Chapter 4 Tertiary plants from Mull<ref>M.S. received March 11, 1921 (Editor).</ref>.

By A. C. Seward and R. E. Holttup<ref>It is only fair to state that Mr. Holttum has done the more laborious and difficult part of the work; he is responsible for the determination and description of the Dicotyledons and he has also assisted me in the description of the other fossils. (A C. Seward).</ref>. With a description of a new Beetle. By T. D. A. Cockerell.

Introduction

The specimens which form the subject of the present Report were sent to one of us for examination from the Museum of the Geological Survey, Edinburgh. They were collected by Mr. Tait from two localities (i) the Ardtun leaf-beds at Bunessan, the locality from which Mr. Starkie Gardner collected numerous specimens (p. 61), and from (ii) a new locality at Carsaig discovered by Mr. Tait: the latter beds occur near the base of the volcanic succession and are believed to be approximately on the Ardtun horizon (p. 64). The great majority of the fossils are impressions of leaves usually far from complete and unfortunately without any carbonaceous films which could be examined microscopically. Our attention has been mainly concentrated on the Geological Survey collection, but use has also been made of the more satisfactory material collected by Mr. Starkie Gardner and now in the British Museum. Though it is seventy years since Tertiary plants were discovered in the Island of Mull the flora as a whole has never been thoroughly investigated. We hope that in the near future it may be possible to undertake a more thorough examination of all the available material from the Island. Our immediate object is to determine as far as we can the specimens submitted to us, to form an opinion on the botanical character of the vegetation and of the geological age of the Mull leaf-beds.

For many years past the investigation of the older Tertiary floras of Britain has been neglected while on the other hand the researches of the late Mr. Clement Reid, and more recently those of Mrs. Reid, have demonstrated the possibilities of palaeobotanical work when the material consists largely of fruits and seeds.

The literature on Tertiary plants is both voluminous and scattered, and unfortunately many of the published generic names have been adopted without any evidence that systematists could accept as satisfactory. Many leaf impressions, however perfect, cannot be identified with confidence, and it is even asserted that in the absence of fruits and seeds, or flowers the palobotanist's task is foredoomed to failure. There would seem to be two alternatives; either wholly to neglect fossil angiospermous leaves or with the assistance of expert systematists to endeavour to steer a middle course between the over-confidence of the enthusiast, who cannot resist the temptation of naming specimens which are indeterminable, and the extreme caution of the botanist, who declines to commit himself to definite opinions which cannot be supported by evidence such as he is accustomed to demand from recent plants. In dealing with Tertiary plants it is easy to be destructive and to throw doubt on the conclusions of other authors. Mere destructive criticism is of little value from the point of view of definite progress. Our aim is to discard material that in our opinion cannot be determined with reasonable confidence, and to satisfy ourselves that the opinions expressed are based on evidence that would not be considered inadequate by botanists possessing a considerable knowledge of the taxonomy of recent plants.

Our thanks are due to Dr. Lee and Mr. Bailey of Edinburgh for references to literature, to Dr. Kitchin of the Jermyn Street Museum, to members of the Botanical and Geological Departments of the British Museum, particularly to Dr. Rendle and Mr. W. N. Edwards. We are also indebted to Mrs. Reid for examining and reporting upon some specimens submitted to her.

In 1851 the Duke of Argyll communicated a paper to the Geological Society on the Geology of the Ardtun leaf-beds, with a note by Professor Forbes on the fossil plants.<ref>Argyll (1851). For reference's cited in this- chapter *see* Special Bibliography, p. 89.</ref> Of the numerous fossils obtained a few of the "most perfect impressions of plants, mostly of leaves only" were selected for illustration, and Forbes with commendable caution stated that "without much more data than such impressions, however perfect, afford, anything like a specific diagnosis satisfactory to botanists may not be constructed." He stated that the plants undoubtedly indicated a Tertiary and probably a Miocene age. The Duke of Argyll from an examination of the manner of occurrence of the leaves in his middle, or second, leaf-bed concluded that they

must have been shed "autumn after autumn into the smooth still waters of some shallow lake, on whose muddy bottom they were accumulated, one above the other, fully expanded and at perfect rest." He drew attention to the presence of only small twigs and the- absence of trunks or large branches.

In 1870 Dr. Grieve and Mr. Mahony exhibited a series of fossils from the leaf-beds of Mull at a meeting of the Natural History Society of Glasgow. The leaf-beds were assigned, for reasons not specified in the Report, to the Miocene period.

A Committee of the British Association appointed to collect and report on Tertiary plants from the north of- Ireland issued four Reports in 1879, 1880, 1881, and 1883. In the third Report (drawn up by W. H. Bailey) it is stated that " by the identification of these plant remains we are enabled to fix the period in which they lived as being lower Miocene they also afford strong evidence of being contemporaneous with other volcanic districts such as those Of the Island of Mull on the west coast of Scotland and of north Greenland, where mid-European plants such as these once flourished." The few illustrations of the plants given are not very satisfactory, but Gardner<ref>Gardner (1886).</ref> has figured in his *Eocene Flora* some good specimens of Conifers with cones from the north of Ireland. It is to be noted that Gardner<ref>Gardner (1887).</ref> subsequently gave reasons for referring the plant remains to a Lower Eocene age.

In 1881 Mr. W. E. Koch contributed notes *On Mull and its Leaf-beds* to the Geological Society of Glasgow. He described a section through the middle leaf-bed "on the north-east side of a glen leading to the sea." His description agrees fairly well with that later given by Gardner except that he found no break in the fossiliferous succession between the middle leaf-bed and a brown soil below, which latter contained roots and branches, one of them "5 inches across and another 2 inches across, and ½in. thick. This bed," he added, "rests on eruptive matter and here I believe we are on the site of the old forest." The, discovery of a local basal root-bed was confirmed by Gardner; but its presence hardly warrants Mr. Koch in dispensing with the swampy lake in which the Duke of Argyll pictured the accumulation of fallen leaves.

The Committee appointed by the British Association to report on the fossil plants of the Tertiary and Secondary beds of the United Kingdom issued Reports in 1885 and 1886 without any reference to the Mull Flora. The second Report contains a paragraph remarking on the inadequacy, from a botanical point of view, of leaf-impressions alone for the identification of genera and species of plants.

Several references are made to the Mull plants in a Monograph on the British Eocene Flora by Baron Ettingshausen and Mr. Starkie Gardner. In the first part, by both authors,<ref>Ettingsbausen and Gardner (1882).</ref> a description is given of the Fern mentioned by Forbes as *Filicites hebridicus:* this is transferred to the genus *Onoclea.* The type-specimen, illustrated both by Forbes and by the later authors, is in the Jermyn Street Museum. In the second part, by Ga.rdner,<ref>Gardner (1886).</ref> several Gymnosperms are described and illustrated. Gardner states that the Mull flora includes types that are also met with in the English sub-tropical Middle Eocene Flora such as *Podocarpus,* the widely distributed southern hemisphere Conifer, together with species recorded by Heer from Greenland in rocks regarded by him as Miocene. Gardner in 1887<ref>Gardner (1887),</ref> gave an account of the lava sheets of Mull and their relation to the leaf-beds, based on personal exploration and quarrying operations. In the latter contribution he discusses the geological age of the Ardtun leaf-beds and points out that Heer's pronouncement on the Miocene age of Scottish, Greenland, and other plant-bearing beds had been generally accepted as an authorative decision, but adds that in his opinion the evidence clearly indicates an early Eocene horizon.

The following lists give (A) the plants recorded by previous authors with the addition of the names adopted in the present paper and (B) the plants described by us

A.

Forbes, 1851	A.C.S. and R.E.H.
Taxites (?) Campbelli Forbes.	*Elatocladus Campbelli* (Forbes).
Filicites (?) hebridicus Forbes.	*Onoclea hebridica* (Forbes).
Equisetum Campbelli Forbes.	*Equisetum Campbelli* Forbes.
Rhamnites (?) multinervatus Forbes.	
R. major Forbes.	
R. lanceolatus Forbes.	

Platanites hebridicus Forbes.	*Platanus hebridica* Forbes.
Alnites (?) MacQuarrii Forbes. Gardner, 1886	
Cryptomeria Sternbergii Goepp.	*Pagiophyllum Sternbergi* (Goepp).
Ginkgo adiantoides (Ung).	*Ginkgo adiantoides (Hug).*
Podocarpus eocaenica Ung. (recorded but not figured from Mull).	
Podocarpus Campbelli Gard. Gardner, 1887<ref>This list includes only the species additional to those recorded by Forbes.</ref>	*Podoccopus Campbelli* Gard.
Sequoia Langsdorfii Heer.	*Sequoiites* (?) *Langsdorfi* (Brongn).
Glyptostrobus europoeus Heer.	
Podocarpus borealis Gard.	
Quercites greenlandieus Heer.	*Quercas greenlandica* Heer.
Boehmeria antiqua Gard.	
Grewia crenulata Heer.	

