To the north, the Indian survey vessel *Investigator* has been active from the Persian Gulf almost to the Straits of Malacca, while individual explorers have borne their full share. Prof. Ortmann examined the reefs of Ceylon, and Prof. Herdman is now publishing a full account of the marine fauna and flora of that region. In addition, Mr. Stanley Gardiner, with Messrs. Borradaile and Forsyth, during the summer of 1902–3, while waiting for

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Tertiary Floras

Great gap between Chalk + Eocene which separates Eocene plant life from all preceding it - Very unique + complete set of floras in Eocene.

Thanet sands

Pinites cones

Fern closely allied to Osmunda regalis

Woolwich + Reading

Temperate facies. May be a survival of Adult indigenous chalk flora of Europe which appeared in Neocomian times. Marked absence of Australian + American types. Sequoia, poplar, plane, hazel, Laurus, acacia, Grevillea, Lindendron

London Clay

Essentially tropical. Innumerable endemic fruits + seeds. Fossil fruits are common in Isle of Sheppey.

Ferns + Cycadites - Ginkgo

Musa [which is really an Oldworld genus tho' now largely cultivated in America]

Magnolia, oak, almond

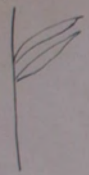
Things now Australian, Eucalyptus, Ficus

Tropical climbers Genus Bauhinia

Diospyros [which date palms] Pandanus belong

Ficus, Acacia, Dryandra, Cassia, Casalpina, Cactus, Nipa

sequoia
Alum Bay



~~pte~~: Leaves of Walnut, Diospyros oak
laurus
fr Alum Bay

L Bagshot

Pipe clay band in Alum bay - Numerous fossil plant remains mostly isolated leaves. The band is almost worked out

Chiefly leaves of deciduous trees. Distinct from those of M. Eocene of Bournemouth.

Coniferae, Podocarpus [S Temperate zone E Asia]
Fern closely allied to modern Marattia, viz Marattia Hookeri. Now essentially Tropical ferns
Proteaceae. [Systematic posn doubtful] Eg Banksia wh is now confined to Australia. Figs, laurels, aralias, maples

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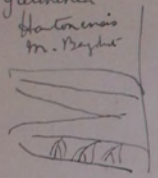
Gleichenia (Bournemouth)
Hantonensis
M. Bagshot

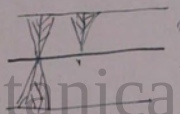


Middle Bagshot (Tropical facies)

Pipe clay band in cliff at Bournemouth: N. American type. Many members of Myricaceae -
Hornbeam, Beech.
Aroids Fan palms
Sequoia Cupressus Araucaria

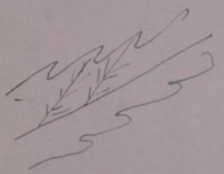
Ferns:-
Lygodium - kaulfussi [Schizaeaceae] Tripinnate frond becoming simple above

Gleichenia Hantonensis
Dichotomous pedate frond, with lanceolate, entire obtuse pinnules



nervation v. char.

Osmunda lignitum



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Cinnamon
[char: neuration]

<u>Bovey & Mull Beds</u>

Example of help of Palaeobotany to Stratigraphy.

Tertiary outlier at Bovey Tracey.

These 2 places were thought to be Oligocene, but their flora shews them to belong to M. Bagshot.

Osmunda lignitum, oaks, figs, laurels, cinnamons of Bovey Tracey, just like Bournemouth.

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From Middle Eocene → Miocene tropical members gradually disappear, & their place is taken by more temperate members. Palms, magnolias & maples occur in early Miocene times, but not in later ones. Palms are absent in newer Miocene.

Oligocene (Sub tropical, more temperate than Eocene)

Only M & L present in Britain.

From top of Hempstead Stop of Pliocene there is a big gap in Britain in our knowledge of the flora.

Plants in Amber in Oligocene of N. Germany.

Has, as a whole, a good deal in common w. flora of E. Asia especially Japan, & parts of N. America. Great abundance of palms, some Lebanese also occur.

Taxodium distichum occurs - W. Europe, tho' now American. Yew, pines, larches, Sequoia.

Chestnut, Aralia, Bignonia, Cinnamon

Occur also with ducts such as beech, juniper, alder, maple etc

Palms

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Miocene [absent in Britain]

Gradual elimination of more tropical types
Great affinity w. Mediterranean flora - many types
closely allied to or identical with recent British
plants. So possibly our present flora may some
day be traced back to Continental Miocene

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Pliocene

First definite traces of present British flora occur in Cromer Forest bed at top of Pliocene

L Pliocene (Coralline Crag of Suffolk) is marine

Newer Pliocene contains Cyprina flora, especially in the Estuarine or Lacustrine Cromer Forest series.

Cold conditions are evidently setting in. Palms almost entirely died out.

Seeds & fruits.

Leaves are exceptional as fossils, generally occur only in Calcareous tufa

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Betula nana fruit-scale

Betula nana

Leaf of a species of Trapa

Pleistocene [i.e. right up to present day]

{ Forest period (where we are now)
{ Steppe "
{ Glacial "

Probably more than one period of intense cold, alternating w. warmer periods. Botanical evidence supports these views if only a small number of alternating periods are assumed

Cromer Forest Bed is a typical preglacial flora. It is interesting; Damp meadow species, aquatics & forest trees. ∴ no floras are known which immediately preceded glacial period. Only 3 plants of C.F.S. are not now known in Britain.

[Picea excelsa. Red pine. Now Central & N Europe but not British
{ Trapa natans. Survived in Sweden till a few years ago. Now occurs in Mediterranean & Tropics
[Najas minor Still survives in Rhine

Temperate flora was driven south by the cold of the glacial period & Arctic plants took their place. We have Salix polaris (now Arctic only) & Betula nana (Now Arctic & N England Scotland) in till of Norfolk coast

A Robertson

On Homœomorphy among Fossil Plants.
By E. A. NEWELL ARBER, *M.A., F.L.S., F.G.S.*

It is fully recognised that among recent plants species of different descent may possess many closely identical characters as the result of adaptation to particular conditions of the environment. Such xerophilous plants as *Cactus, Euphorbia,* and *Stapelia* are instances among many which might be quoted.

It is interesting to find that there is some reason to believe that similar instances of parallelism of development may be found among fossil plants. Attention has been called to this subject by recent progress in the study of fossil invertebrates. It has been pointed out by Mr. S. S. Buckman in regard to the Jurassic brachiopods, and by Messrs. Nicholson and Marr with reference to the graptolites, that species sprung from different stocks commonly exhibit 'the phenomenon of similarity in general with dissimilarity in detail,' and such have been termed by Mr. Buckman *homœomorphs.*

Among fossil plants the following genera and species exhibit the phenomenon of homœomorphy:—

Alethopteris and *Lonchopteris*	(Carboniferous).
Neuropteris heterophylla and *Linopteris Münsteri* .	,,
Neuropteris gigantea and *Linopteris sub-Brongniarti* .	,,
Otozamites and *Dictyozamites*	(Jurassic).
Glossopteris and *Gangamopteris ?*	(Permo-Carboniferous).

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1st glacial period = Ice age proper
Interglacial period. Temperate forms gradually drove out Arctic with a few exceptions.
In Boulder Clay of Sussex coast at Selsey Bill. Get oak, rose, hawthorn etc, with 2 or 3 southern forms not now found in Britain, Acer monspessulanum Najas minor & graminea

2nd Period of dry cold (2nd glacial period) Probably Loess of continental deposit. In clays of Bridlington & Bovey Tracey. Dryas octopetala with arctics is abundant

Warmer period now prevailing = Forest Period.
Char.d in Britain by large oak forests
Survival of arctic sp.
Introduction of weeds & foreign plants
Record of minor Changes of forest period in peat mosses, river gravels & submerged forests
One of these changes is disappearance of Pinus sylvestris wh was very common in earlier pt of period

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"Kieselguhr" – Yellowish or white layer of diatomaceous earth in places in peat bogs etc where pools have dried up. e.g. Scotland
Oldest rocks where diatoms occur in any abundance Cretaceous. Do not occur in oldest rocks. – Coral reefs consist a good deal of algae. Reefs in Mediterranean of Lithothamnium. A little way below surface vegetable structure somewhat obliterated, & further still a quite homogeneous l.s.– So perhaps some of older limestones may have been formed in this way.

Microscopic exam^n. rendered possible by silicification or infiltration of $CaCO_3$. The latter especially in Coal measures in England; former from France & Saxony. Extinct synthetic types eg Cycadofilices.

Distribution. – In present day some isolated types in all senses e.g. Ginkgo. – Remains very frequent in rocks of different ages. Ginkgo happens to be a plant in which form of leaf is very important. – Seeds & ♂ flowers have also been found. Leaves most abundant in Jurassic, also in Rhaetic & Trias.
In Tertiary, remains in Arctic circle & Mull leaf beds. These are found between outpourings of lava. Some are lake deposits.
(1883 Krakatoa eruption 1886 Treub found number of plants had reestablished themselves. First one of Cyanophyceae then ferns etc. Somewhat same conditions in Tertiary in west of Scotland).
Some of best leaves of Ginkgo South of Scarborough in Inferior Oolite, leaves & ♂ flowers. Also Baiera. Much more cut. So, at least, two representatives in Jurassic. – In Rhaetic Baiera abundant, Ginkgo less so. In Permian forms about which there is some uncertainty. Ginkgo Baiera in Jur. of Spitzbergen, France, Germany. – almost world wide including S. America, China etc.
Similar series may be mentioned from ferns eg. Matonia & Dipteris (= Polypodium) Malay Peninsula & an sp of Dipteris in India. Dipteris 5 living sp, one a 2 very rare. Matonia 2 sp, one in one spot only. Both abundant in Jurassic & Rhaetic. Have been found fossil in England & Scandinavia. Fossil plants give evidence of

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direction of migration. Tansley. Lang, photos of Dipteris & Matonia on Slopes of Mt. Ofir in Malay Peninsula — might do for a restoration of Jurassic flora!
Brongniart concluded that plant bearing strata might be divided into groups char^d by diff. plants e.g.

Tertiary } Angiosperms. Jurassic } Gymnosperms
Cretaceous } Triassic }
Palaeozoic Cryptogams

Before Cretaceous no really trustworthy remains of Angiosperms known. Seem to occur suddenly & whole char^r of vegetation seems to change. They seem at once to have driven out the dominant families — Arborescent Vascular Cryptogams in Palaeozoic. Their disappearance extraordinarily sudden.

Preservation of Plants

Paper coal of Toula. L^r Carboniferous. Brown strips like brown paper. Strips of cuticle with polygonal cells marks showing form of cells. Bothrodendron

I Incrustation —
II Petrifaction —
Amber may be both. Generally by I a mould is left in the amber on the decay of the plant fragment. Sometimes pine forest over parts of NE Germany occur
II Internal structure may be preserved
Sézanne (Eocene). Calcareous Travertine with hollows where plants used to exist. Fill with wax or plaster of Paris under an air pump & dissolve away travertine

Structureless casts are the commonest way of preservation.
Impressions. Leaf generally rep^d by thin film of coal, less commonly oxide of iron or talc. Reduction in bulk is result of conversion of the plant material into coal. Sometimes the thin film

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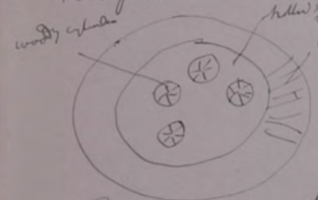
of coal can be removed & treated with macerating fluid, may get outlines of epidermal cells well preserved, giving details of stomata, guard cells etc

"Coal-ball". (Sometimes applied to what are probably rolled fragments of pre existing coal seams.) But generally you mean Calcareous nodules full of little plant fragments which show very clearly on treatment with a little acid. Even the most delicate tissues are often well preserved. The nodules are surrounded by ≷ laminated coal. Calcareous water may have been introduced into the peaty layers.

In Saxony petrified plants usually in Silica

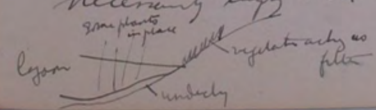
In Scotland plants occur in volcanic ash — portions of forests sometimes sealed up & preserved in volcanic ash, Pettycur in Firth of Forth. Petrified stems in volcanic ash in Island of Arran.



Lepidodendron

all but one of the woody cylinders didn't belong, but got washed in.

<u>Surface soils</u> Underclays of coal measures often spoken of as old surface soils. Sometimes Stigmaria rootlets are found spreading out in a way that looks like being in natural position. But this doesn't necessarily imply that the coal seam stuff grew there.



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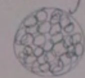
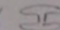
Nomenclature Brongniart's Sphenopteris Mantelli is like modern Onychium, so name changed to Onychiopsis Mantelli
Onychiopsis Mantelli (Brongniart) means that B. was author of specific name only. If the name is not in brackets it means B. was author of sp. & genus

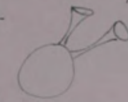
Thallophytes

Coccospheres First described by Huxley. Described in detail in Challenger reports.





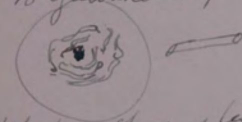
Rhabdolith



Entangled in tissues of fossil sponge in Lias. Also occur in
Ref. cretaceous. Murray & V H Blackman Trans Roy Soc:
Regard them as very simple form of alga
Dickson & Joly desc. from Irish coast.

Schizophytes { Cyanophyceae, or Schizophyceae
{ Schizomycetes

[illegible] suggested that all oolitic structure due to [illegible] presence to Girvanella, a simple tubular organism. Wethered



Nicholson & Etheridge found them first in Ordovician

Utah. Shores of lake. Modern oolite grains which consist in part of some cyanophyceous alga. Round calcareous pebbles from Michigan. The outer parts contain [illegible] nostoc tubules. Cohn in 1862 described formation of Oolite grains by [illegible] blue green algae
Ref Science Progress 1894 Seward Algae as Rock builders

Zonatrichites Calcareous nodules in Triassic rocks.

Gloioconis In Permian Coprolites

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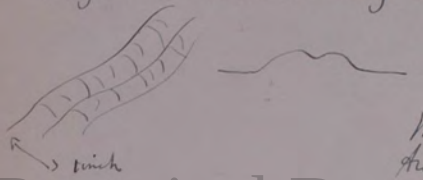
Schizomycetes Reynault. Permian coprolites. Minute rod like bodies

Nathorst artificially made things like Saportas fossil algae

Cambrian Eophyton Sandstone in Scandinavia. Sweden. Eophyton can be produced by trailing an alga over a surface, or by the tentacles of medusae. The remains of medusae do occur in these actual rocks.

W Mearnson took casts of rill marks by sea shore & they were extraordinarily like certain fossil algae



It was suggested that some of these bilobites represent the tracks of Balanoglossus.

Eozoon (Silurian) Originally described as fossil algae may be produced by purely mechanical means

Diatoms Deposits nr Berlin, Bilin (Bohemia) Kingsbey, Mt Richmond in Virginia, New Zealand

Some Liassic diatoms found entangled in fibres of a Liassic sponge. One apparently identical with Pyxidicula a modern genus. No trustworthy evidence earlier than this. Hooker 1844 Account of voyage of Erebus & Terror, mentions vast deposits of diatoms in Antarctic seas.

Murray & Renard described oozes dredged up by Challenger. Presence of carbonaceous matter confirms the organic origin of certain impressions. Also in these impressions small hard shelled creatures are found. Sediment composing casts is often chemically different; Carbon may be invisibly present, a minute remains of structure.

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Specimens from Eocene of Paris basin

Uterus

Broken piece

Acicularia

Dactylopora

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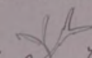
Siphoneae

Caulerpaceae. Murray desc. Caulerpa Carruthersii (Brit: Mus)
The impressions of the branches seem too deep for a soft alga like this. Perhaps egg capsules are more likely

Codiaceae. Codium. Penicillus Eocene sediments of Paris basin contain minute calcareous bodies "ovulites" ◯ ◯ 1877 Munier Chalmas suggested that these were remains of calcareous siphoneous alga. The 2 holed beads occur where branching takes place

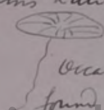
Sphaerocodium Hemispherical calcareous bodies met with in Trias of Tyrol on corals 4 30 cm. Makes large masses of the Jurassic & Kreide cf. Girvanella
In section appears to be a plexus of branched tubes



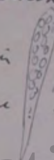
Halimeda Tertiary rocks.

Dasycladaceae Axial tube giving off verticels of branches of limited growth. Solms Laubach

Acetabularia



Eocene sands of Paris basin

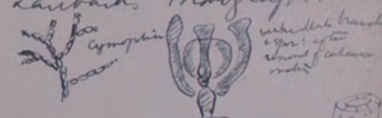


Called Acicularia
Cf. Carpenter's
Monograph
Foraminifera

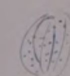
Occasionally 2 or 3 of the specimens were found sticking together. This led Munier Chalmas to refer them to the beds of caps of Acetabularia. They presented some differences to known Acetabularias but since a new one has been found

Linn Soc Trans 1895 Solms Laubach's Monograph.

Cymopolia Tertiary.



Vermiporella Silurian



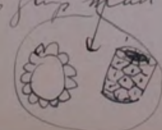
Sycidium Devonian

Diplopora Triassic Tyrol limestone sometimes almost made of these

Gyroporella Triassic, Tyrol; & Permian Alps

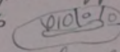
Dactylopora Eocene sands of Paris basin
like a more complicated diplopora

This group must have been very abundant in Tertiary.



Confervoideae

"Boghead" in Fifeshire. Carboniferous. Kerosene shale of New South Wales is a boghead.

Bertrand & Reynault. In section light particles in a brown matrix. These under higher power appear to be sacs whose walls are made of thick walled cells 

Bertrand thinks these are bodies of algae cf some pleurococcaceae with gelatinous walls. Small sacs occur in larger sacs. He thinks it is reproductive. He thinks it is a deposit at bottom of Permian lakes Cf. Fleurs d'eau "breaking of the meres"

The bodies were sealed up in an "ulmic ppt"

Bertrand calls those in Scotch bogheads Pila, & another name to New South Wales ones

Some people think the origin inorganic

Rhodophyceae

Lithothamnion & Lithophyllum build up modern coral reefs.

Leithakalk nr Vienna built of Lithothamnion

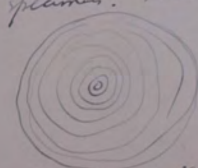
Archilithothamnion (Eocene) very like recent, slight diff in arrangement of tetraspores

Ref Solenopora (Ordovician) Scandinavia etc Geol. Mag. 1894 Brown

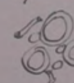
Phaeophyceae

Nematophycus. Carruthers 1870. (Dawson had previously described as Prototaxites) of Canada.

N. Logani Large specimens in Devonian rocks. In museum of McGill University Montreal. 1 ft × 2 or 3 ft, largest specimens.



Surface of stem often covered with loose carbonaceous matter = cortical tissue?



Minute structure of stem, loose tubes, curving about a good deal in their longitudinal course, with a very set of much smaller tubes between the larger ones, irregular course

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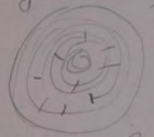
Apparently the tubes are almost non septate in certain
Connection of smaller & larger tubes has not been made out.
Penhallow says small ones arise by branching of large ones.
Diameter of large tubes decreases at regular intervals on cross section. In certain radial areas the large tubes are altogether absent, the smaller tubes seem to branch abundantly.
They look very like medullary rays.



N. Stockii Silurian rocks at Cardiff. Not well marked
diffs bet: large & small tubes.
Several other species. Silurian Devonian rocks Canada, U.S.
Germany, Wales, England.
Carruthers compared it chiefly with Siphoneae, thought
it represented Siphoneae Phaeophyceae. Annals 1876
Ref Penhallow puts it in Phaeophyceae. Some of the large tubes with a bulge, he compares with
Sieve tubes of brown algae

Pachytheca found often associated with Nematophyceae.
Ref Annals 1889 1891 Barber
Structure tubular septate

Barber thinks Pachytheca an alga
Some people have thought it a reproductive organ of
Nematophyceae.
Lately a specimen was found like this, & figured by Mr Murray in the Phycological memoirs
Ref Chondrus crispus.

NOTES ON FOSSIL FUNGI,

By F. W. Oliver.

[*Reprinted from* The New Phytologist, *Vol. II, No. 3.*

March, 1903.]

[With Plate IV.]

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<u>Fungi</u> Renault has described various fossil fungi, including Myxomycetes. Apparent fungal hyphae are found in cells of fossil plants. He describes Teleutospora from Permian, but on doubtful & misty evidence

<u>Charophyta</u> Jurassic & even Muschelkalk (Trias). Chert bands of Purbeck in Dorsetshire coast. Stem & oogonia. And Oligocene of Hampshire coast.

Bryophyta

The few authentic species differ very little from recent species. No absolutely certain traces of bryophytes from Palaeozoic rocks. Several have been recorded from Carboniferous & Permian, but on insufficient grounds.

<u>Muscites polytrichaceus</u> France. No trace of reproductive organs

Tertiary mosses in Amber of Baltic coast. Practically identical with recent species.

Naiadita. Lias nr Bristol. Lycopodiaceous

<u>Hepaticae</u>

Marchantites. Fucoides erectus. Inf Oolite of Yorks coast. Seward prefers to call it Marchantites erectus

Palaeohepatica Lias.

Neither of these shew any trace of reproductive organs.

Marchantites Sezannensis. Calcareous tuff of Eocene. Outlines of individual cells, & some remains of reproductive organs

This is one of those of which a mould has been made

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Pteridophyta — Equisetales / Sphenophyllales / Lycopodiales / Filicales

Equisetales — Equisetum / Equisetites / Calamites / Phyllotheca / Schizoneura

Equisetum. Pretty wide distribution at present day. Equisetum giganteum 30–40 ft high & only an inch in diameter in S. America.

In abnormal modern species sporangiophores have been found below as well as above the annulus.

Ref Cormack Annals 1893 On a cambial devt. in Equisetum.

There are no grounds for supposing Calamites have strobili, though they have not been found.

~~Calamites~~ Equisetites. No specimens known in which internal structure is preserved. Appear to be exactly like equisetum.

Kidston described Equisetites Hemingwayi from a specimen consisting chiefly of a cone. Best spec in British Museum.

Zeiller from Permian rocks has described some Equisetites. Founds his divisions on characters of leaf sheath.

In Calamites bases are not joined into a collar or sheath, except in rare cases. Zeiller's Permian specimens have sheaths joined together for some distance.

Lower Trias. Equisetites Mirabilis. Germany etc. Very like modern equisetum, but seem to have been capable of growth in thickness. Diameter of 6 inches

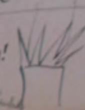
Equisetites Columnaris. Inf. Oolite of Yorkshire coast. Beds of impure coal almost made up of this. Some stems have diameter of 2 or 3 inches. Not quite so big however as Triassic.

E. columnaris [= E lateralis] Wheel like impressions or internode ~~modern~~ Really displaced nodal diaphragm.

E. Munsteri Rhaetic E Burchardti Wealden (tubers)

Phyllotheca also occurs in Italy! Jurassic rocks. P. Brongniarti in Siberia specimens

Ref. with reproduction organs. P. deliquescens. (Sidney Coal)



Sheath ~~parts~~ smaller & looser, rather cup like & much divided

Indian Permian. – Char member of Glossopteris Flora. [illegible] in [illegible] hemisphere

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Further Observations etc. Pt. I Williamson & Scott Phil Trans 1894 p803

Calamites Calamostachys (& Sphenophyllum)

The obvious resemblances between Equisetum & Calamites have what attracted the attention of the earlier paleobotanists turned out to be fallacious. The supposed Equisetum like ribbed stem is no ribbed stem at all, but merely a cast of the pith cavity. The external surface of the larger specimens could not possibly have shewn ribs like those of Equisetum, for the course of the vascular bundles in the Calamites was overlaid by an immense zone of secondary wood & cortex

The leaves were separate, not cohering to form a sheath as in Equisetum. The alternation of the leaves of successive whorls was less constant in Calamites than in the recent genus. Sometimes each bundle passes thro' 2 internodes instead of one before joining on to the trace of another leaf. Sometimes the forks of a bundle around the node curve round the outgoing leaf trace & unite on the opposite side

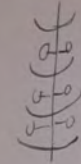
The secondary wood appears & consist of long pointed element, — not vessels, & pits are limited to the radial walls. This shews that the mechanism for the passage of sap thro' the wood of Calamites was the same as in existing Coniferae.

Periderm was produced in the diaphragms of Calamites; it coated them on both sides & probably isolated the persistent diaphragm from the disappearing tissue by the destruction of which the medulla became fistular.

The branches of Calamites were in many cases abortive, or of short duration & their bases then became sheathed in like knots by the wood of the parent stem

(See over)

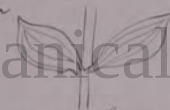
Zeiller has described some U Carb Phyllotheca from Asia Minor. P. Rallii. This species occurs in connection with cones of a Calamitean type. Zeiller points out that it is like the typical coal measure & Permian Annularia



Grand 'Eury – Calamocladus frondosus. Slender axis with cup like verticils of leaves. Apparently just like Phyllotheca.

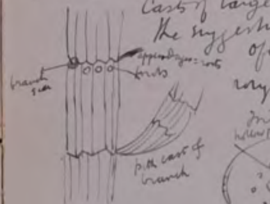
Annularia. Common coal measure fossil. From N hemisphere;
Phyllotheca chiefly S hemisphere, but not confined to it. spec from
Schizoneura (originally Convallarites, a monocot) Best known genus in India. S. Gondwanensis from Lower Gondwana rocks, fresh water deposits & very thick. Permo-Carb age.
Resembles equisetum & Phyllotheca, but leaves very much broader

Know nothing of structure or fructification.

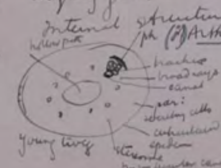


A very similar form S. paradoxa in Europe. Identical?
Occurs in L. Trias sandstones of Vosges.

Calamites Most towards end of Carb. Term first used 1786 Suckow
Casts of large hollow pith. Even Suckow suggested this, though the suggestion was lost sight of for 50 yrs!
Often casts covered by thin film of coal. Coal film x 27 roughly gives thickness of tissue producing the film.



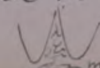
Internal structure: – Arthropitys type



pits of 8.5. to Calamites ... French ... (Renault)

Williamson figured a stem in which the ... was ...

Generally all tissue external to xylem has gone



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Calamostachys Binneyana

Whorls equidistant. Each fertile whorl exactly in middle of internode between 2 verticils of sterile bracts. & Usually about ½ as many sporangiophores as the bracts of a sterile whorl. The sporangia, unlike the bracts, do not alternate with one another in successive whorls, but are placed one above the other in vertical rows. The alternating verticils of sterile bracts are without analogy in equisetum (except for the "annulus".)

Two types of stele in the axis:– ① bluntly triangular ② quadrangular (in either case the bundles are situated at the prominent corners.

It is often difficult to distinguish the thick walled medullary cells from tracheides, & hence the mistake arose of regarding the stele of Calamostachys as a solid vascular axis. In some of the clearest triangular sections there are clearly 2 pxy groups at each of the prominent angles

The intercellular spaces come to an end at the sterile nodes, but are continued without interruption through the nodes at which the sporangiophores are borne. This is one of the points in which the sterile, or bract-nodes of Calamostachys resemble the nodes of Calamites.

This frequently the case that many of the spores in the sporangium were abortive

C. Casheana Heterosporous. And well marked zone of secondary wood in axis!

The differences between the Calamostachys & Palaeostachya type of strobilus are:– ① posn. of sporangiophores, axillary in Palaeostachya & midway between whorls of bracts in Calamostachys ② anatomy of axis wh is quite calamitean in Palaeostachya, while Calamostachys differs in small number of vbs, relatively small persistent pith. Bruckmannia grand'Euryi bridges over the gap. Structure & arr. of sporangiophores like Calamostachys, anatomy like a calamite with large fistular medulla & numerous bundles surrounding it, containing well defined canals

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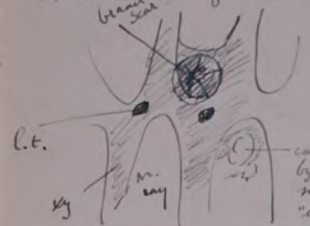
Diff. types of medullary rays – Sometimes almost obliterated by interfascicular ct

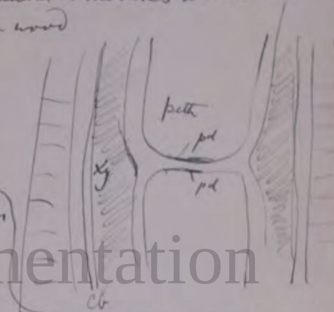
Tracheae with scalariform & rarely (reticulate) pitting.