B.

Pteridophyta

Equisetales. *Equisetum Campbelli* Forbes.

Filicales. *Onoclea hebridica* (Forbes).

Gymnospermae

Ginkgoales. *Ginkgo adiantoides* (Ung).

Coniferales.

Abietinem. *Finites* sp.*

Cupressinem, *Cupressites .MacHenryi* Bail.*

Sequoiinere. *Sequoiites (?) Langsdorfi* (Brongn).*

Podocarpinetae. *Podocarpus Campbelli.* Gard.

Araucarinese (?). *Pagiophyllum Sternbergi* (Goepp).

Coniferales incertie sedis.

Elatocladus Carapbelli (Forbes).

Coniferous Wood.

A. *Cupressinoxylon sp.*

B. Wood in Lava.

Angiospermae. Dicotyledones.

Betulacem. *Corylites hebridica* sp. nov.

Dicotyledonous Wood (? Betulacem).

Fagaceae, *Quercus greenlandica (Heer).*

Platanaceae. Platanus hebridica (Forbes).

Dicotyledones incertie sedis.

Phyllites platania (Heer).

Phyllites ardtunensis sp. nov.

Phyllites spp.

Plantae Incertae Sedis.

Specimen A*

Specimen B*

Specimen C

Specimen D

Specimen E.*

Specimen F

The species with an asterisk are from Carsaig; the others from Ardtun

Description of specimens

Insecta

Mr. Starkie Gardner figured an elytron of a beetle and the "hind wing of a Cercopid insect"<ref>Gardner (1887), Pl. XIII, Fig.8, and 9</ref>which was found in association with some of the Mull plants. The few specimens of elytra among the fossils submitted to us were shown to Professor Cockerell of the University of Colorado who kindly contributed the following description of an elytron which he makes the type of a new species, the first Tertiary insect from Scotland to receive a name.<ref>Cockerell (1921), p. 22, Fig. 28.</ref> *"Carabites scoticus* sp. nov. Elytron 5 mm. long and 2 mm. wide, the apex obtuse; inner basal corner rectangular; margins very slightly convex except at apex and outer base; ten striae, not counting the inner absolutely marginal one; striae weakly and closely punctate but the general effect sharp; outermost striae marginal except near base; third and fourth striae (counting from inner margin) joining a considerable distance from apex, with a short appendiculation beyond; seventh striae ending before the sixth or eighth. Eocene; Isle of Mull. Much smaller than the elytron figured by Gardner,<ref>Cockerell (1921), Fig. 8.</ref> and abundantly distinct from the Eocene beetles described from the south of England. It resembles such genera as *Anchomenus* in the present fauna of Britain, but is different and probably represents an extinct generic type. It is placed in the genus *Carabites* in the absence of more complete material. In the same collection are two other elytra, too imperfect to describe. One is at least very close to the above. The other is only about 3 mm. long, weakly striate; apparently a weevil.

"For permission to examine these interesting specimens I am indebted to Professor Seward."

Pteridophyta

Equisetales

Equisetum Campbelli Forbes. The largest specimen is an impression of an aerial shoot 12.5 cm. long with internodes 1–1.5 cm. in length (Figure 5)A. The leaf-sheaths with acuminate segments (Figure 5)B extend almost the whole length of the internode. Imperfectly preserved pieces of adventitious roots are seen near the base of the shoot. There is no evidence of branching. It is clearly impossible to give a complete diagnosis even of the vegetative features: in size the specimen shown in (Figure 5)A agrees with shoots of the recent species *Equisetum maximum,* particularly with fertile shoots in which the leaf-sheaths are relatively large and there are no branches.

An examination of the original specimen figured by Forbes<ref>Forbes in Argyll (1851), Pl. III., Fig. 6.</ref> convinced us of its specific identity with the specimen shown in (Figure 5). Forbes's figure is misleading as the actual specimen shows very clearly a portion of a leaf-sheath. (Figure 5)C represents an elongate, oval impression of an unexpanded part of a shoot, probably a fertile shoot, of the same type. The surface is covered by overlapping segments of crowded leaf-sheaths.

The specimen reproduced in (Figure 6) may or may not belong to the species represented in (Figure 5). An imperfectly preserved slender stem is seen in close association with a slightly crushed spherical body which may be a tuber similar to the subterranean tubers of certain recent species.

Filicales

Onoclea hebridica (Forbes). The fragmentary impressions of this fern do not enable us to add anything to the description of the Mull specimens previously published,<ref>Forbes in Argyll (1851), Pl. II., Figs. 2A, 2B; Ettingshausen & Gardner (1882), p. 68, Pl. 13, Fig. 5, Fig. 6.</ref> but through the courtesy of Mr. W. N. Edwards of the Geological Department of the British Museum we are able to give the accompanying figure (Figure 7) of some spores which he obtained from fertile fronds collected by Mr Gardner in the Island of Mull.

These spores agree closely with those of the recent species *Onoclea sensibilis* and support the generic identification based on sterile fronds. The genii's *Onoclea,* represented by a single species, occurs in eastern North America from Newfoundland to Florida and extends to Saskatchewan and Nebraska; it also occurs in Japan and north-east Asia. Like many other plants it has a discontinuous range and the fossil records show that the genus had a wider and more continuous geographical distribution in the early Tertiary period. Christ<ref>Christ (1897), p. 284, and (1910), p.

340.</ref> points out that *Onoclea* affords a good example of the similarity between the flora of east Asia and that of eastern North America which was first recognised as an interesting phytogeographical problem by Asa Gray.

Sterile fronds of *Onoclea* were described by Forbes and later by Gardner from Mull. The same species is recorded by Heer<ref>Heer (1868), p. 86, Pl. I., Fig. 16; (1869), Pl. XL., Fig. 6; (1883), Pl. LXX., Fig. 6 [Specimens obtained in Greenland in 1921 by the authors of this paper confirm the accuracy of Heer's determination].</ref> from Greenland in beds assigned by him to the Miocene; by Newberry<ref>Newberry (1898), p. 8, Pl. XXIII. Fig. 3; Pl. XXIV., Figs. 1–5.</ref> from Dakota, and by Knowlton <ref>Knowlton (1902), p. 705, Pl. XXVI.</ref> from Montana, in beds belonging to the Fort Union and other series, which are believed to- be Lower Eocene in age. It has also been found in other North American localities.4 <ref>I take this opportunity of correcting a careless mistake In the *Hooker Lecture,* published in vol. xlvi. of the Linnean Society's Journal, 1922, leaves of *Onoclea,* indistinguishable from those of the recent plant, are said to have been recorded from Upper Cretaceous rocks in various parts of North America *(toe. cit.,* p. 222). The American specimens are from the Fort Union, the Lance, and Paskapoo formations, all of which are believed to be Lower Eocene in age. I am indebted to Mr. Knowlton and Mr. Hollick for drawing my attention to this unfortunate mistake A. C. S.</ref> The only previous record of the- association of sterile and fertile fronds is that by Knowlton.<ref>*Loc cit.*</ref> Lesquereux<ref>Lesquereux (1878), p. 101, Pl. XIV., Figs. 1–3.</ref> in his *Tertiary Flora* described specimens of *Caulinites fecundus* from Erie, Colorado, which Knowlton<ref>Knowlton (1898), p. 153.</ref> refers to the genus *Onoclea.* It is possible that Knowlton is correct, but the figures are not convincing and moreover there are no sterile leaves. Hollick and Berry both figure fertile fronds as *Onoclea inquirenda* Holl. from the Upper Cretaceous (the former<ref>Hollick (1906), p. 32, Pl. 1, Figs. 1–7.</ref> from Long Island and Martha's Vineyard, the, latter from South Carolina<ref>Berry (1914), p. 14, Pl. II., Figs. 7, 8.</ref> and Maryland<ref>Berry (1916) p. 764, Pl. LI., Figs. 1, 2.</ref>), but in the absence of sterile fronds the identification as *Onoclea* cannot be considered certain.

Newberry, in his original remarks on the fossil leaves, notes the wide range of variation in the living species and states that he is unable to separate the fossil from the recent fern.

Gymnospermae

Ginkgoales

Ginkgo adiantoides (Ung). Only one imperfect fragment of a leaf of this species was detected among the fossils submitted to us from the leaf-beds of Ardtun.<ref>Gardner (1886), p. 99, Pl. 25.</ref>

Coniferales

Abietineae

Pinites sp. The impression from Carsaig represented in (Figure 8) is probably an imperfectly preserved dwarf shoot of a five-needled Pine. The longest filiform leaf, which is incomplete, is 4 cm. long and not more than 0.4 mm. broad.