In Calamites course of bundles is not quite so regular & constant – Amt of wood at nodes is greater than at internodes. Diaphragms of parenchyma at nodes. Some of these diaphragms form a corky layer.



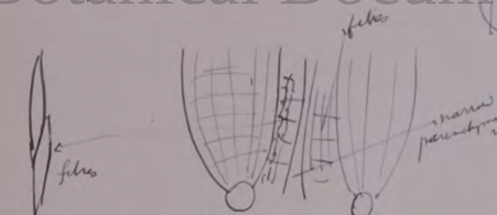
Torsion of tracheid cf outgoing tracheids of conifer

The branches sometimes aborted like knots in wood



The term Arthropitys first suggested by Goeppert in 1864

(ii) Calamodendron char. of French Upper Carboniferous. (Brongniart 1849)



Brongniart on discovering 2' thickening in Calamites, put those which showed it in Calamodendron & put it among the phanerogams. Calamites he put among vr. cryptogams. Williamson showed the unnaturalness of this divn. We now know 2' thickening in Isoetes, Botrychium, & a trace in Equisetum

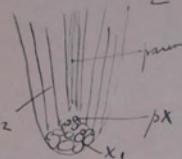
Parenchyma associated with fibres

(iii) Arthrodendron suggested, but it had been previously used (Calamopitys was the 1st name first in a different sense)

Very large carinal canals & rays of 1st parenchyma matter elements. Greater abundance of reticulate elements in 2ry xy

Roots of Calamites

W. Williamson called them Astromyelon



Roots have now been found organically attached to Calamite stems

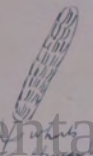
Groups of ptr alternate with pX.

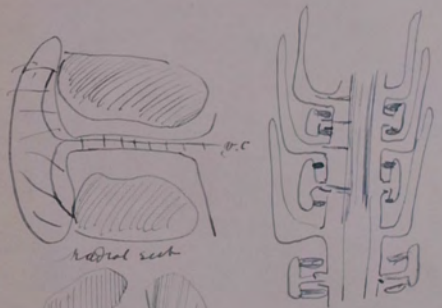
Endodermis double. Same as in many equisetum roots

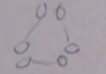
W. Williamson & Scott 1894-5

Reproduction

Calamostachys





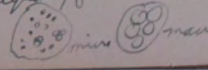


Bracts fused in their basal portion into a horizontal plate. Even 36 bracts have been counted in a vertical rank spaced 4 sporangia

Some types homosporous; others heterosporous

C. Binneyana homosporous

C. Casheana heterosporous. Gradual evidence of gradual reduction in size of sporangia



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Some years ago Carruthers described stalks, but they were really form walls of spore mother cells

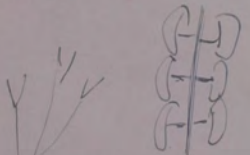
Palaeostachya sporangiophores in axils of bracts.

Perhaps ought to have use sporangiophore, because they look as if they were not properly leaves.

The axis of this type practically identical with ordinary calamite twigs.

Archaeocalamites Coal measures & Permian. Seems to have been replaced during Permian & then succeeded by Equisetites

Archaeocalamites L. Carb & Devonian. Stems of construction very slightly marked, ribs & grooves continuous from one internode to the next. In structure seems practically identical with ordinary calamite. Renault has described some cones from it



same structure as in modern equisetum

Succession of whorls of sporangiophores

Leaves dichotomise frequently, rare filiform. This reminds us of sphenophyllum

Leaves of calamites Simple linear structures, several occurring at each node. Practically same arrangement as in the horse tail. Leaves are not always separate all the way down

pal cells of longer than wide cells Rather like small pine needle
A few tracheids, then some parenchyma cells w. dark contents
Looks like a plant of comparatively moist & sunny situations

__Asterophyllites__ Brongniart suggested this term for certain fossils whose stem had long internodes & bearing at nodes whorls of slender linear leaves, which are free or united

Asterophyllites = Leafy shoots of Calamites
= __Calamocladus__

__Annularia__ resembles calamocladus, but leaves of each whorl of unequal length. Broader than leaves of Asterophyllites

Stomatal grooves on each side of midrib.
Certainly some annularias were borne on Calamitean stems

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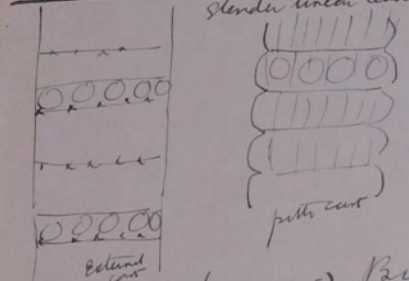
Different Types of Calamites

Calamitina
Stylocalamites
Eucalamites
} Weiss' names

Suggested names for diff. types of Calamites pith casts.

Calamitina. Short internodes. Whorls of branches at regular intervals
slender linear leaves have been found attached



Stem not markedly grooved.
Cortex cracked of formed in old stem. Fairly deep seated cork was produced.
Some lateral branches bore small lateral axes terminating in cones

Stylocalamites (Commonest) Branches few & far between without any particular order

Eucalamites Bore a whorl branches from each node arranged in regular equal series

Ref Williamson Scott Phil Trans 94
+ Roots of Calamites 95

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Meeting Aug 25

In an article on the affinities of Equisetum in the May number of the *American Naturalist* Prof. D. H. Campbell comes to the conclusion that these archaic plants are related to ferns rather than to lycopods, and that both ferns and equisetums are probably divergent branches from a common ancestral stock

Sphenophyllales { Sphenophyllum

Further observations on Pt I (Calamites, Calamostachys)
† Sphenophyllum
Williamson & Scott. 1894. Phil Trans

Sphenophyllum

Slender articulated stem, superposed verticillate leaves, in multiples of 3. Species originally described has wedge shaped leaves. The forms with deeply divided or linear leaves cannot be distinguished by external characters alone from Asterophyllites.

Sphenophyllum plurifoliatum (Oldham spec)

Xylem solid without medulla or xylem pair: Large pitted & bordered tracheids at middle of strand, smaller reticulated tracheides on approach angles, exactly at angles very small reticulated & spiral elements. All the primary elements appear to have terminated top & bottom in pointed ends.

Vascular system strictly cauline. It passes thro' the nodes without any appreciable change of structure

The secondary wood consists of large square ~~cells~~ tracheids, pitted on the radial sometimes on the tangential wall, while the primary tracheids are pitted equally on all surfaces. The secondary tracheal elements appear to form continuous tubes. Parenchymatous cells occupy the spaces left between the truncated angles of the tracheae. These are connected

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Sphenophyllales { Sphenophyllum

by radial cells or strands of cells, which are however not continuous enough to be called rays, except in the "fascicular xylem". In the fascicular xylem the X_2 elements are smaller. Cambium is sometimes found well-preserved.

Probably the formation of X_2 always began in the interfascicular region.

S. insigne (Brantenland spec.

A canal at the 3 corners of the strand. Numerous spiral tracheids near it, & in the canal, indicating that growth was long or actively when the differentiation of the primary began. In S. plurifoliatum & other species are rare & when a canal, probably this was not the case.

The secondary X_2 elements bear scalariform markings on their radial walls, & in all parts of the wood there are uniseriate medullary rays.

The great development of internal parenchyma, & thinness of the whole primary cortex was characteristic of the genus.

Very large elements resembling sieve tubes have been detected in the primary xylem of the fascicular region.

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Sphenophyllales { Sphenophyllum

Sphenophyllum Dawsoni

Bracts of cone coherent at base. ~~Bases of~~ Bracts of successive whorls alternate, not superposed as might have been expected from the vegetative leaves (Scott in the Studies says [illegible]). Sporangia not borne directly on the bracts, but each seated on the end of a long pedicel. These are twice as numerous as the bracts.

The xylem of the axis was triangular with obtuse corners. Each corner is prolonged into 2 projecting points with a bay between them, so in this case there were 6 px groups. This was also the case in some vegetative Sphenophyllum from Autun. The bundles going out to the bracts are centripetal. Each bract bundle divides into 3. One branch runs out into one of the free bracts while the other 2 supply the 2 sporangiophores.

Spores with prominent spines connected by a raised reticulation.

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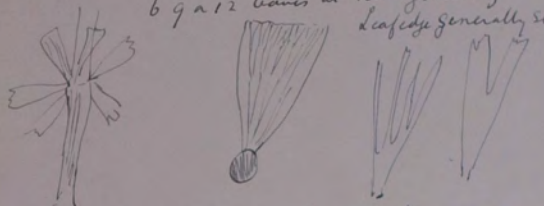
Sphenophyllales { Sphenophyllum / Cheirostrobus

Sphenophyllum Carb + Perm. ad few in Devonian. Max^m Dev. towards latter end of Carb. Sometimes described as foliage shoot of Calamite!

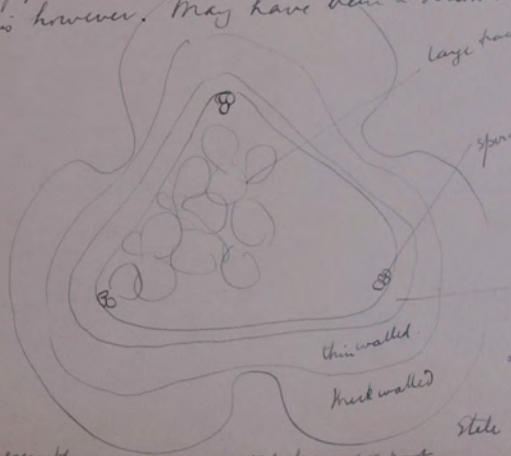
Stems always slender. Long internodes marked by faint but broad ridges + grooves, not alternating in different nodes.

6 9 a 12 leaves at node generally

Leaf edge generally serrate



Sometimes 2 distinct kinds of leaves on one branch. Some [illegible] dwarfed than the others. Thickled [illegible] Suppose it was a water plant. Anatomical [illegible] this however. May have been a scrambling stem



Much resemblance in arrangement of tissues of a root.

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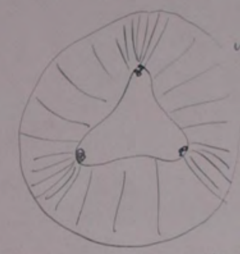
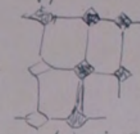
Secondary thickening. Sec xy sep^d from prim xy by layer of parenchyma. Typical cambium. Sec xy first formed in the 3 bays, & later comes all round. Round the px the tracheids produced are smaller.

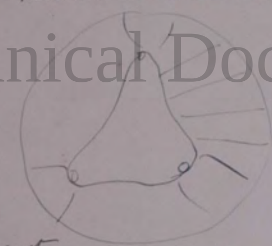


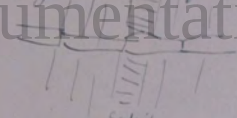
Sphenophyllum plurifoliatum. Typ of Carb. X_2 pitted on radial walls. No regular med rays. Angles between tracheids occupied by little groups of par. cells. Cfas normal rays may occur.



Cork deep seated, & may even cut off some ph_2

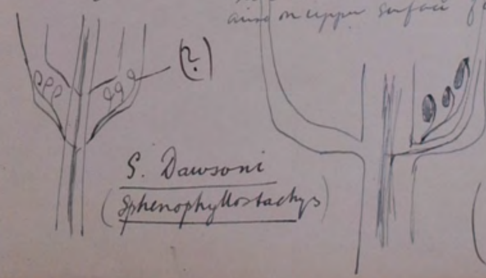
S. insigne. Pettycur nr Burntisland. Beds of volcanic ash. L^r Carb px canal.





Triarch roots.

<u>Cone</u>. Externally rather like calamite cone. Linear bracts cohere basally into continuous disc, which is not at rts to axis as in calamite. Stele similar to that of vegetative axis. Sporangiophores arise on upper surface of each of whorls of bracts something like an annulus where the sporangia dehisce. Another type 2 spor. from each sporangiophore. Another type spor. sessile (?)



S. Dawsoni

(Sphenophyllostachys)

(Shd be only 2 sp. seen in diagrams)

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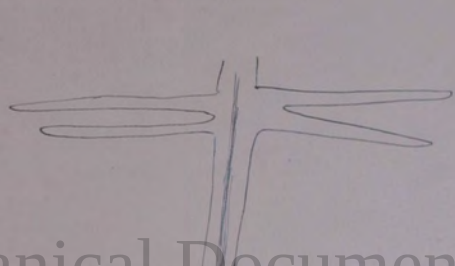
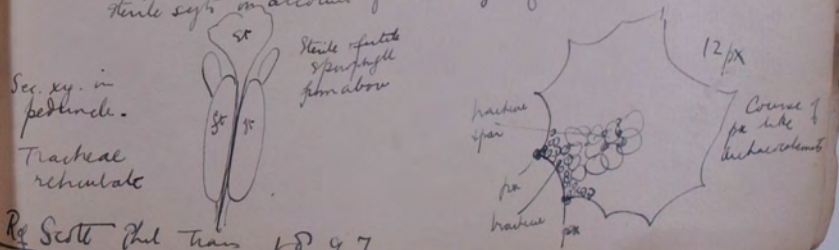
Cheirostrobus Sporophylls branched like a hand (X sp.) We know nothing of vegetative structure except peduncle.

[Second type of Sphenophyllum cone from Germany. S. Römeri
Two sporangia at top of each sporangiophore]

Cheirostrobus is a synthetic type. Appendages of cone in whorls. The sporophylls are very complicated. The most highly organised pteridophytic cone we know of.





R. Scott Phil Trans 1897.

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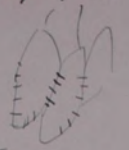
Affinities

With calamites:-
Lateral appendages of calamites given off in whorls. Fertile portions of sporophylls like sporangiophores of Calamostachys
Walls of sporangial cells in calamites & Cheirostrobus
Leaves on vegetative branches deeply divided in Calamites



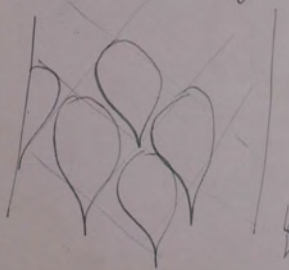
With sphenophyllum:-
Similarity of stele. Similarity of sporophyll with that of S. Römeri

With lycopods:-
Axis of cone very like psilotum, + Lepidodendron
The px form - projecting lattice work in lepidodendron, unlike the fluted column appearance of cheirostrobus.
This type has no connection bet: Lycopodiales & Equisetales. It is one of the oldest known, yet the same time the most complicated of [illegible]

Lycopodiales

Lepidodendron.

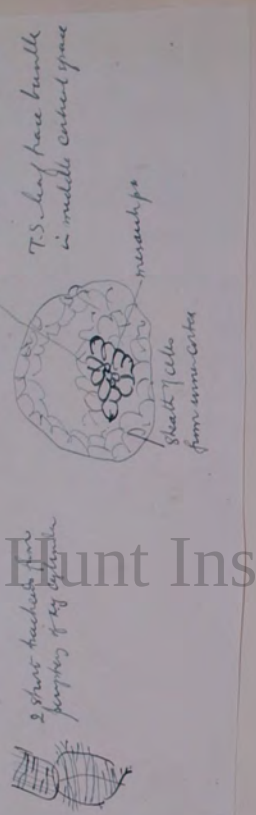
Devonian Carb Permian.
Sec. thickening.
Sometimes 100 ft.



Equally and leaf cushion Parichnos
leaf scar
pts also where parichnos comes to surface.
leaf base

Dichotomizing stems with acicular leaves

Structure & Affinities of Lepidodendron Braeleri
Edinburgh Phil Trans 1899 (p 357)



* Braeleri - Edinburgh Phil Trans
Trans Linn Soc 99 thinks these strias appear so constantly in the best preserved sections of various species of lepidodendrons, that they can hardly be referred to the effects of maceration, but must be considered as a structural peculiarity

On the Phloem of Lepidophloios & Lepidodendron
Weiss. Vol 45 Pt III Mem. & Proc. Manchester Literary & Phil. Soc. 1901

Weiss has examined some well preserved specimens, but only in transverse section.
He concludes that the function of the so-called ph was that of normal phloem. In both genera large & smaller elements are found, arranged in a manner characteristic of phloem. The ph of a Lepidophloios in wh. secondary thickening was taking place, showed great resemblance actually. Weiss considers that the ph does not differ materially from the phloem of recent Lycopodiaceae, except in such particulars as are probably connected with the absence of secondary thickening in recent Lycopods, & the consequent diminished need of storing organic material within the stele. Weiss says that the characters of the secreting cells of the intercortical zone are very different from the tissues he describes as ph. The cell walls of the

species. This led Brongniart to separate it from the Lepidodendra
Still it is almost certainly this tissue

surface of 4th cylinder

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phl elements of recent lycopods is made of amyloid which is probably more readily permeable than cellulose. This may account for the scarce tubes in recent lycopods being poorly devd. Campbell speaks of the poor devt. + difficulty in demonstration of the S. plates. If the fossil lycopods had amyloid cell walls, this would account for the very bad preservation of this tissue

Weiss in his paper says that the secondary tissue is "bounded on the outside by a very clear + sharply defined layer of cells which have generally been identified as a secondary meristem, though differing in many respects from the cambium of recent plants" taken from the cambium of other fossil cryptogams". He marks this zone in his figures as "cb" [Plate 2 figs 1, 2, 3] In his 1903 paper he has changed his view on this zone, for he says:-

"This ring of radially elongated cells is probably not a meristematic nature, as it occurs ... in the lateral organs in which no secondary thickening takes place. Probably one or more of the rows of cells within the radially elongated cells were of a meristematic nature, differing somewhat from the flattened cambium cells of recent plants." In this paper he also uses the term "secondary meristem" which in his first paper referred to the meristem which occupied the position of a normal cambial layer, for a layer of meristematic cells lying outside the ph.

Of A Biseriate Halonial Branch of Lepidophloios fuliginosus. F S Weiss D Sc

Trans. Linn Soc. (Bot) Vol VI pt 4 - Jan 1903

Some variation of opinion as to what constitutes the alveolar and what the halonial condition. Weiss describes the "halonial condition" as the fruiting branch of Lepidophloios, bearing a no of elevated tubules either in quincuntial or biserial arrangement.

A dist[n] of Lep. Harcourtii from Lep. fuliginosus is that in the latter the leaf traces run very obliquely, or nearly horizontally through the mid-cortex.

Besides the normal ph groups in the secondary tissues, Weiss considers that there is a secondary meristematic zone in the region of the pc (cf Isoetes + certain conifers) Inner cortex fun. Middle cortex loose + trabecular, - char[s] of L. fuliginosus. This tissue passes out as the parichnos

The most important pts by which this branch is identified as Lepidophloios fuliginosus are:-

(1) Por. path + general arr[t] of X[yl].
(2) char[s] 2[y] parts resulting in the almost exclusive form of par. cells
(3) The well preserved mid. cortex + its peculiar structure
(4) The secretory tissue of the outer cortex

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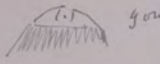
Lepidodendron

- (Lepidophloios)
- Ulodendron
- Halonia
- Lepidostrobus

Diffce bet. Lepidodendron & Lepidophloios only external.
Lepidophloios leaf cushion much reduced in size & leaf scar transversely elongated

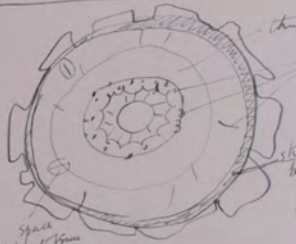
yg Old Lepidophloios

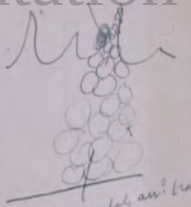


young Lepidophloios

Ulodendron } probably repr point of cone bearing branches
Halonia }

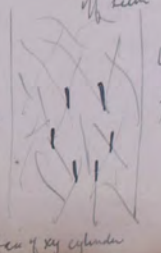
L. Harcourtii Dese 1833 Witham More detail 1837 Brongniart





Tracheids scalariform

No undoubted case of sec. thickening in the species. This led Brongniart to separate it from the Lepidodendra



Surface of xy cylinder

Trans Roy Soc Edinburgh. Vol XXXII Pt IV No 34

Structure & affinities of a Lepidodendroid stem from the calciferous sandstone of Balmenny Scotland, Possibly identical w. Lepidophloios Harcourtii (Witham)

Seward & Hill 1900

NOTE.

ON THE PRESENCE OF A PARICHNOS IN RECENT PLANTS[1].—If a mature sporophyll of *Isoetes Hystrix* be examined, there will be seen in the lateral expansions of its base two longitudinal cavities containing a certain amount of mucilage, and situated one on each side of the vascular bundle, in close proximity to the sporogenous mass. By the examination of sporophylls in different stages of development, it may be ascertained that the above-mentioned canals arise by the mucilaginous degeneration of two strands of parenchyma. The structure in question does not extend into the cortex of the stem, but is confined entirely to the base of the sporophyll, its limits seemingly depending upon the extent of the sporangium. Whether the same features obtain in sterile leaves has not been determined, owing to the lack of material. Indications of a similar structure were observed in other species of *Isoetes*.

It is suggested that these strands of degenerating tissue, and the resulting mucilage-containing canals of the mature leaf, represent the parichnos occurring in *Lepidodendron, Sigillaria, Lepidocarpon*, &c.

T. G. Hill.

Kew.

[1] Abstract of paper read before Section K at the Cambridge Meeting of the British Association, August, 1904.

[Annals of Botany, Vol. XVIII. No. LXXII. October, 1904.]

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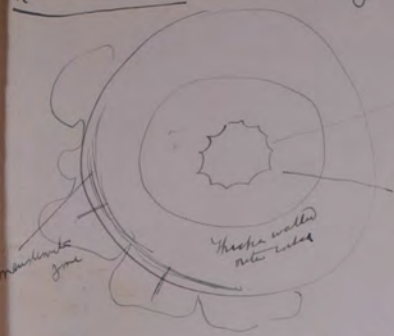
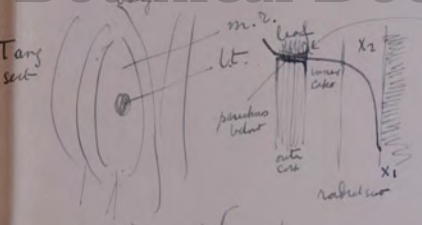
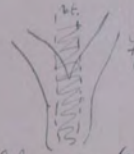
L. vascularis & L. Selaginoides



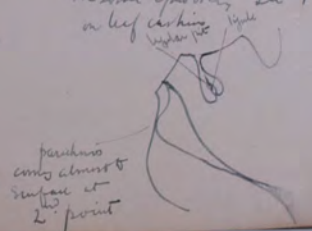
Hoplite in middle of Xy, but a good deal of parenchyma mixed with radiating tracheids

Secondary thickening begins in the plant at an early stage. Often begins as a crescent shaped arc





In some Lepidodendra &c & traces of parichnos on leaf cushion under pit

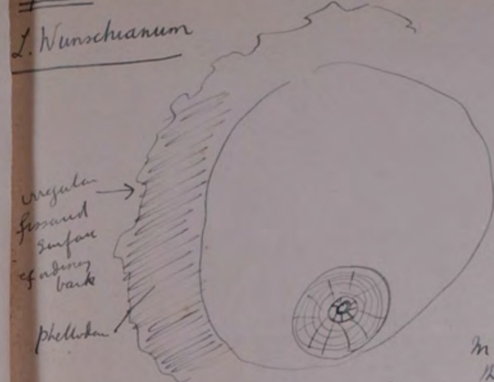


Specimen from Calciferous sandstone, volcanic ash at Dalmeney nr Edinburgh

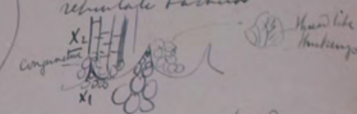
L. Wunschianum

Leaf bases have all been thrown off

Identified with L. Wunschianum from Arran



In peripheral part of pith which is preserved ~~contains~~ there are abundant isodiametric reticulate tracheids



Some narrow & some broad m. rays

M. r. cells have delicate thickenings like the conjunctive between X_1 & X_2

Leaf traces pass out almost horizontally thro' m. r.

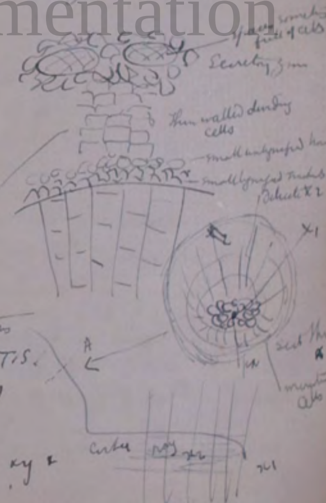
No trace of rings of growth in X_2, at least no regularity. Argument for uniformity of climate

We don't know leaves & leaf bases. Nearly all outer band of cortex consists of phelloderm

Secretory canals in phelloderm

The form of the little tracheids which the X_2 is probably due to occurrence of unfavourable conditions of growth. Cb cannot have been quite of the kind we are accustomed to in the higher plants.

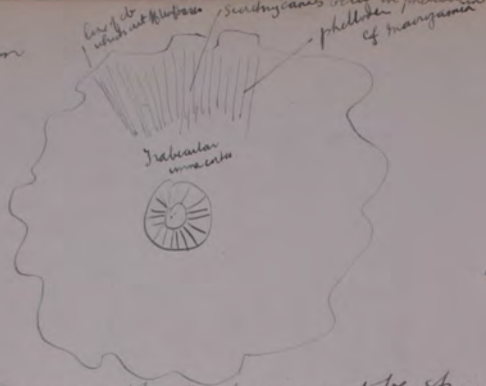
Called ph by Scott. Seward doesn't think so. In long sect the cells of this zone look much the same as in T.S. Cf hard band of meristem in Yucca, also Isoetes



Leaf traces Pass out from edge of primary xy & pursue oblique vertical course

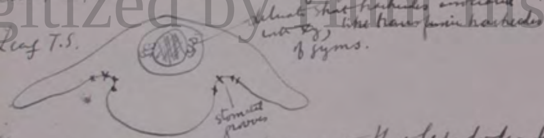
The few primary strands become partially enclosed in a fan shaped patch of X_2

Typical Lepidodendron Stem



Structures exposed to bending forces must be strong near the periphery. The phelloderm from the mechanical pt of view took the place of the more peripheral X_2 of an ordinary forest stem.
Secreting tissue of a similar kind occurs in many coal measure plants. Sometimes abundance of secretory tissue means Xerophily.
Leaves seem to have come off by a regular abciss layer.

Leaf T.S.



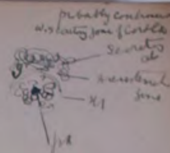
These characters seem to suggest that lepidodendra were xerophytes or halophytes.
This latter was long ago suggested by Binney etc

Note on Lepidodendron Harcourtii & L. fuliginosum (Wm) by W. C. Williamson. Proc Roy Soc Vol XLII-p6 1887

First public notice of L. Harcourtii read by Witham in 1832. Williamson could not find the type spec. The first spec. he found + described approached less closely to the original descr. than some he found later.
He now concludes that Part XI Pl. 52 fig 9 is a young L. Harcourtii whereas in Pl 49 fig 11 & 51 fig 10, & Part II Pl 25 fig 12 are L. fuliginosum.
He distinguishes fuliginosum from Harcourtii by (1) single instead of double vbs (2) greater uniformity in cortex, inner part of which is preserved, is dense & sooty looking.