It is impossible in the absence of more satisfactory material to identify the specimen with confidence, but we are inclined to regard it as evidence, though not amounting to proof, of the occurrence in the Mull flora of a species of *Pinus* similar in its foliage to the existing species *Pinus Strobus.* Gardner makes no mention in his monograph of the occurrence of five-needled Pines. A similar foliar spur is figured by Saporta<ref>Saporta (1873), p. 98, Pl. I., Fig. 17.</ref> as *Pinus palccostrobus* Ett. from the Eocene plant beds of Aix, a species originally described by Ettingshausen<ref>Ettingshausen (1855), p. 35, Pl. VI., Figs. 22, 23.</ref> from Häring in the Tyrol.

Cupresseae

Cupressites MacHenryi Bail. The impression of a small piece of branched shoot from Carsaig shown in Fig, 9 appears to be identical with the Irish species first figured by Bailey<ref>Bailey (1869), Pl. XV., Fig. 5.</ref> and afterwards more fully described and more adequately illustrated by Gardner from much better material, including cones, from the Irish beds. Gardner<ref>Gardner (1886), p. 82, Pl. XVI, Figs. 8, 9; Pl. XVIII., Fig. 1; Pl. XIX.</ref> substitutes for Bailey's designation the name *Cupressus Pritchardi* on the ground that blocks of a Cupressineous wood from Lough Neagh, which Goeppert

named *Pinites Pritchardi*<ref>Seward (1919), p. 305.</ref>and Kraus later referred to *Cupressinoxylon,* were from the tree which bore the type of shoot figured by Bailey as *C. MacHenryi.* This assumption may or may not be correct, and we prefer therefore to retain Bailey's specific name.

The leaves of the Mull specimen are small and scale-like and are arranged in decussate pairs (Figure 9)A. This type of shoot has not previously been recorded from Mull.

Sequoiineae

Sequoiites (?) Langsdorfi (Brongn). Among the specimens sent to us there are a few from Carsaig which appear to be identical with the small twig compared by Gardner with those from Greenland described by Heer as *Sequoia Langsdorfii.*<ref>Gardner (1887), p. 289, Pl. XIII., Fig. 1.</ref>The best of the Mull specimens is shown in (Figure 10). (Figure 10)A illustrates the clearest example we have noticed of the manner of attachment of a leaf by a petiole-like constricted base. We do not, think, however, that this is sufficiently clear to indicate whether it represents the real constriction seen at the base of a leaf of *Taxus* or the apparent constriction in *Sequoia sempervirens* due to the twisting of the leaf as described by Gardner.<ref>Gardner (1886), p. 101. p. 97, Pl. XXVI.</ref> We consider therefore that we have not sufficient evidence to assign these specimens with certainty to any particular genus, though we believe them to be probably identical with the specimen figured by Gardner in 1887.

Podocarpineae

Podocarpus Campbelli Gard. A few rather poor specimens of leaves are most probably of the same species as the better preserved examples collected by Gardner and named by him *Podocarpus Campbelli.* <ref>Gardner (1886), p. 97, Pl. XXVI.</ref> Gardner regards it as significant that similar leaves have not been found in the Arctic floras described by Heer. More recently Schindehütte<ref>Schindehütte (1907)), p. 15, Pl. 1, Fig. 3</ref>. has recorded what he considers to be the same species from the Lower Miocene near Homberg, the flora as a whole being sub-tropical. This may be evidence of a southward migration of the species after Eocene times. In no instance have reproductive organs been discovered, and the absolute identity of the German and Mull specimens cannot be considered certain. Gardner, however, had no doubt as to the, generic identity of his specimens with *Podocarpus.*

?Araucarineae

Pagiopyllum Sternbergi (Goepp). The piece of vegetative shoot represented in (Figure 11) appears to be identical with a rather larger specimen figured by Gardner<ref>Gardner (1886), P1, X., Fig. 3.</ref> from Mull as *Cryptomeria Sternbergii* (Goepp). Under this name Gardner also figured several good specimens of shoots and cones from Ireland,<ref>Gardner (1886),, PL X., Figs. 10–13; Pls. XX., XXI.</ref> and it was the close resemblance of the fossil cones to those of the recent Japanese conifer *Cryptomeria japonica* that led to the inclusion of the Irish specimens in the genus *Cryptomeria.* Unfortunately no cones of the *Cryptomeria* type, or of any other type, have been recorded from Mull, but only a few pieces of sterile branches. The majority of the Irish fossils are characterized by leaves which seem to be identical in their almost straight form and in arrangement with those of *Cryptomeria japonica.* On the other hand, in the Mull impressions the leaves are rather stouter and relatively shorter and distinctly falcate as in twigs of the recent *Araucaria excelsa* and allied species. In the absence of cones it would be somewhat rash to assign the fossil fragments to *Araucaria,* though there is little doubt that the genus existed in the Eocene floras of western Europe. We prefer to adopt provisionally the non-committal generic name *Pagiophyllum.* In our opinion the Mull specimens are identical with the species instituted by Goeppert as *Araucarites Sternbergii* and by some authors subsequently transferred to the genus *Doliostrobus.*<ref>See Seward (1919), p. 267-</ref>

Coniferales Incertae Sedis

Elatocladus Campbelli (Forb). The Mull specimen on which Forbes<ref>Forbes (1851), p. 103, Pl. II., Figs. 1A,</ref> founded this species under the name *Taxites (?) Campbelli* is part of a vegetative shoot with lateral branches having spirally disposed linear leaves in two ranks. Forbes's illustration adequately represents the specimen, which is now in the Jermyn Street Museum, and shows the decurrent and twisted leaf-bases. Gardner<ref>Gardner (1886), p. 41, Pl. X., Figs. 1, 1A.</ref> at first regarded this species as *Sequoia Langsdorfii,* but after examining additional material he

reverted to the opinion of Forbes and proposed the generic name *Taxus.*<ref>Gardner (1886), p. 101, Pl. XXVII., Figs. 1–3.</ref> Reference has already been made to a small twig figured by Gardner as *Sequoia Langsdorfii*<ref>Gardner (1887), p. 289, Pl. X., Fig. 1.</ref> and compared by him with Heer's Greenland specimens, (Figure 10) illustrates what we believe to be the *Sequoia* type. The Mull collection also includes four indistinct specimens from Ardtun which appear to be identical with *Taxites Campbelli.* We are not, however, convinced that Gardner has definitely proved this to be an undoubted species of *Taxus,* and in the absence of stronger evidence we prefer to adopt Halle's provisional generic term *Elatocladus.*<ref>Halle (1913) p. 82. See also Seward (1919), pp. 352, 417, 429.</ref>

Coniferous Wood

A. Cupressinoxylon sp.

Some pieces of lignitised wood from the upright tree described and figured by Macculloch<ref>Macculloch (1819), Pl. 21. Fig. 1.</ref> (see Frontispiece, and pp. 43, 111 of this Memoir), and subsequently mentioned by Gardner,<ref>Gardner (1887), p. 283, footnote.</ref> were submitted to us for examination. They present the appearance of charred wood and are very friable in texture; the tissues are relatively soft and not petrified. By suitable treatment it was possible to prepare sections with a razor. Though the preservation is far from perfect. the anatomical features are sufficiently well shown to enable us to refer the tree to the comprehensive genus *Cupressinoxylon.*<ref>Seward (1919), p. 186.</ref>This generic type includes members of the Cupressineæ, Podocarpineæ, and some other recent. Conifers. It is clearly impossible to assign the wood with any confidence to a particular type of vegetative shoot. The trunk may be that of the tree which bore the foliage shoots identified as *Cupressites MacHenryi* or it is possible that the vegetative shoots were those named *Sequoiites* (?) *Langsdorfi.* The anatomical characters of imperfectly preserved specimens do not afford any satisfactory means of distinguishing between wood of the *Sequoia* type and that of *Cupressinoxylon.* The wood is clearly not that of a Pine or, in all probability, of any other member of the Abietineae; it is certainly not Araucarian and it is not the wood of a *Taxus.*

The annual rings are well marked, but owing to the crushed condition of the tissues it is impossible to give a detailed description of the spring and summer wood. There are no resin-canals. The frequent occurrence of dark brown material, presumably resin, filling the cavities of cells in vertical rows, with an occasional transverse wall preserved, indicates the presence of resiniferous xylem-parenchyma which is not confined to any particular region. There is usually a single row of circular bordered pits on the radial walls of the tracheids; rarely the pits are in contact and slightly flattened. Rims of Sanio are occasionally preserved. The medullary rays are numerous and uniseriate, and deep. One or two, pits occur in the field (i.e. the area bounded by the radial walls of a ray cells and the vertical walls of a tracheid as seen in a radial section) which are either oval or circular: in the oval pits the major axis is approximately radial (horizontal). There are no pits in the tangential or transverse walls of the ray cells.