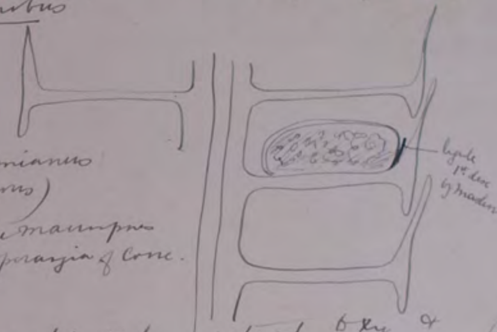
See over

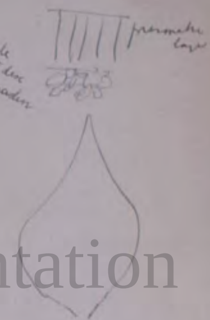
L. fuliginosum



Secondary tissue largely parenchymatous
Find no trace of ph_2, so perhaps the "secretory zone" accompanying the l.t. functioned as ph.
The so-called periderm of lepidodendra is not corky. It is of the nature of secondary cortex

Lepidostrobus





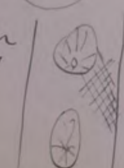
L. Veltheimianus (heterosporous)
8–16 large macrospores in lower sporangia of cone.

In cone axis delicate tissue external to xy &

Ref
Trans Linn Soc 1899. Maslen
" Annals 1893. Bower. L. Brownii
" Phil Trans 94 Bower
" Trans Roy Soc Edinburgh 1890
" Cam Phil Soc Vol X pt 3
" Williamson Monographs especially 1893 on

Sometimes prof. extend right into sporangium, cf. trabeculae in Isoetes

Ulodendron



2 rows of large oval scars opp. each other
c.f. branch scars of Agathis
But more probably caused by pressure of base of cone directly on branch
But how did the scars come to be so big!

De Bary. Fossil Plants p. 226

The true L Harcourtii is rare
De B. calls fuliginosum, L Williamsoni –
The small teeth on the edge of the wood are larger & more projecting in L. Harcourtii than in L Williamsoni
De Bary also concludes that the leaf traces of L. Harcourtii contain bast fibres, not those of L. Williamsoni

Williamson Mem XIX ~~1887~~ 1893 p 3
Says that in his note to the 1887 R.S. he pointed out, that no one of the examples he had previously descr.^d was true L. Harcourtii. He now figures a number of true L. Harcourtii
(He does not mention the Fig 9 Plate 52 Ph X which he appears in the R.S. note to consider as probably L. Harcourtii)

Wholly or Stealth (?) ... (or distinctly so) tubercles: ... further

Notes on the Binney Coll: of Coal Measure Plants
A C Seward.
Proc Camb Phil Soc Vol X p. 137. 1899
Part I Lepidophloios
Absence or late devt. of secondary traces in L. Harcourtii
Comparatively early form.. . . . . . . L fuliginosum
Seward points out that the structure of the leaf trace is nearly identical in each.
Probably in L. fuliginosum the middle cortex was more firm & durable than in L. Harcourtii
The more or less prominent ridges on the face of the xylem can hardly be considered as diagnostic characters
"In Lepidophloios fuliginosus, which in most respects appears to be practically identical with L. Harcourtii, the development of secondary stelar tissues began at an earlier period."

trace) ! pollen chamber

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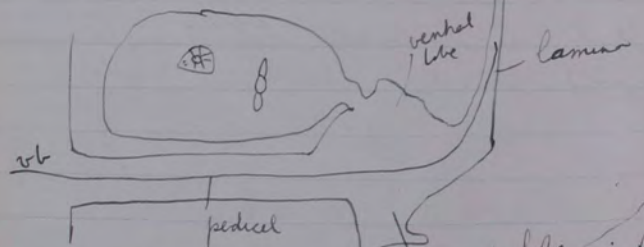
De Bary. Fossil Plants p. 226

On Two New Specimens of Spencerites insignis
F.W. Berridge. Annals of Bot. Vol XIX Apr 1905

The new specimens, rather large examples. Only 4 cones were known before. 20 px in core axis, contrast to 10 as given by D. Scott. The form of the sporophylles is more complicated than in D. Scott's specimen.



no v.b. branch has been observed passing from to the ventral lobe + sporangium. This matter is unlikely

Dorsal lobe The comparison of the ventral lobe with the sporangium in Sphenophyllum will hold no figure

Spencerites Scott Phil Trans 1897 1897B p83

Williamson first described these sketches, but merely called them: Lepidostrobus insignis. Later on he established the connection between a supposed vegetative stem wh. he had described as Lepidodendron spenceri & these cones. The former were really the pedicels of the cones.

Later Williamson said that it might be a new genus

Spencerites insignis

The central strand of wood may be medullated or not. Usually about 10 px

Cortex "dictyoxylon" cortex is well dev.

Short sporophylls & spheroidal sporangia are a clear dist. from Lepidostrobus. The sporangium is attached by a narrow neck of tissue only to the upper side of the sporophyll, near its distal end where the lamina begins to expand. The fact that there is no attachment whatever to the hinge-shaped pedicel of the sporangium is a sharp dist. from Lepidostrobus. Each spore has a broad hollow wing running round it equator. The spores are large for megaspores & small for macrospores.

S. magnificus Outer cortex uniform.

3 wings running along the 3 angles of the quadrant

The distal insertion of the sporangium may perhaps be a sign of archaic ness

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De Bary. Fossil Plants p. 226

Halonia Spirally disposed (or distichously arr'd) tubercles; ~~with~~ fertile branches.

On Structure & Affinities of Fossil Plants from the Palaeozoic Rocks IV The seedlike fructifications of Lepidocarpon

D H Scott

Phil Trans 1901. 194 B p. 291

Wild & Lomax discovered the cone (Annals. March 1900)

Scott's specimens prove that Cardiocarpon anomalum of Williamson was borne on a lepidostrobus cone

[The Cardiocarpon anomalum of ~~Williamson~~ Carruthers was a Gymnospermous seed]

The coal measure form is Lepidocarpon Lomaxi

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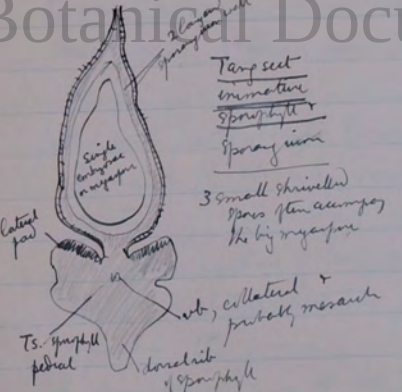

This is the only case known in Lycopodales of less than 4 megaspores coming to maturity

When the integument grows up it does not close together at the top, but leaves a long radial slit, the endosporic micropyle. The ridge which runs along the top of the sporangium fits into this micropyle (there is no trace) - pollen chamber

De Bary. Fossil Plants p. 226

The [illegible]
De [illegible]
The sm[illegible]
L-[illegible]
De B[illegible]
ba[illegible]
Wil[illegible]
Cyp[illegible]
or[illegible]

Halonia Spirally disposed (or distichously arr.) tubercles; with fertile branches.

In the mature seed like forms the distal end of the sporophyll shews clearly that the integument is a true integument & not just a wrapping round of the wings of the sporophyll, for the lamina of the sporophyll extends into 2 wings distinct from the integument.

At the distal end the integument abutted on, & was continuous with the ascending lamina of the sporophyll, but we have no evidence as to whether the union was or was not congenital. The integument itself seems to have closed the seed at the proximal end.

One specimen was found in which the embryo sac was filled with prothallial tissue

The axis of the strobilus resembled Lepidostrobus in its anatomy, except that the inner cortex was firm & resistant, instead of being delicate like Lepidostrobus. This wd be correlated with the greater mechanical strength required in the former.

A possible ♂ cone of this sp. has been found. The integument was less complete than in the ♀, & seems to have had the shape of a coal scoop, forming a sheath in which the distal end of the sporangium was seated.

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De Bary. Fossil Plants p. 226

Halonia Spirally disposed (or distichously arr'd) tubercles; with fertile branches.

Lepidocarpon Wildianum. Catafrema sandstone Scis
Very like the other sp. but really given a separate name on account of the great diff.ce of horizon

All known megasporangia of Lepidocarpon are naked, or completely integumented

Morphology

The indusium of the megasporangium in Azolla is exactly like an integument
It appears that the enlgumented megasporangium is shed as a whole like a seed. Its points of agreement with a true seed are:—

(1) inlg.t + micropyle
(2) Single functional megaspore
(3) "retention of megaspore" involving
(4) detachment of seedlike organism as a whole + its endosporic character

Differences (1) elongated micropyle
(2) embryo apparently not dev.d

We can't know if pollination took place on the parent plant or not.

De Bary. Fossil Plants p. 226

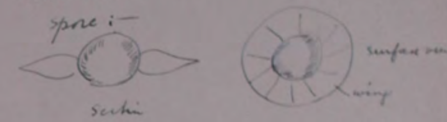
Halonia Spirally disposed (or distichously arr.) tubercles; cone fertile branches.

Spencerites another cone described by Scott.

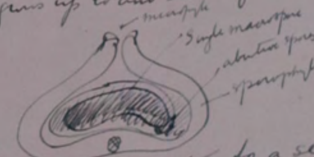
For correction of this see note on Miss Benson's paper opp.

Sporangia almost spherical & attached near distal end

spore :—



Cardiocarpon anomalum seeds from coal measures described by Williamson. These have recently been described by Scott as occurring in a Lepidodendroid cone = "Lepidocarpon" (See abstract of Scott) Sporophyll grows up round sides of gradually elongated sporangium. Macrospore is a cell extending the whole length of the sporangium.



Tangential section

This practically amounts to a seed.

cf Scott Annals 1900.

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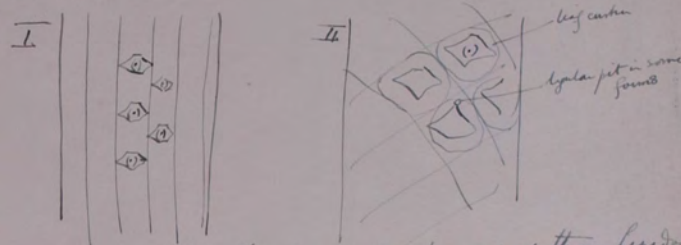
Sigillaria

S. oculina. L. Trias. Not a very good spec:
Agrees in many respects with Lepidodendron

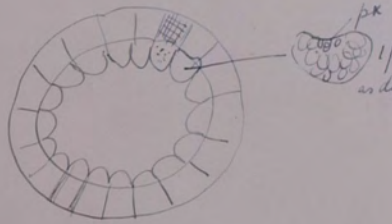
I Eu-Sigillaria
II Sub- "

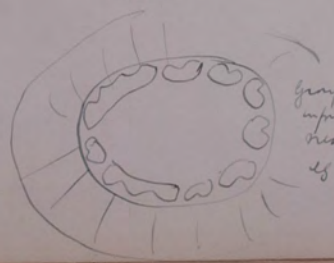


Spines 100 ft long. Less frequently branched than Lepidodendron

Subsigillaria

Leaf-cushion ... like Lepidodendron.





EDINBURGH.

Royal Society, May 1.—Prof. Geikie in the chair.—The internal structure of *Sigillaria elegans* of Brongniart's "Histoire des Végétaux fossiles" [illegible] R. Kidston. The primary xylon formed a continuous ring as in *S. elongata*, Boul., described by Prof. Bertrand, but the protoxylon groups formed rounded projections, not pointed, as in *S. elongata*. The paper concluded with some general remarks on the development of the primary xylon of the Carboniferous lycopods, and the opinion was expressed that the solid stele was the most primitive type, followed by the continuous ring with a medulla, the series ending in that type of structure found in *S. spinulosa*, where the primary xylon assumes the form of a circle of isolated bundles

Monograph of Sigmaria Ficoides

W. C. Williamson.

Palaeontographical Soc 1887

W. is fully satisfied that Sigmaria performed the function of root, & that it is the root of various sp. of Syllaria & Lepidodendron

The Vascular branch of Sigmarian Rootlets

Weiss Annals of Botany 1901 p 559

Conclusions:- In the various types of Sigmarian rootlets fine strands of spiral tracheids may be seen leaving the px elements. These strands do not pass out into lateral rootlets as are called by Renault & Zeiller, but terminate in the outer cortex, sometimes in connection with peculiar groups of large parenchymatous cells.

The v. strands are not directly connected w. the px of the outer cortex, but pass out into short & wide spirally marked cells resembling the transfusion cells of leaves.

The v. strand & the transfusion cells is what is termed for a special mean of conducting water for the periphery to the central tissues of the rootlet, a mean which is rendered necessary by the def. of the middle cortex wh an air containing tissue & pass

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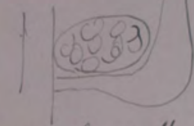
Very few petrified Sigillarias are known –
In Sigillaria Primary Xy continuous
Bertrand has described a similar stem.
of Annals 1899
Cortical tissue much the same as
Lepidodendron
Leaf traces secondarily thickened

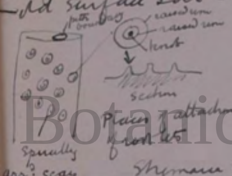
Cone on long peduncle. Central axis several inches in length
Ref Trans Roy Soc Edinburgh 97
Kidston



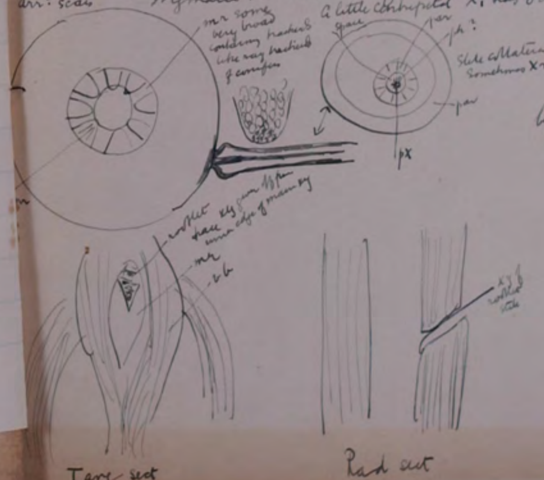
Stigmaria Generally in underclay of coal seams – Described as
old surface soil – Appendages of Stigmaria ramify in all direction

Fine specimen in Owens Coll: Museum from coal measures near Bradford. 4 branches spreading from base of vertical portion of plant. Each branch dichotomises repeatedly.

The vertical upright portion in
Some spec shews Sigillaria markings
Stigmaria has also been found attached to Lepidodendron –



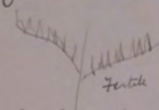
X, has occasionally been described
The inner space is probably due to destruction of delicate tissue. The larger space probably existed during the life of the plant.



Stigmaria generally spoken of as root of ~~Stigmaria~~ Sigillaria & of Lepidodendron. Some shew undoubted Sigillaria, but probably none undoubted Lepidodendron.
Differs anatomically from roots. Cf rhizophores of Selaginella (See Scott's Fossil Bot)
Ref. Scott & Hill. Isoetes. Annals.

Ferns

Existed in Devonian, (but no satisfactory evidence of their existence earlier). Archaeopteris hibernica. U. Dev. Fertile & sterile pinnules, details of form not preserved. Pinnules rather like some adiantum

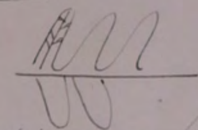


It has been suggested, on unsatisfactory evidence, that it belonged to Marattiaceae

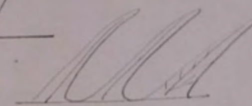
Carboniferous Brongniart suggested a number of names for different types of venation

Pecopteris Bi- or Tri-pinnate. Ultimate segs linear

[See Mr. Arber's notes for these form genera]



Alethopteris

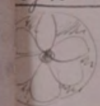


Most ferns where sporangia are known are more like Marattiaceae than Leptosporangiate ferns.

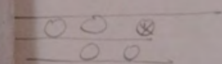
Ptychocarpus Circular sorus, 6–8 spor joined into a synangium cf. Kaulfussia

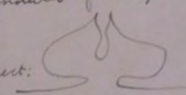
Found on a Pecopteris frond.

Sporangia of these older ferns were generally separate



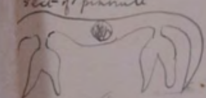
Asterotheca Sori on pinnules of Pecopteris type. Spor. partially separate.





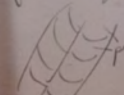
Scolecopteris

sect. of pinnule



Sori sometimes shortly stalked cf Marattia Kaulfussii

Sporangia much larger & more tapering than any modern ferns. This fern first described as fossil segmented worm!



On *Rachiopteris Williamsoni* sp. nov. A new fern from the Coal measures. Seward. Annals Bot Vol VIII p 207

Petiole w. concentric bundles. Whole structure agrees more closely with petioles of Marattiaceae than any other living plant

Urnatopteris Coal measures plant w. Sphenopteris type of frond. Fertile pinnae had much reduced lamina, elongate oval sporangia in 2 rows, one on each side of axis of segment. Sporangia opened by terminal pore.

Bassin Houiller et Permien d'Autun et d'Epinac
Flore Fossile

R. Zeiller   Paris 1890

Psaronius p. 178

Fern stems with structure preserved, a number of steles in the centre in the form of flattened bands following a series of concentric cylindrical surfaces, + anastomosing, towards the periphery separated from one another by bands of sclerised fibres. Often a sclerosed sheath to the outside of the central cylinder interrupted for the passage of leaf traces; the latter are gutter-shaped with their concavity turned inwards

The steles of scalariform tracheids surrounded by a sheath of ph. CC surrounded by par. tissue containing adventitious roots

In certain specimens of Psaronius, e.g. the Ps. infarctus desc. by Stenzel, two ~~peripheral~~ steles lying close together near the surface of the CC anastomose. From this point a leaf trace is given off. But it is generally more complicated. The strands round the edge of the CC are alternately leaf traces & "peripheral steles." The "peripheral steles" are responsible

On *Rachiopteris Williamsoni* sp. nov. A new fern from the Coal measures. Seward. Annals Bot Vol VIII p 207

Pet
Ch

Urnatopteris Coal measure plant w. Sphenopteris type of frond. Fertile pinnae had much reduced lamina, elongated sporangia in 2 rows, one on each side of axis of [illegible]. Sporangia opened by terminal pore.

The peripheral steles pursue a slightly sinuous course up the stem for the vascular supply of the adventitious roots. Also as soon as a leaf trace passes out, "the peripheral steles" on each side give off a branch. The two branches approach one another & in so doing fuse with one of the steles further in. They finally join & form another leaf trace.

[Very full account of Psaronius (93 pages). Only for part read A.R.]

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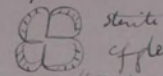
On Rachiopteris Williamsoni sp. nov. A new fern from the Coal Measures. Seward. Ann. of Bot...

Petiol...
Closed...

Urnatopteris Coal measure plant w. Sphenopteris type of frond. Fertile pinnae had much reduced lamina, & large oval sporangia in 2 rows, one on each side of axis of segment. Sporangia opened by terminal pore.

Crossotheca Also on Sphenopteris. Fertile segs rather spathulate at distal ends.

Oligocarpia



Sterile fronds Sphenopteris type
cf Gleichenia sporangia

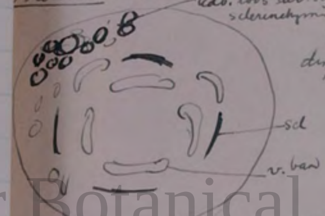
We expect more variety among the palaeozoic Marattiaceae as the family was not restricted as at present]

Dactylotheca Sterile fronds of Pecopteris type. Sporangia large & occurring singly.

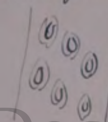
no distinct annulus

Polypodiaceous ferns.

Psaronius U. Carb & Perm. Tree ferns. Structure preserved. Posn of px not known. Casts with external markings.



Caulopteris. Casts in U Carb & Perm. Spirally disposed leafscars, but internal structure that of psaronius



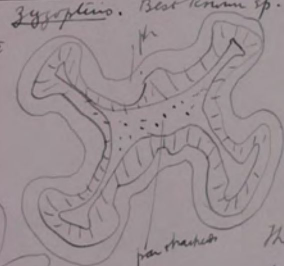
Psaronius stems 20–30 ft & more. Probably Marattiaceae nearest living repns. Roots 3–6-poly arch. Roots in cortex is like Marattiaceae. Roots could thicken secondarily

Sporangia numerous on fertile fronds & occur

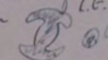
Botryopterideae (See Scott's studies)

in tufts. Zygopteris. Best known sp. Z. Grayi. Monostelic. Shape of stele

Stellate

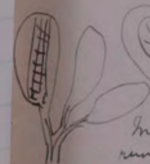


The arms rept leaf traces about to be given off. Leaf trace becomes triangular, elliptical, branches, & trace itself assumes an H-shaped form

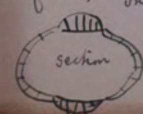


branch is like a simplified stem stele

C.f. hymenophyllaceae. (Tr. radicans reniforme)
Branches come off from leaf trace.
The H-shaped petioles = Rachyopteris. This word used for any isolated petioles of ferns



Individual spor large with short thick stalks into the base of each a v. b. runs of Botrychium & Helminthostachys. Wall of sporangium with several layers of cells. Annulus distinct but peculiar. Not a single row of cells, but multiseriate. This shews some resemblance to the less distinct one of Angiopteris. Also some resemblance to Osmundaceae. This is one of the numerous synthetic types.



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Botryopteris Stem ^ monostelic. Solid mass of xy, surrounded by ph. Petiole of B. has a very distinctly shaped xy group. Rachyopteris tridentata of Williamson. Sporangia in tufts with multiseriate annulus on one side

Not so close to hymenophyllaceous type of anatomy.

Geological history of different fern families

Marattiaceae Very abundant & widely distributed in palaeozoic times. (A number of cases of occurrence of distinct leptosporangiate sporangia are known) In more recent geological periods get only impressions.

Taeniopteris Simple, broadly linear form:  Can't tell if they are fronds or pinnae.

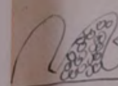
T. Münsteri (= Angiopteridium) Triassic. Widely dist. in Europe. Without much doubt Marattiaceae.

Ophioglossaceae Been suggested as primitive by several botanists. Fossil evidence untrustworthy. Nothing satisfactory from Palaeozoic. Rhacopteris paniculifera from L. Carb. This has often been compared w. Ophioglossaceae But resemblance is only superficial as the fossils are not well preserved.

Records of fossil Oph. in never with very unsatisfactory.

III Osmundaceae A number of well preserved sporangia from the Pers U. Coal measures with [illegible], Kidstonia. Fronds of Sphenopteris type, sporangia borne singly, peculiar annulus. Zeiller recently described them.

In Triassic & Jurassic, Todites. Frond bipinnate of Todea Barbara. Todites Williamsoni widely distributed in Jurassic. Similar sp from L. Triassic. The sporangia large & round & cover whole of lower surface of sg.



In Tertiary several good petrified osmundaceous stems have been described. Osmundites Dowkeri. Petrified stem fr Eocene of Herne Bay. Structure practically identical with Osmunda. Several fr Germany

IV Cyatheaceae No good evidence in Palaeozoic.

But certainly played an important part in Jurassic. Thyrsopteris fr Jurassic & L. Cretaceous have been frequently described. Now very isolated in Juan Fernandez. But the American who desc. 30 or 40 of them had no grounds for calling them Thyrsopteris! But apart fr this we know a good many genuine Jur. ones with sporangia. Coniopteris. Sori like modern Dicksonias of Cyatheaceae. Protopteris C. hymenophylloides in Jurassic of Yorkshire coast.

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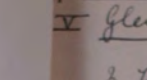
V Gleicheniaceae  Oligocarpia gleichenioides type Jurassic. L. Carb.

In Jurassic period the family appears to have been fairly abundant, especially at beginning of Cretaceous period.

Some examples (not yet described) from a lower sand (Wealden) at Brussels. Internal structure of stem preserved. (Matonia in same deposit)

VI Matonineae Now restricted [as family] but formerly under Dict.

Laccopteris: Rhaetic of Germany (Schenk) etc. Wide range at this period; permitted well into Jurassic. Thirty species in Mesozoic of Eastern coast.

Matoniadium. Abundant in Jurassic extends up into L. Cret.

1864. Phil. Trans. 1849. Stokes.

Very few remains in S. hemisphere rocks, though now only belongs to S.

VII Dipteris. Isolated Jurassic genus rep. by a number of fossil forms.

Dictyophyllum. Lindleys name. Distribution widely dist. in Europe

VIII Glossopteris. Known very little about its exact position. Tongue shaped leaf traversed by midrib, lateral veins form a continuous network. Other plants in rocks in masses, plants seem to have occupied large areas, compare modern bracken

Glossopteris [illegible] rest. rhizomes of Glossopteris.

Compared with rhizomes of [illegible]

a sclerenchyma.

India, Australia, S. America.

Ganganopteris very like glossopteris. No midrib.

Well marked characteristic assemblage of plants. Certain strata and rubbly

of glacial origin.

In N. hemisphere Permo-Carb. characterised by characteristic coal measure plants, no glossopteris or Ganganopteris. A few lepidodendra & similar plants in Africa & Australia below those containing Glossopteris, like those of Culm & L. Carb. So at this period The vegetation was very uniform all over the world. Conditions appear to have changed towards end of Carb. Lowering of temp. over wide region in the south seems to have brought about a change in the flora. So two botanical provinces in Carb. times.

Recently in S. Africa a few specimens of Sigillaria apparently specifically identical with one of Coal measure forms of N, occurring in association with glossopteris, Ganganopteris etc. Same thing has been desc. for S. America. So it seems as if there was a overlapping.

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median section of small seed 3 mm long, enclosed in black capsule many glands seen

Base of seed stands

BOTANICAL MUSEUM, U.C.L.

Lagenostoma photo F.W.O.

One of the most fruitful lines of recent research in botany has been concerned with the investigation of fossil seeds, of which several species of Lagenostoma are the best known. The evidence in favour of referring these seeds to certain vegetative portions of Carboniferous plants, formerly regarded as fern fronds, formed the subject of Dr. Scott's presidential address to the Royal Microscopical Society, which is published in the April number of the Journal. The cycadofilicinean position assigned to *Lyginodendron Oldhamium*, which shows a sphenopteris type of foliage, was confirmed by the evidence which connected the same plant with *Lagenostoma Lomaxi*. Mr. Kidston's discovery of the fructification of *Neuropteris heterophylla* fixed the seed to another typical fern-frond,

and recent research points to the production of winged seeds by a species of Adiantites.

NATURAL SCIENCE

NEW PHYTOLOGIST.

Vol. 2., Nos. 4 & 5. May 30th, 1903.

THE SEED OF *LYGINODENDRON*.

The communication made to the Royal Society on May 7th by Professor Oliver and Dr. Scott contained the most important discovery bearing on the great problem of the connexion of the Flowering with the Flowerless plants which has been made since Hirase in 1896 found motile antherozoids in the pollen-tubes of *Ginkgo*. Hirase's discovery, supplemented by those of Ikeno in *Cycas* and of Webber in *Zamia*, shewed that a character which had previously been thought to be confined to the Pteridophytes had been retained in a few of the Gymnosperms, and thus so to speak, pulled up a thread from below to bridge the gulf between the two classes. Oliver and Scott have now shewn that a coal-measure plant of fern-like habit and largely fern-like anatomy produced a structure which in most of its essential features must be called a seed, and have thus pulled down a thread from above to bridge the same gulf. When we consider, indeed, the extremely complete series of forms (making up Potonié's group the Cycadofilices) which lead up from a typical fern-structure to typical Gymnosperm-structure in the details of vascular anatomy, and when we add to this the two discoveries which have just been alluded to, it becomes very doubtful whether we should any longer speak of a "gulf" between the Ferns and the Flowering Plants. Such an excellent bridge is being bit by bit erected, or to vary and perhaps improve the metaphor, the strait of water between the two land masses—a division at one time thought to be the most important in the plant-kingdom—is being so largely filled up with solid earth, that it is already nothing like so important, for instance, as that between the Bryophytes and Pteridophytes, or even as that separating the Bryophytes from the Algæ.

The essential point of the present communication is the conclusion that the coal-measure seed *Lagenostoma Lomaxi* Williamson (MS), a seed with many of the essential features of a modern Gymnosperm, but of considerably more complicated structure, was

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median
section of
small ...
3 mm long
enclosed in
black cup
many glands
seen

Recently Glossopteris & Gangamopteris in Siberia. This was first discovery N of India

In Trias, esp. L. Trias of Germany etc., a certain number of S. hemisphere plants occur abundantly.