B. Fragments of Coniferous wood enclosed in lava from river mouth, S.E. of Tavool House

The occurrence of these fragments is dealt with on p. 113. Their preservation is much less satisfactory and we cannot with any confidence refer them to a genus. The annual rings are numerous and narrow, the narrower late summer tracheids, which are very sharply contrasted from the larger spring tracheids, being confined to a very narrow zone in each ring. There are no resin-canals and no indication of resiniferous parenchyma. In the absence of such characters as the pitting of the tracheids and the pitting of the medullary-ray cells it is impossible to attempt a diagnosis of the material.

Angiospermae: dicotyledones

Betulaceae

Corylites hebridica sp. nov.

A careful examination of the type of Forbes's species *Alnites MacQuarrii* in the Jermyn Street. Museum shows that, with the exception of the slightly cordate base, the leaf is incomplete and the apparent teeth on the margin are the result of tearing of the lamina. There is one<ref>Specimen No. T. 297, E.</ref>. imperfect leaf in the present collection which is probably identical with *Alnites MacQuarrii* as figured by Forbes, but in the absence of more adequate material we cannot

make any definite suggestion as to the true nature of this species. The specimen is not, we believe, specifically identical with the majority of leaves figured by later authors under the name *Corylus MacQuarrii,* though it was taken by Heer<ref>Heer (1868), p. 104, Pl. 9, Fig. 1.</ref> as the type of this species and other writers have so regarded it. Moreover the recently collected leaves which we believe to be examples of the *Corylites* type, and which are undoubtedly identical with *Corylites MacQuarrii* as figured by Gardner,<ref>Gardner (1887), Pl. 15, Fig. 3.</ref> are not in our opinion specifically identical with the torn specimen figured by Forbes. We give expression to this view by adopting the name *Corylites hebridica* for the leaves sent to us for examination. The characters of these leaves vary within fairly wide limits, but the following account may be taken as typical of the majority. The base is more or less cordate and rather narrow, the lamina increasing gradually and evenly in width up to just over half way towards the apex, after which it tapers gradually with a slight inward curve to the tip. The smallest leaves are hardly more than 5 cm. long by 3 cm. at their greatest width, while the largest leaf in the British Museum collection is almost 13 cm. long by 10 cm. broad. One leaf which is 10 cm. long is only about 4 cm. broad; in all cases the length is greater than the breadth. The secondary veins are numerous, 10 to 14, and almost straight; the lower ones are closer and at a larger angle to the midrib; on their lower side they bear strong tertiary veins which pass into marginal teeth. The teeth are broad and short, with usually a sharp point; those at the ends of the secondary veins are generally larger than the others and often somewhat more prominent though never so prominent as they normally are in most recent species of *Corylus.*

The specimens represented in (Figure 12)A and (Figure 12)B show the marginal teeth; (Figure 12)A shows part of a very slightly cordate base. (Figure 12)C represents the acuminate apex of a young leaf.

The question of referring these leaves to a recent genus is a very difficult one. Gardner<ref>Gardner (1887), p. 290.</ref> remarks that "the total absence everywhere in the Eocene of anything like nuts, and their abundance in the Pliocene, renders it difficult to believe that the genus *Corylus* was actually in existence during early Tertiary periods." Heer's figures<ref>Heer (1868), Pl. IX., Fig. 5; (1874), Pl. III. Fig. 10.</ref> of Hazel nuts are certainly not convincing. The fossil shown in (Figure 13) may possibly be a nut split open, but it is not well enough preserved to be identified with certainty.

On leaf characters alone the recent genera *Carpinus, Betula,* and *Alnus* cannot confidently be separated.<ref>*See* Reimann (1917), pp. 21–25.</ref> Many of the *Corylites* leaves are very much like those of *Carpinus Betulus,* though the largest and broadest leaves are far nearer the *Corylus* type. The recent species, the leaves of which appear to agree most nearly in form and in range of variation with these fossils, is *Corylus rostrata,* though a striking point of difference is the smaller number of secondary veins. *Corylus Avellana* has on the average much broader leaves and the characters of the edge and apex are different. A comparison-of these leaves with other fossils is also difficult. One of us has carefully examined a number of Heer's figured specimens in the British Museum. of what he called *Corylus MacQuarrii* from various localities in Greenland. Nearly all are very poor specimens and often inaccurately figured. The following agree fairly closely with the leaves from Mull:

- *Corylus MacQuarrii.* Heer, *Flor. Foss. Ant.* vol. v., Pt. I. (Grinnell Land); especially Pl. VI., Figs. 4 and 6.
- *C. MacQuarrii.* Heer, *Flor. Foss. Alaskana* (1869), Pl. IV.
- *C. MacQuarrii.* Heer, *Flor. Foss. Arct.* vol. i. All the leaves referred to this type except those from the Mackenzie River which are very doubtful.

The above are all considered by Heer to be Miocene in age. The leaves from Atanikerdluk<ref>Heer (1869), p. 469, Pl. XLIV., Fig. 11A; Pl. XLV., Fig. 6B.</ref> collected by Whymper are poor but may belong to the species *Corylites hebridica. Corylus* leaves from Menat (Oligocene or Eocene) described by Laurent<ref>I Laurent (1912), pp. 79–83, Pl. VI. Figs. 5, 6; Pl. VIII., Figs. 3, 4, 5; Pl. IX., Fig. 1.</ref> do not agree very closely with the Mull specimens: that shown on his (Plate 6), (Figure 6) is perhaps the nearest. They have fewer secondary veins, like the recent species of *Corylus,* and show other differences. One cannot be certain that these leaves are not a variety of *C. hebridica,* but they certainly differ notably from the usual Mull type. Menzel's leaves from: the Posener Ton<ref>Menzel (1910), Pls. XIL-XV.</ref> (Upper Miocene) are somehwat like the smaller, narrower leaves from Mull but they .appear to agree more closely with *Carpinus* than with *C. hebridica.*

There are various references of leaves by American authors to *C. MacQuarrii,* but none of them are very satisfactory. One of Lesquereux's figures<ref>Lesquereux (1883), Pl. XLIX., Fig. 4.</ref> may be of the same type as the Mull leaves. Newberry's leaves,<ref>Newberry (1898), Pl. XXXII. Fig. 5; Pl. XLVIII., Fig. 4.</ref> which he calls *C. MacQuarrii,* are less like the Mull type than those referred to C. *americans fossilis* and *C. rostrata fossilis.* Ward gives some good figures of leaves referred to *Corylus,* but his one leaf of *C. MacQuarrii*<ref>Ward (1887), Pl. XIII., Fig 7.</ref> is hardly to be distinguished from his *C. americana fossilis* which closely resembles one of Laurent's figures<ref>Laurent (1912), Pl, VI. Fig. 6.</ref> which he calls *C. MacQuarrii.*

The comparative study of these American leaves is not easy; so few examples are given from each locality that it is impossible to get a general idea of the range of form of each type. In general it may be said that none of the figures mentioned shows a really close agreement with the Mull *Corylites.* However the experience gained by examining specimens of one recent species from different localities indicates that it is not impossible that some of the American fossil leaves .may be varieties of the species found at Mull. But one cannot say exactly how much latitude should be allowed in this matter.

Though we cannot assert, from a botanical point of view, that the Mull leaves are proved to belong to the genus *Corylus,* we think that they agree more closely with that genus than with any -other and may reasonably be included in *Corylites.*

Dicotyledonous Wood (? Betulaceae)

We have examined sections of portions of a prostrate trunk which occurs at Uamh Mhic Cuill, Rudha na h-Uamha, enclosed in the same lava as the *Cupressinoxylon* described above (see also p. 112).

The wood appears to be most nearly related to that of members of the Betulaceæ, particularly *Betula,* but there are certain differences. It agrees with *Betula,* in the radial groups of vessels, the oblique ends of the vessels being crossed by numerous fine scalariform bars, and in the number and size of the medullary rays some of which are uniseriate and some as much as four cells in width. No aggregate rays are present in the sections examined. Vessels appear to be evenly distributed throughout the transverse section. No annual rings have been detected, but only a small part of the section shows well-preserved structure. Points of difference from *Betula* are the presence of irregular large scalariform or rounded bordered pits on the wall of contact of one vessel with another, instead of the closely packed very small pits of *Betula,* and a peculiar ray character which is present to a small extent in *Betula alba,* but more marked in species of *Fagus.* The broader rays of the fossil wood consist of narrow cells, radially elongated, with one or more rays of larger cells, not radially elongated above and below them. The cells of the uniseriate rays are also of this latter kind, and it frequently happens that two broader rays are connected vertically by a plate of the larger cells. In the Birch there are indications of this but the disparity of size between the two kinds of cells is not so great.<ref>In the examination of this wood we have received valuable assistance from Mr J. Line, of Emmanuel College, Cambridge.</ref>

It is hoped to publish a more detailed description of this wood in the near future. At present we refrain from giving it a name.

Fagaceae

Quercus greenlandica Heer. Gardner<ref>Gardner (1887), p. 291, Pl. XIV. Fig. 2.</ref> in his paper of 1887 refers to a "new and very rare leaf at Mull" which "is perhaps to be identified with the *Quercus greenlandica* Heer, from Atanikerdluk, some of the specimens of which seem, however, to have been placed in *Castanea Ungeri* by that author, though they do not resemble the Miocene chestnuts of either Europe or America." Among the leaf impressions in the red-brown matrix there are many which appear to us to be identical with Heer's *Q. greenlandica*<ref>Heer (1868), p. 108, Pl. VIII. Fig. 8; Pl. X., Figs. 3, 4; Pl. IX., Fig. 4; Pl. XLVII., Fig. 1.</ref>and with Gardner's figured leaf. These impressions are all fragmentary and of varying size. The largest was probably about 10 cm. long with at least 14 secondary veins on either side, and the smallest is about 5 cm. long with 10 pairs of secondary veins.

There appears to be no distinction between *Q. greenlandica* and *Fagus castanecefolia* Ung. as figured by Heer in the *Flor. Foss Arct.* Vol. I., Plate XLV., and the latter in his *Flor. Alaskana* <ref>Heer (1869), p. 32.</ref> is identified with *Castanea Ungeri.* In Vol. VII., p. 85 of the *Flor. Foss. Arct.* he includes the leaves figured in Vol. I. of the same work

(Plate XLVI., Figs. 1–3) as *Fagus dentata* Ung. with *Castanea Ungeri.*

It is extremely difficult to separate these leaves into different species, especially when one takes into account the close resemblance between leaves of some existing species of *Quercus* and those of species of *Castanea,* and the small amount of difference between the leaves of different species of the latter genus. Thus it is possible that Heer is justified in separating the leaves called by him *Castanea Ungeri,* though some of those referred to *Fagus castanecefolia are* indistinguishable from *Q. greenlandica.* He records but does not figure flowers and fruit of *C. Ungeri* from Atanikerdluk<ref>Heer (1883), p. 84.</ref>.

There is one reference of leaves found in America to this species by Newberry<ref>Newberry (1898), p. 75, Pl. LI., Fig. 3; Pl. LIV., Figs. 1, 2.</ref> from the Miocene of Alaska, but this seems to us very doubtful, the leaves being long and narrow, with teeth more like those usually found in *Castanea.*

As several authors have remarked, it is impossible to decide definitely on leaf characters alone, whether a doubtful leaf belongs to the genus *Quercus* or to *Castanea.* The very blunt and prominent teeth of *Q. greenlandica* resemble very closely those of *Q. Prinus* and other oaks and cannot be matched in any Castanea: though not absolutely certain, it would seem very probable that we are here dealing with a true *Quercus.*

Platanacae

Platanus hebridica (Forbes)

The only pubished figures of leaves of this species arc those of Forbes,<ref>Forbes (1851), Pl. III. Fig. 5; Pl. IV. Fig. 1.</ref> both of which show incomplete specimens, so that it is doubtful whether any of the edge is shown in either. He remarks that "this leaf is one of the most abundant and characteristic of all those found in Ardtun." Gardner gives a further description and records the presence of numerous male flowers and detached anthers, some of which he illustrates;<ref>Gardner (1887), Pt XIII., Figs. 13–15.</ref> also one cluster of female flowers.

The leaves vary considerably in size and shape. Gardner records one, 37 cm. in length. In the present collection we have only three undoubted specimens, all imperfect; the smallest of these, which shows the edge of the lamina most clearly is represented in (Figure 14).

Of the leaves in the British Museum many are nearly 20 cm. in length, and are all imperfect. They are typically three-lobed, the lateral lobes being usually rather narrow and ending in sharp points. There occur also large leaves in which these lateral lobes are, almost suppressed. The edge is nearly smooth, or with small projections at the ends of the main veins (Figure 14). There is nothing to be seen of the large prominent recurved teeth of recent species. The two main lateral veins branch from the midrib at the base of the leaf (often not opposite each other) and usually curve inwards slightly. They bear numerous smaller veins on their lower sides, which end in the small marginal teeth. There are only a few other secondary veins branching from the midrib. The leaf lamina may be decurrent as much as 2 cm. below the junction of the main lateral veins, forining a cuneate base, but in the broader, strongly lobed leaves it is less decurrent and the base is almost square to the petiole. Heer<ref>Heer (1859), pp. 313, 314.</ref> pronounced these leaves to be probably *Platanus aceroides* Goepp. though he had only seen Forbes's figures and not the actual specimens: this identification was used by him as an argument in favour of the Miocene age of the leaf-beds. Goeppert's leaves from Schossnitz<ref>Gœppert (1855), Pls. IX, X., XI.</ref> including the original of *P. aceroides,* which he divided into several forms, are probably all one species and are much more akin to the recent *P. occidentalis* than to the Mull leaves.

Gardner<ref>Gardner (1887). p. 290.</ref> says of the *Platanus* leaves "they (i.e. the Mull species) have been collected at Atanikerdluk, but of much smaller size, by Whymper, Colomb, and others, and being wholly different from any Miocene form, should bear the name given by Forbes." Heer's Atanikerdluk leaves<ref>Heer (1868), Pl. XII., Figs., 1–8; Pl. XLVII., Fig. 3.</ref> may be identical with *P. hebridica,* but they are too imperfect to be determined with certainty. The same remark applies to those from Iceland:<ref>Heer (1868), Pl. XXXII.</ref> The Mackenzie River leaves<ref>Heer (1868), Pl. XXI., Fig. 17s; Pl. XXIII., Figs. 2B, 4.</ref> are still less satisfactory. We have examined the specimens from Disko Island<ref>Heer (1869), p. 473, Pls. XLVII., XLVIII., XLIX., Figs. 4s, C. D.</ref> called by Heer *P. Guillelmae* Goepp.:

these are all very poor impressions, the best being shown on Plate XLVII., Fig. 1 (even in this specimen the edge is very indistinct). The veins are very slender and straight and the general appearance of these leaves is very different from that of those from Mull. The leaves from Hare Island (off Disko I) (Lower Miocene) referred to *P. aceroides*<ref>Heer (1883), p. 96, Pl. XC.</ref> are more like the Mull forms in general appearance, but the large sharp teeth, if accurately represented, are very different from those of *P. hebridica,* though not so much recurved as those on the Schossnitz leaves.

Newberry's large *P. nobilis* from Dakota is considered by Knowlton to be probably the same as *P. hebridica* and he quotes this supposed identity in his evidence for regarding the American Fort Union beds as Eocene.<ref>Knowlton (1909), p. 225.</ref> Newberry's first figure<ref>Newberry (1898), Pl. XXXIV.</ref> of *P. nobilis* shows a leaf of much the same form as those from Mull, with similar edge, but the number of secondary veins is much greater and the leaf has a small extra lobe. The second figure<ref>Newberry (1898), Pl. L. is very much more like the Mull leaves, as is also that of Ward<ref>Ward.(1887), Pl. XVI.</ref> from the Laramie beds. It is quite likely therefore that both the American and the Scottish leaves belong to the same species; they are certainly closely related.

Perhaps also *P. Raynoldsii* var. *integrifolia* Lesq.<ref>Lesquereux (1878), p. 185, Pl. XXVI., Figs. 4, 5; Pl. XXVII., Figs. 1–3.</ref> from Golden, Colorado, and Black Buttes, Wyoming, both localities regarded as Lower Eocene, may be included in the same group. Lesquereux's *P. aceroides* and *P. Guiltelmae,*<ref>Lesquereux (1878), pp. 183–185, Pl. 25.</ref>which are hardly to be distinguished from each other, as he says, are both from his third group considered to be Lower or Middle Miocene. Both these agree far better with Goeppert's Schossnitz leaves than with *P. hebridica.* Knowlton's *P. aceroides latifolia*<ref>Knowlton (1917), p. 321, Pls. XCII., XCIII., XCIV.</ref> from the Raton formation (Eocene) is very like the Mull leaves in form and venation as also in size.

Lesquereux's *P. primaeva*<ref>Lesquereux (1892), p. 72, Pls. VIII.-X.</ref>from the Cretaceous Dakota group is a very interesting species. Its leaves vary greatly in form from the variety *grandidentata,* hardly to be distinguished from Heer's *P. aceroides* from Hare Island,<ref>Heer (1883), Pl. XC.</ref> to a variety with almost entire leaves. One leaf is recorded as 17 cm. long by 20 em. in width, but those figured are all much smaller. Lesquereux considers this species to be essentially the same type as *P. Guillelmae* and *P. occidentalis* and we think he is very likely correct. This species is perhaps the ancestor of the types widely spread in Miocene and recent times, and possibly also of the large leaved type including the American *P. nobilis* and the British *P. hebridica.* This latter type would seem to have disappeared early, as it is not recorded later than the Eocene.