So, many forms of the Glossopteris flora migrated towards N, & certain

Science Progress 1897 Seward

Zeiller. Geol Soc France

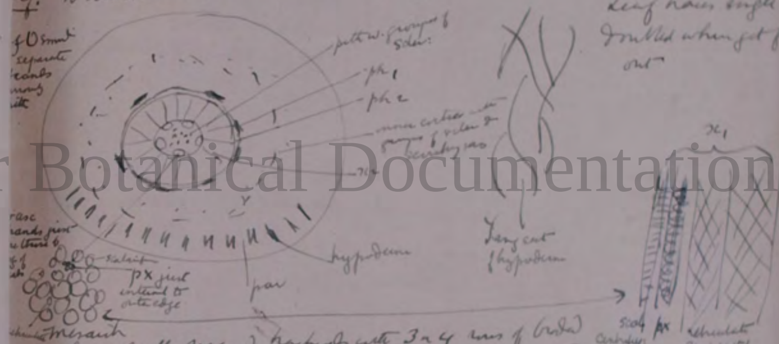
Cycadofilices   Cycadales [Cycadaceae / Cycadofilices

Braun suggested a fairly close relation between cycads & ferns.

Motile sperm. Cycas. Zamia. Stangeria.

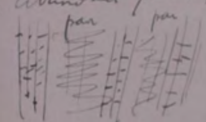
Lyginodendron Oldhamium (Desc 1866 by Binney as Dadoxylon Oldhamium.)

Cf. Williamson & Scott. Phil Trans 95.



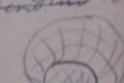
Leaf traces single inside, doubled when get further out

X_2 has radially arranged tracheids with 3 or 4 rows of bordered pits. Abundant parenchyma in X_2 of secondary wood of X_2



Cambium seems more typical than those of Lepidodendron or Sigillaria

Deep seated periderm.

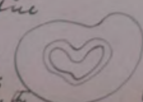


Primary xy of the stem consists entirely of leaf traces. Leaf trace passing out with zone of X_2

The X_2 is lost early in cortex, leaf trace divides, & form collateral becomes concentric

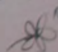
Sphenopteris Hoeninghausi

Foliage of Lyginodendron. No well preserved endodermis in leaf stalk; probably it wasn't well marked as the whole thing is beautifully preserved. Connection w. Lyginodendron quite certain.



The fructification is not known for certain.

Calymmatotheca = fertile frond of Lyginodendron?



Rather fern-like sporangia

possible sporangia borne on special fronds

(Scott)

I Cycadofilices

~~Lyginodendreae~~ (Sec. thick.

Heterangium = (~~Polystelic~~ Glathenia)

To this Megaloxylon links on, differing in 2 pts

① Centre of metaxylem of peculiar isodiametric tracheides & parenchyma

② Exarch primary strand

Lyginodendron

To this Calamopitys links on, differing in 2 pts

① L.t. become conc. directly leave stele

② L.t. break up into many bundles in petiole

II Cycadoxyleae

Lyginodendron robustum (= Cycadoxylon) } char.^d by strong dev.^t of inverted zones of X_2 & phl. in pith, & disappearance of centripetal

Cycadoxylon

Ptychoxylon

III Protopityeae

Protopitys Much sec. wood, resembling Conifers

Continuous zone of primary wood

Distichous leaves

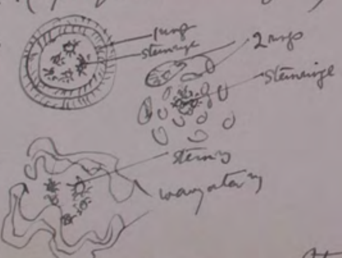
IV Medulloseae

M. anglica. (= polystelic Heterangium)

M. stellata

M. Solmsii

M. Leuckarti



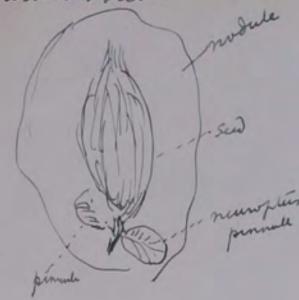
Colpoxylon monostelic in pts; in other pts becomes polystelic by branching

Primary structure of roots resemble Marattiaceae; ad roots resemble those of cycads — they have secondary thickening

Heterangium Grievii & Tiliaeoides

Neuropteris = Medullosa [Seed. Trigonocarpon

Mr. Kidston's seed.



...ming concentric
...k sometimes
...actually same
...ndron.
...ans, Lower
... Heterangium stem
...eserved.
...through the
...ly loses itself
...the Sec
...
...ch. But
...
...tions of X, of each
...ns out as leaf
... In the cortex
...ec X_2 & phloem
...
...leaf structure
...pleris. This

(Scott)

I Cycadofilices

~~Lyginodendreae~~

Heterangium = (Sec. thick. ~~Polystelic~~ Gleichenia)

To this Megaloxylon links on, differing in 2 pts

① Centre of metaxylem of peculiar isodiametric tracheides + parenchyma

② Exarch primary strand

Lyginodendron

To this Calamopitys links on, differing in 2 pts

① L.t. become conc. directly leave stele

② L.t. break up into many bundles in petiole

II Cycadoxyleae

Lyginodendron arbustum (= Cycadoxylon)

Cycadoxylon

Ptychoxylon

} char^d by strong dev^t of converted zones of x_2 & ph in pith, & disappearance of centripetal

III Protopityeae

Protopitys — much sec. wood, resembling Conifers. Continuous zone of primary wood. Distichous leaves

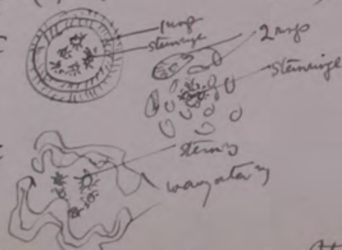
IV Medulloseae

M. anglica (= polystelic Heterangium)

M. stellata

M. Solmsii

M. Leuckarti



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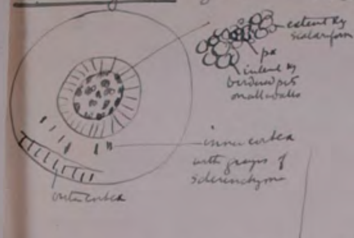
Heterangium Grievii & Tiliaeoides



Leaf traces collateral & becoming concentric on passing out.

Well marked pc where cork sometimes arises

Leaf stalk practically same as Lyginodendron.

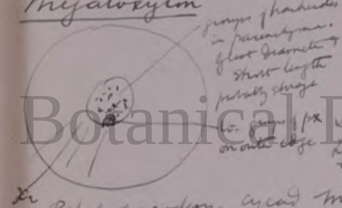
Sphenopteris elegans, Lower Carboniferous, borne on Heterangium stem

Roots much like those of Lyginodendron.

Cf Gleichenia (tracheids scalariform & not reticulate)

H. Tiliaeoides. Secondary ph well dev^d; sieve tubes well preserved.

Megaloxylon



As l.t. passes vertically down through the stele it spreads out & gradually loses itself

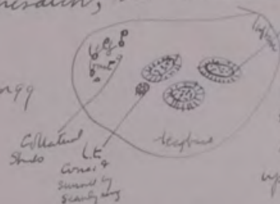
Ref Seward Proc. Camb. Phil Soc

Leaf traces ... Heterangium etc. Cf Lygodium where px ... search

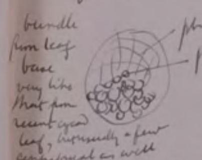
Petiole of modern cycad mesarch, but in stem endarch. But peduncles mesarch

Medullosa anglica

Ref. Scott Phil Trans. 1900 & 99



Portions of X_2 of each stele pass out as leaf traces. In the cortex these lose X_2 & break up into distinct collateral bundles



Practically a polystelic Heterangium. But leaf structure essentially cycadean instead of filicinean

Leaf borne was of Alethopteris. This type is one of the commonest in the coal measures.

[See Scott for Origin of Cycads]

Poroxylon & the Cordaiteae (Scott)

Poroxylon Leaves broad, thick, simple, ||l veined cf Dammara xy all centripetal

General stem structure like Lyginodendron, but bundles exarch. &

Leaf traces double, (& unlike Lyg:) don't fuse till they have run for ~~the~~ some time on the edge of the pith.

Anatomy of whole leaf like a single leaflet of Bowenia, obs mesarch & collateral throughout the leaf, unlike the cone: bundles of Lyg:

Its general structure seems to argue descent from filicinean ancestors

Cordaites Tall slender trees, poor roots, simple ||l veined leaves. ♂ & ♀ catkins

Discoid pith.

General type of structure that of a conifer, but the pith larger than any conifer & more like a cycad.

Xy all centrifugal.

X2 essentially structure of Araucaria

L.t. often double cf Lyginodendron, Ptychoxylon, Poroxylon Ginkgo

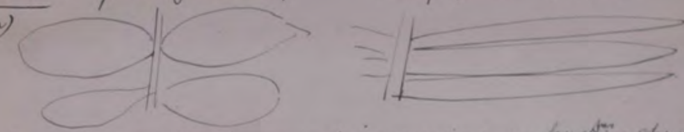
At St. Etienne certain beds of coal of carbonised leaves of Cordaites.

Leaf bundles mesarch as in recent Cycads

(see over)

Cycadales { Cycadaceae (Sago palms) / Bennettiteae

Permian (French) Sphenozamites; Pterophyllum cf Dioon



Evidence not satisfactory, as only impressions, no fruct^n or structure

Triassic Very abundant, especially towards close of period

max Abundant in **Jurassic** & also **Wealden**

~~Gretr~~ **Tertiary** only 2 or 3 examples. So really a very sudden disappearance

Cordaites Renault (Paris)

U Carb & Perm

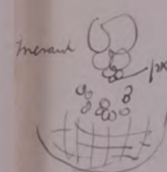
Gymnosperm.

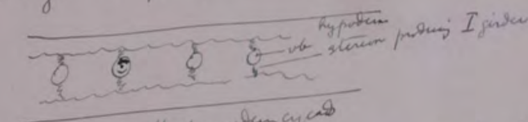
~~Structure~~ Stem almost identical with Araucaria.

Large pith

Leaf traces come off in pairs, cf Ginkgo

Leaves long & strap shaped. Parallel veins





Cf leaf or leaf stalk of modern cycad

Pith Discoid. cf walnut, not original structure

Ref Annals 1900 Seward & Gowan Ginkgo

Psygmophyllum. Potonié Palaeoz. Ginkgo.

Cycadeoidea. Kent & Portland desc by Seward.

Fl Williamsonia Pecten. Flowers & fronds. Inf Oolite — Bennettiteae

= Zamites gigas. Flowers first desc as Cynara

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EXPLANATION OF PHOTOGRAPHS AND FIGURES ON PLATE IX ILLUSTRATING MISS M. STOPES' PAPER ON "THE LEAF STRUCTURE OF *CORDAITES*.

Photograph 1.—Trans. sect. of the leaf of *Cordaites lingulatus* (×130.)
- *px*. protoxylem
- x^1. centripetal xylem.
- x^2. centrifugal xylem.
- *ph*. phloem.

Photograph 2.—(et seq). *C. principalis*. Trans. sect. of leaf (×75.)
- *v*. vascular bundle.
- *s*. large sclerotic strand on the lower side.

For details see photos. 3 and 4.

Photograph 3.—Single bundle enlarged (×200). The one nearest the broken end of leaf, phot. 2.
- *px*. protoxylem.
- x^1. centripetal xylem.
- *p*. xylem parenchyma.
- *ph*. phloem.
- *ss*. inner pitted sheath ("primitive transfusion-tissue").
- *s*. outer pitted sheath ("peridesmic transfusion-tissue").
- *f*. crushed phloem cells, which appear somewhat like xylem as they are out of focus.

Photograph 4.—Bundle about to divide (×200). From another bundle of the leaf partly shewn in phot. 2. The inner sheath is beginning to grow in, separating the two groups of phloem.

Figure 5.—Diagram of trans. sect. of a single bundle and adjacent tissues (×180.)
Lettering as phot. 3.

Figure 6.—Diagram of long. sect. of bundle (×300.)
Lettering as above.
- *si*. sheath cells adjacent to and above centripetal xylem (? pitted.)

Figure 7.—Parenchyma of leaf (×130), section cut parallel to midrib and at right angles to plane of leaf, somewhat oblique.
- *sc*. sclerenchyma of large strand on the lower side.
- *s*. spongy tissue.
- *p*. palisade tissue.

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EX
ILI

Cordaites (notes from Scott, contd. from left hand sheet on page before)

L.S. ♂ catkin

Single stamen

3 – 6 sacs

Renault regards them as sporophylls with [illegible] [illegible] sterile bracts. Thus the ♂ catkin would differ from Ginkgo only in the presence of sterile bracts

Many sterile bracts in ♀ catkin. Ovules on short lateral axillary axes. 2 integuments ^Perhaps these are only a single structure^ surrounding a nucellus, Pollen chamber is surmounted by a curious neck. The ovule of recent cycads sometimes resembles this with extreme closeness

The pollen grain has divided a good deal before while still in the anther

If we compare this ♀ catkin with an ordinary recent Coniferous cone we are led to regard the semi-inferous scale of the latter as a reduced axillary shoot

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Seward · Fossil Plants — Notes on use & manuscript in laboratory — 1.

Ward L. F. Sketch of Paleobotany
U.S. Geol Surv. Fifth Ann Rep Washington 1883 84

1828 Sprengel. On Psaronius Commentatio de Psarolithis Halle 1828

1833 Henry Witham of Lartington "The Internal Structure of Fossil Vegetables. Edinburgh 1833
The art of making transparent sections of the tissues of fossil plants seems to have been first employed by Sanderson, a lapidary + afterwards improved by Nicol

W. Nicol Observ upon structure of recent + fossil Coniferæ Edinb. New Phil. Journal XVI p137 1834

Knowlton. Desc of a problematic organism from the Devonian at the falls of Ohio
Amer. Jr. Science Vol XXX VII [3] p202 1889 New Jrl 1225

Corda Beitrage zur Flora der Vorwelt Prag New Ed. enlarged 1867 1845

"Lindley + Hutton, in the preface to the first volume of the Flora, claim to have demonstrated that both Sigillaria + Stigmaria were plants with "the

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highest degree of organisation, such as Cactæ, or Euphorbiaceæ, or even Asclepiadeæ."