Upper Cretaceous leaves from Kunstadt described by Krasser<ref>Krasser (1896), pp. 138–144, Pls. XII.-XV.</ref> are very like the less markedly lobed leaves of *Platanus hebridica* there is close agreement in venation, margin, and base, and many of the Kunstadt leaves are large. Krasser describes eight leaf forms, admitting that it is possible that all belong to one botanical species.

Dicotyledons Incertæ Sedis

Phyllites platania (Heer)

One leaf impression in the recently obtained collection, though showing no edge, is very similar in venation and size to some large leaves obtained by Gardner. These leaves agree closely with those called by Heer *Quercus platania* from Atanikerdluk<ref>Heer (1868), p. 109, Pl. XI., Fig. 5; Pl. XLVI., Figs. 8, 9; (1869), p. 472, Pl. XLVI., Fig. 5; Pl. LV., Fig. 3; (1883), p. 91, Pl. LXVIII., Fig.</ref> though the veins of the latter in the specimens examined in the British Museum are finer and less strongly marked. Schimper<ref>Schimper (1870), II., p. 657.</ref> remarks that the reference of these leaves to *Quercus* is "fort contestable", and with this we agree though we are unable to suggest their true position. A complete leaf from Ardtun in the British Museum measures 18 cm. by 9. cm. and a larger one, which is incomplete, is 13 cm. in width. Dawson<ref>Dawson (1889), p. 72, Pl. XI.</ref> records this species from the Laramie of Bow River (Canada) and figures a comparatively small complete leaf. He notes that the leaves appear to be variable, and that *Q. platania* was "evidently one of the most magnificent of the Laramie species in point of size."

Phyllites ardtunensis sp. nov

The British Museum collection of Mull plants includes numerous well-preserved impressions of leaves of the type figured by Gardner on Plate XIV. (Fig. 3) of his paper published in 1887, though most of them are larger than his figure. The specimen reproduced in Plate II. (British Museum coll) is 15 cm. long. Among the fossils sent to us there are two very imperfect specimens which belong to this type. The leaves are ovate, usually with a broad, almost straight base at right-angle. to the petiole. At the apex the lamina tapers off evenly to a point. On the edge are numerous small, not quite evenly placed, strongly recurved narrow teeth. The secondary veins are numerous and strongly marked. They are more crowded at the base where they are almost straight and nearly at right-angles to the midrib; higher up they are distinctly curved. Near the margin of the leaf the secondary veins usually fork in a very characteristic fashion, sometimes twice or even three times, the ends of their branches entering the marginal teeth. Of these leaves, Gardner remarks that they seem as yet peculiar, and we can only repeat that statement. In searching the records of both American and European Tertiary floras we cannot find any leaves which at all closely resemble them.

Among fossil leaves that most nearly resemble them in shape and in the arrangement of the secondary veins is Saporta's *Fagus pristina,*<ref>Saporta (1893), Pl. V., Fig. 5. </ref>but the teeth are absent and there is no branching of secondary veins. The texture was probably something like that of leaves of *Fagus* or *Castanea* and the teeth of some species of the latter genus are very like those of the fossil examples, but the general form is very different. The branching of the veins is similar to that often seen in *Ulmus effusa* and the recurved_ teeth of that species sometimes resemble those of *Phyllites ardtunensis,* but are double instead of single. The closest resemblance in leaf form and arrangement of the secondary veins that we have seen among recent leaves is in the Chinese genus *Davidia* (Nyssace); but the leaves of *Davidia* are smaller.

Phyllites spp.

The Survey collection includes leaves undoubtedly specifically identical with those figured by Gardner (1887) in his Figs. 3 and 4, Plate XVI., also larger leaves probably of the same species as those named by Forbes<ref>Forbes (1851), Pl. III. Figs. 2, 3. </ref>*Rhamnites major* and *B. multi-nervatus;* the latter may be an unexpended leaf of *R. major.* Of the former leaves, Gardner says<ref>Gardner (1887), p. 291. </ref>,"there are a number of simple ovate leaves resembling those of the Bay and Laurel etc., as well as the *Rhamnites* of Forbes; but it seems scarcely probable that any of these are capable of generic identification from the leaves alone." The description of the drawings of these leaves is "evergreen leaves, like those of the Myrtaceae".

We feel at present entirely unable even to suggest the probable genera to which these leaves belong, and as in this case the leaves are of no use for comparison of the Mull flora with those of other localities we do not propose to describe the fossils in detail.

Plantie incertæ sedis

Specimen A

The fragment represented in (Figure 15)A is part of a lamina characterised by numerous very oblique and rarely forked veins; those on one side being rather more crowded than those on the other. No definite midrib is recognisable, but it is not improbable that lower in the lamina the line where the convergent veins meet was represented by a median strand. It is impossible to determine whether the fragment is a portion of a leaf or a phylloclade; the venation agrees closely with that of the phylloclades of the recent Conifer *Phyllocladus.* Ettingshausen<ref>Ettingshausen (1886), p. 94, Pl. VIII., Figs. 28–31.</ref> in an account of the Tertiary flora of Australia refers some specimens, much larger than ours and showing both axes and flattened appendages (probably phylloclades), to *Phyllocladus asplenioides* in which the phylloclades resemble but are not identical with the Mull fossil. Numerous examples of impressions of leaves or phylloclades, in most cases detached and not borne on an axis, are figured by American authors<ref>For references to records of American species *see* Seward (1919), pp. 414, 415.</ref> from Upper Cretaceous beds under the generic name *Thinnfeldia, Phyllocladus,* or *Protophyllocladus..* We are inclined to think that the American fossils are true leaves and not flattened branches (phylloclades). The fragment shown in (Figure 15)A is very similar to the species *Phyllocladus subintegrifolius* Lesq., which was afterwards transferred by Berry to his genus *Proto-phyllocladus,* and at an earlier date assigned by Newberry to *Thinnfeldia,* a genus characteristic of Jurassic and Rhaetic rocks.

We propose to refrain from giving a name to the Mull specimen as it is too small to determine with any degree of confidence, but we are inclined to think it may be identical with, or at least closely allied to, *Protophyllocladus subintegrifolius* (Lesq).

Specimen B

The specimen shown in (Figure 15)B is an impression on black shale of a leaf-like organ 2 cm. long, with a thick prominent keel at the smaller end which dies out distally. It is characterized by a partial division of the lamina into a smaller proximal and a larger ovate distal end. No veins have been detected. It may be a bract or possibly a leaf of leathery texture which was partially divided into two laminar regions like the leaves of some recent species of *Citrus.*

Specimen C

The specimen shown in (Figure 15)C appears to be a fruit or seed 0.5 cm. by 0.4 cm. Its surface is covered by a film of carbonaceous matter irregularly cracked, with no apparent vascular bundles except possibly at the edge. It has irregular ridges and is in shape and size not unlike the fruit of *Carpinus Betulus.* The absence of any signs of vascular, strands on the ridges or of any scar of attachment at the base seems to rule out *Carpinus* as a possibility. Mrs. Reid suggests that the ridges are merely due to the nature of the matrix and not to any special features of the fruit. It may be the remains of a fleshy fruit: the carbonaceous film and the absence of vascular bundles support this view.

Specimen D

The fossil represented in (Figure 15)D resembles a scale-leaf with a smaller body attached near its pointed end. The surface is composed of a carbonaceous layer irregularly cracked with no trace of any definite vascular bundles. Mrs Reid suggests that it represents half a fruit pod bearing a single seed, the form being not unlike that of one segment of a pod of *Hedysarum* though the mode of attachment of the seed shows that it is not a member of the Leguminosw. We think that this is a probable explanation of the specimen, but we do not feel able to determine its systematic position.

Specimen E

A small scale rounded at one end and bluntly pointed at the other is shown in (Figure 15)E. Near the rounded end there is a definite circular scar as if some organ had been attached. A mass of black material covers part of the surface. We cannot make any definite statement as to the nature of the specimen.

Specimen F

The stalked object shown in (Figure 15)F consists of a comparatively thick mass of carbonaceous material irregularly grooved. The size and shape suggest comparison with an old 'cone' of an Alder, but as it is impossible to make out any definite scales this cannot be regarded as a satisfactory explanation of the specimen.

Conclusion

The collection dealt with in this paper is by no means fully representative of the Mull flora. Some of the most interesting types, *e.g.* the leaf called by Gardner *Boehmeria antiques,* are absent or represented by very poor specimens in the material which we have examined. A few very imperfect leaf fragments we have been unable to identify and have not described them.

The vegetation from the leaf-beds of Ardtun indicates that the climate was temperate like that of the regions in which at present summer deeidnous forest is typically developed. The great majority of the leaves from Mull are those of deciduous trees such as *Platanus, Corylites,* and *Quercus* though the probable presence of such Conifers as *Podocarpus* and *A raucaria* points to a warmer climate than exists over most of the British Isles to-day. The possible presence of evergreen shrubs is another indication of a warm; fairly moist climate. The leaves were most probably preserved by falling into a still lake round the marshy borders of which *Onoclea* and *Equisetum* flourished.

We see no reason to dissent from Gardner's opinion, expressed in 1887, that the flora is Eocene; it may well be, as Gardner believes Lower Eocene. A relationship with the Lower Tertiary floras of Greenland and other Arctic regions—regarded by Heer as Miocene, but by Gardner and other more recent writers as Eocene—is undoubtedly indicated by *Corylites, Quercus greenlandica,* and possibly by *Quercus Platania.* Relationship with the Laramie floras of North America is also suggested by *Onoclea, Platanus,* and possibly *Quercus Platania.*

The relationship to the sub-tropical Eocene floras of southern Europe is less marked: these according to Berry exhibit a closer resemblance to the Eocene floras of Carolina and Georgia.

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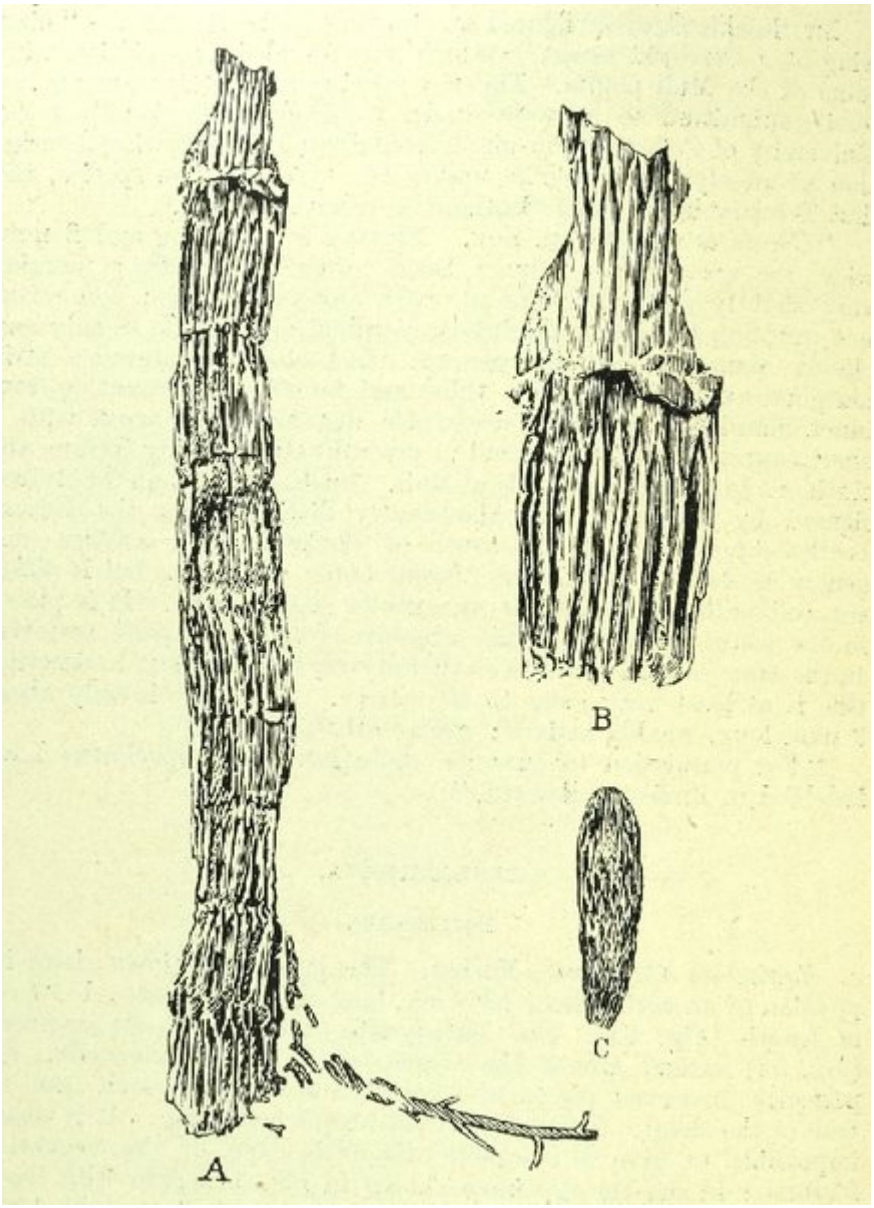
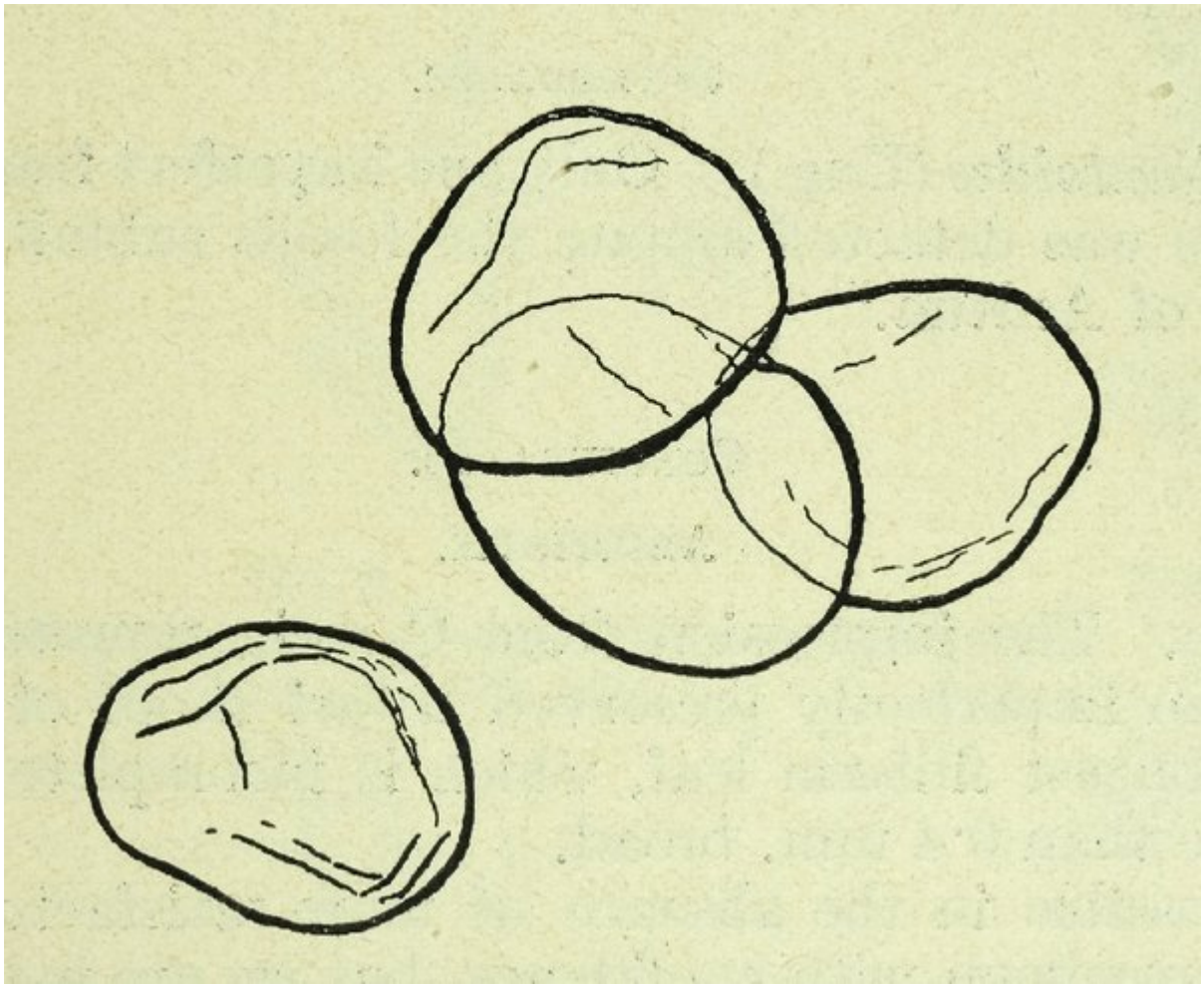
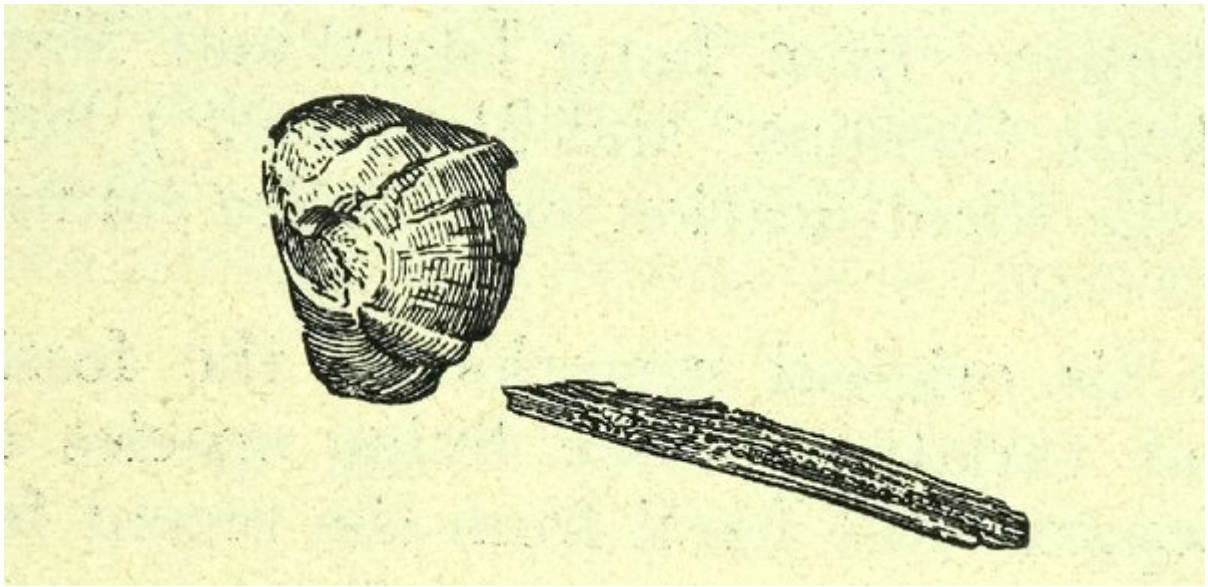