Lindley & Hutton. Fossil Flora of Great Britain
London 1831-37

"In the neighbourhood of Autun there used to be found in abundance loose nodules of siliceous rock containing numerous fragments of seeds, twigs, & leaves of different plants. The rock of which the broken portions are found on the surface of the ground was formed about the close of the Carboniferous period. [illegible] the hands of French investigators the microscopic examination of these fragments of a Palæozoic vegetation have thrown a flood of light on the anatomical structure of many extinct types. Sometimes the silica has penetrated the cavities of the cells & vessels, & the walls have decayed without their substance being replaced by mineral material. Sections of tissues preserved in this manner, if soaked in a coloured solution assume an appearance almost identical

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th that of stained sections of recent plants. The spaces left by the decayed walls act as fine capillaries & suck up the coloured solution".

It is occasionally possible to obtain from petrified plant stems perfect casts in silica or other substance of the cavity of a sclerenchymatous fibre, in which the mineral has been deposited not only in the cavity but in the fine pit canals traversing the lignified walls".

"Some of the most perfectly preserved tissues as regards the details of cell contents are those of gymnospermous seeds from Autun & certain of the Carboniferous Seeds which I recently had the opportunity of examining in Prof. Bertrand's collection, the parenchymatous cells contained very distinct nuclei & protoplasmic contents. ^ ^ ^ ^ If we consider what these facts mean — the microscopic investigation of not only the finest framework but even the very life-substance of Palaeozoic plants — we feel that the aeons since the days when these plants lived have been well-nigh obliterated".

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Williamson p. 507
Phil Trans R. Soc Vol CLXI p 477 1871

The name Calamites was first suggested by the supposed resemblance of the Palaeozoic plant to reeds

"The wonderful perfection of preservation of many fossil plants enables us to investigate the contents of petrified cells & to examine in minutest detail the histology of extinct plants. To those who are familiar with the possibilities of microscopical research as applied to silicified & calcified fossil tissues, it is by no means incredible that evidence has been detected of the existence of Bacteria as far back in the history of the earth as the Carboniferous & Devonian periods

Calamite roots. Cortex with large lacunae like water plants, shews that Calamites grew either in water or on swampy ground

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Solms Laubach. Fossil Botany. epiliyn Carb
Leaves occurring from the Devonian beds upwards
& of rubbon-like shape & parallel venation used to be
taken for Monocots, & called Cordaites. The
actual proof that they were gymns was furnished
by Grand'Eury (Flore Carbonifère du dépt. de la
Loire et du centre de la France 1877)
Water stomata & epithemata over the ends of the
nerves can be observed in some fossil ferns

Scotts' fossil botany Studies in Fossil Botany
In the class of recent plants, systematic botanists,
so far at least as the flowering Plants are concerned,
are accustomed to rely chiefly on the morphology of
the reproductive organs, usually on their more
external, as distinguished from their microscopic
features. Such characters, however, are often
absent in fossil specimens, & it becomes necessary
to make use of other means of discrimination.
In the case of the Cryptogams, which play so
important a part among the plants of the earlier

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periods, few conclusions can be drawn, even when the fructifications are preserved, without the use of microscopic characters. Still more is this the case when the vegetative organs alone are preserved. Among the plants of the more ancient formations, necessarily very remote from any now living, little reliance can be placed on the mere external vegetative characters, while experience has shewn that anatomical structure affords a much more trustworthy clue, when interpreted with proper care & judgment."

Osmundaceæ. Only a single specimen of the core, or fragment of the peduncle known from base of carbonaceous. From this one specimen by sections in different directions the whole structure has been elaborately worked out & the final conclusion is that it is "perhaps the most complex Cryptogamic fructification at present known to us" It is a synthetic type combining the characters of the Horse tails & Club mosses, & with an extinct family called the Sphenophyllaceæ "The evidence for the common origin of these

phyla, now so distinct, has been obtained exclusively from the study of fossil botany." We might say, by the application of the microscope to fossil botany.

There are a series of forms with fern-like leaves in the Carboniferous strata which are now, from anatomical investigation with the microscope, known to occupy a position intermediate between ferns & gymnos; These ~~forms~~ [illegible] gap which is entirely extinct, is not available [illegible] in the [illegible] are now called "Cycadofilices" *

Gigantic horsetails existed in the coal measure forests. These instead of remaining slender like our little modern horsetails produced secondary wood about like the fir trees of the present day, & in sections under the microscope these seventy [illegible] can be seen

* Even on the evidence of recent forms alone many botanists have stoutly maintained the origin of Cycads (& [illegible] of gymnosperms) from ferns, & Dr Scott says about the Cycadofilices

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Palaeozoic Strobili

"we may safely say that the existence, in early times, of this great synthetic group, confirming the conclusions drawn from recent morphology, gives overwhelming strength to the evidence for deriving the Cycadales from the Ferns

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Palaeozoic Strobili

I Sphenophyllales

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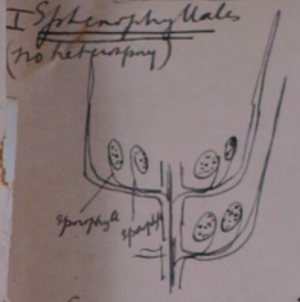
Palaeozoic Strobili

L.S.

I Sphenophyllales
(no heterospory)



Sphenophyllum Dawsoni

Bowmanites Römeri

Differs from S. Dawsoni in having the sporophylls pellate, each bearing
2 sporangia
3 concentric vertical
4 sporangia

T.S. the lower fertile portion of sporophyll

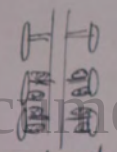
T.S. the upper free portion of stalk of sporophyll

Cheirostrobus

II Equisetales

Calamostachys
Heterospory in C. Casheana

Palaeostachya

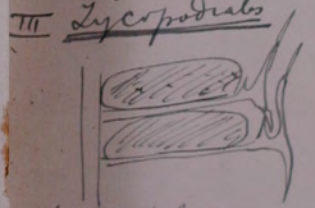


Archaeocalamites

Sporophylls with 2 sp. close below sterile whorls

Cingularia

III Lycopodiales



Lepidostrobus
Heterospory in L. Veltheimiana

Spencerites

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Observations on Fossil Vegetables accompanied by representations of their internal structure as seen through the microscope.

1831. Henry Witham

The external forms in many instances" are obviously too much altered, to permit us to refer the objects in question, with perfect satisfaction, to any natural family. But a method has lately been discovered, by which the stems or branches may be sliced & afterwards reduced to such a degree of thinness as to permit us to inspect the most minute remains of organic texture."

"A piece of this fossil wood obtained in the usual manner. One side of it is ground perfectly flat, & is then applied to a piece of plate or other glass, by means of a transparent gum or resin. The other side is then ground down, parallel to the glass, & , as being brought to the necessary degree of thinness, polished. By this means, the internal structure may be as distinctly seen as in the slice of a recent vegetable."

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Beiträge zur Flora der Vorwelt
A J Corda 1845

Herr Witham war der erste, welcher dünne Schnitte der fossilen Hölzer anfertigen liess."

Lindley + Hutton

"It may be observed, that no trace of any Gramineous plant has been met with, even in the later Tertiary Rocks, although we know that Grasses now form a portion, & usually a very considerable one of every Flora of the world; from New South Shetland, to Melville Island, inclusive. It may, indeed, be conjectured, that, before the creation of herbivorous animals, Grasses & Sedges were not required, & therefore, are not to be expected in any beds below the Forest Marble, & Stonesfield Slate."

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The Probable Physiognomy of the Cretaceous Plant Population. Conway Macmillan

Amer. Nat. Vol XXVII p336
April 1893

He thinks that though we get such a preponderance of metaspermic plants in the Cretaceous fossil deposits this was: they at that date occupied the coast lines or "tension lines" because they were new, weak & few. The preponderance of the flora was ferns, cycads ferns & club mosses. The tension line is the transitional region between 2 formations eg. forest & prairie, & he says that there is a tendency for a higher phylogenetic type to accumulate on the tension line, but the example he gives is Compositae predominant over Archichlamydeae & Monocots on a border between wood & prairie! The imperfectly established plants "work out" to the tension line. If the more composites are born in the middle of a grass field, in 3

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-eas they will have got a good foothold round
the edges, but very little in the middle
He thinks most variation takes place on the tension
line. The causes of evolution are working at
their highest ∴ of the simultaneous working of
the struggles bet: individual & individual, indiv:
& formation, & form^n: & form^n:
It is the sandy beaches & mudflats which
persist as the Cretaceous rocks.
The man [illegible] of [illegible] [illegible] [illegible].
He [illegible] the shore line of Cape Cod for
one month!
The coast line, ∴ it was peripheral & terminated
ejection must have dev^d a tension line grp of
plants in Cretaceous times
"The picture of the Cretaceous plant physiognomy
which these consideration brings before our eyes is of
great solid inland forest of conifers, cycads
ferns, & Calamites (?), bounded by a thin peripheral
line of metaspermic trees, shrubs & herbs.

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those ages" (Triasic early") we may imagine the metaspermic types developing in the ancient forests of Cycads — or even of Lepidodendrons & Annularias — & beginning their forced marches to the peripheral regions of the solid archaic formations of their birth. Thus for century upon century they may have existed, & fail to appear in the fossils, because of their internal position in the formations. But when, after this long struggle for food & light will for ever exist they emerge upon the periphery of the parent formations we find them already arborescent or arboreal, & soon almost universal upon littoral areas. They then first come into a position where preservation in the rocks is possible"

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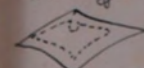
Bennettiteae Lecture by Prof Oliver U.C.L. February 1905

Bennettites (England) = Cycadeoidea (America)

Specimens in this country consist of a single trunk L^r Greensand of I. of Wight, B. Gibsonianus petrified in Calcium phosphate. Stems much like modern cycads in appearance. axillary buds.

Anatomy on the whole Cycadean. Behaviour of leaf trace rather like Medullosa than Lyginodendron.



Tang leaf base

B. Gibsonianus

B. Museum & Kew have pieces of this stem. Carruthers wrote a memoir on the B M part.

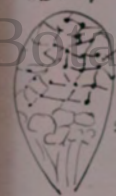
Solms in eighties came over & look at it, & also secured the Kew piece & wrote a new paper. Annals Botany 1891. Read "Studies" first, then Solms, then Carruthers plates in Linnaean Transactions 1867, then read American work. The one specimen up to quite recent times gave all we know about the genus. Possibly there are some bits in the Museum at U.C. The strobili wrapped in their scales are about 2 inches long. Some American specimens of the trunks are huge.

The only fossils of any antiquity we know containing an embryo

Fern like ramenta instead of hairs

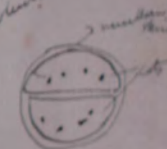
The v. strand of the seed pedicel is not properly described, possibly concentric seeds about size of Lagenostoma ovules 3–4 mm long. Carruthers called the content of the seed "endosperm", but really it is filled with 2 succulent cots.

The surface of the fructification of the [illegible] of the involucre



Cushions = surfaces of interseminal scales = pericarp

The mosaic of interseminal scales forms a pericarp – they are all [illegible] completely united



B. has often been compared with an Angiosperm, tho' there seems no doubt that the pollen was received directly on the nucellus. The English specimen is too advanced

If the interseminal scales arose from the seed stalk (which apparently it doesn't) we should have something very like an angiosperm ovule

Lignier in the French material thinks he has found a pollen chamber

In the English material the micropyle is apparently closed by expansion of inner layer of integument

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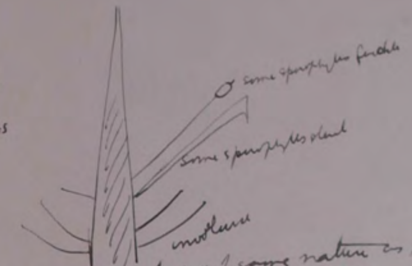
Views on homology of ♀ cone :–

(1) all leaf structures

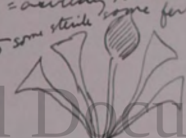


Scott thinks seminal scales are of same nature as interseminal scales.

(2) Lignier thinks seed stalk = axillary structure

(3) Oliver .. leaf segments some sterile some fertile

Analogy with some other structures



U.S.A Marsh who worked on evolution of horses' hoof made over a collection of specimens of Yale University at least 800! Dr. Wieland

Far too much material for one man.

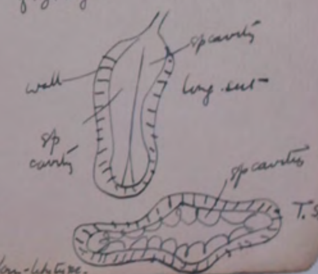
Wieland has established the fact that the Bury bore cycadean leaves.

Cycadeoidea ingens weighs 800 lbs. We ought to get a complete developmental series from Yale

Wieland has found a spec with ♂ sporophylls, & also an abortive seminal cushion in the middle, apparently ☿. Out of a small bud, about 2 inches long. Cy. ingens none other sp.

G. R. Wieland

Coulter's Gymnosperms gives a figure of synangia



♂ sp of Ben. corresponds to ♀ sp. of cycas, because fern-like type.

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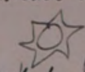
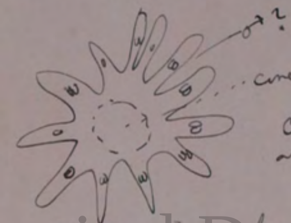
The French species Bennettites Morierei consisted of a single ♀ cone - seeds more complicated in micropyle region than other sp. Lignier described it. Integument becomes winged, so that neck of ovule stellate in section



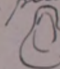
Prof Oliver thinks Bennettites & Cycads came off separately from Cycadofilices

Zamia gigas (Williamson) = Williamsonia gigas (Carruthers)
Cones stalked & grouped round apex



Cone broken open & looked at from above.

Wieland ~~1905~~ Dec. 04 (~~1904~~?) has found what he thinks to be a proembryo. Seeds more or less filled with a tissue which he thinks is the proembryo, the pear shaped body into which the oospore segments



modern cycad
If this Ben: thing really is a proembryo, it is ~~to~~ solid not hollow, & more like Ginkgo, in which also there is no suspensor. Wieland infers ∴ that Ginkgo is the most archaic of living types!

Nathorst describes a plant which he attributes to Williamsonia as of a branched habit! Axis ending in flower. Below flower a regular production of fronds, then a sympodial branching, & thing repeated

W. angustifolia

Rather Banksia like
The attribution is not absolutely certain

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