(Figure 5) Equisetum Campbelli Forbes. A. Nat. size. [T. 2905E]. B . Leaf-sheaths. x 2 [T. 2905E].C. Unexpanded shoot. Nat. size. [T. 2887 E.].



(Figure 6) Equisetum sp. Nat. size. [2900 E.].



(Figure 7) Onoclea hebridica (Forbes). Spores. x 384. [British Mus. V. 14848A.].

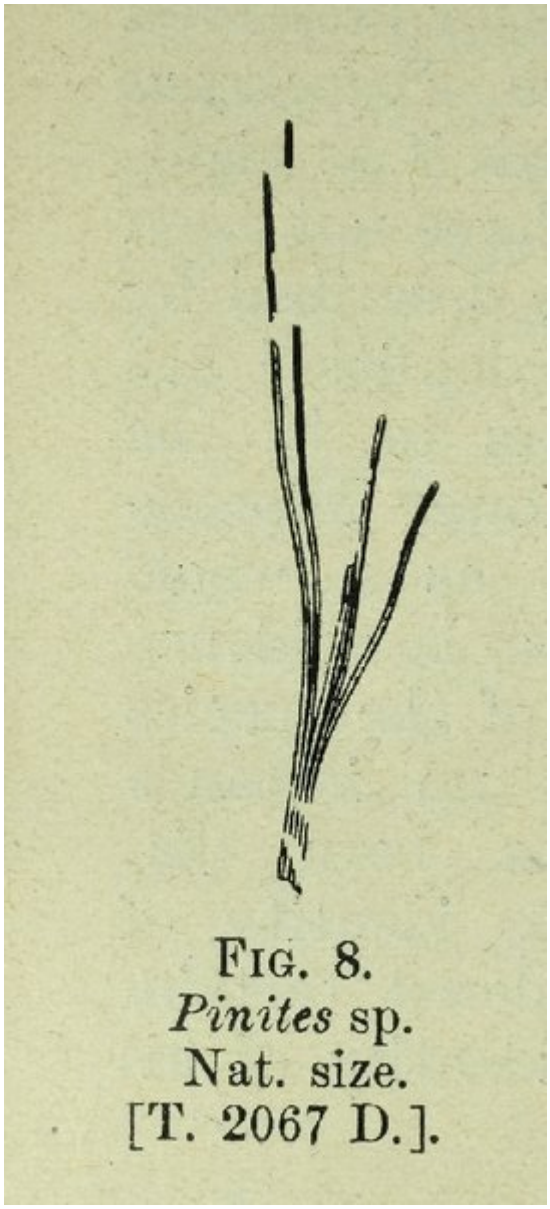


FIG. 8.
Pinites sp.
Nat. size.
[T. 2067 D.].

(Figure 8) Pinites sp. Nat. size. [T. 2067 D.].

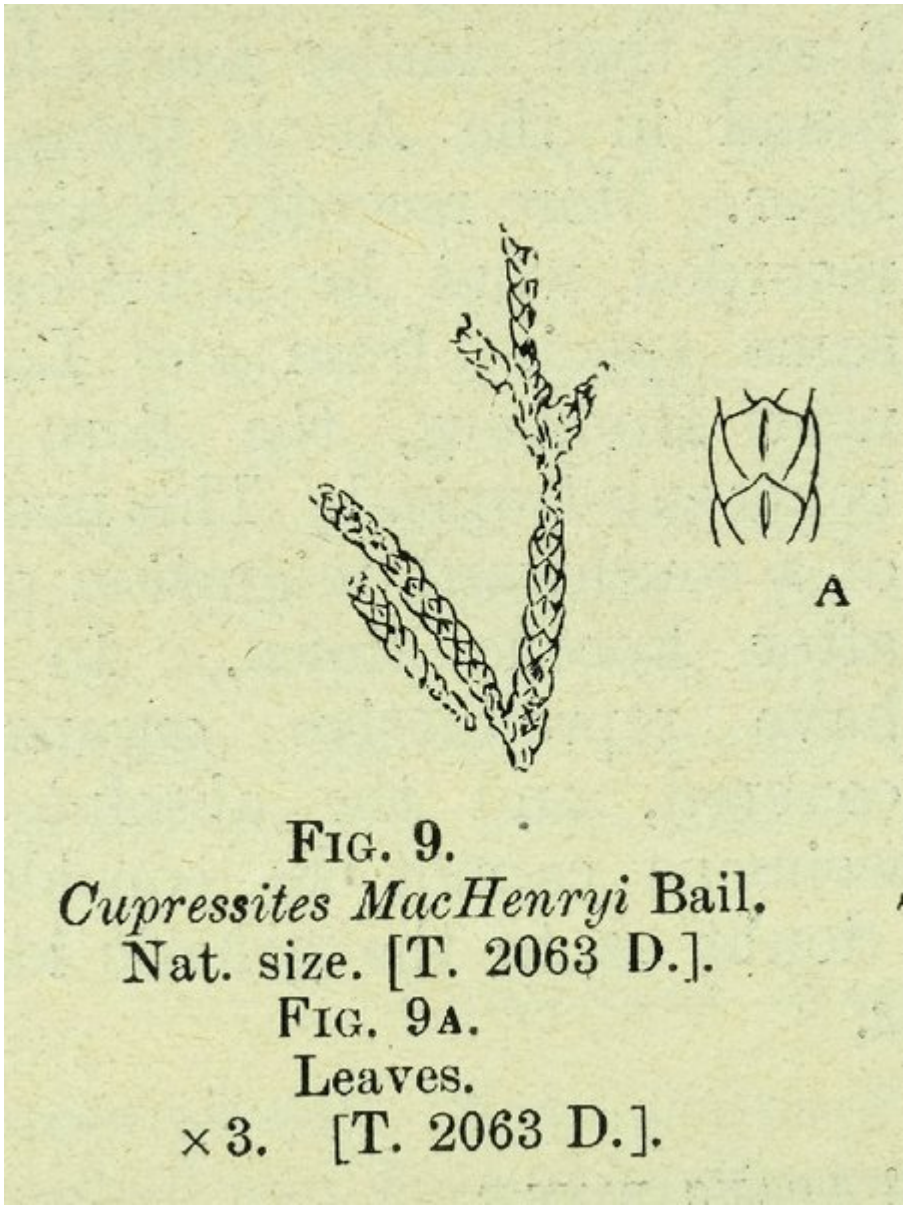


FIG. 9.
Cupressites MacHenryi Bail.
Nat. size. [T. 2063 D.].
FIG. 9A.
Leaves.
× 3. [T. 2063 D.].

(Figure 9) Cupressites MacHenryi Bail. Nat. size. [T. 2063 D.]. Figure 9A. Leaves. x 3. [T. 2063 D.].

FIG. 10.
Sequoiites (?) *Langsdorfi* (Brong.).
Nat. size. [T. 2058 D.].
FIG. 10A.
Base of leaf.
× 3. [T. 2058 D.].

(Figure 10) Sequoiites (?) Langsdorfi (Brong.). Nat. size. [T. 2058 D.]. Figure 10A. Base of leaf. x 3. [T. 2058 D.]

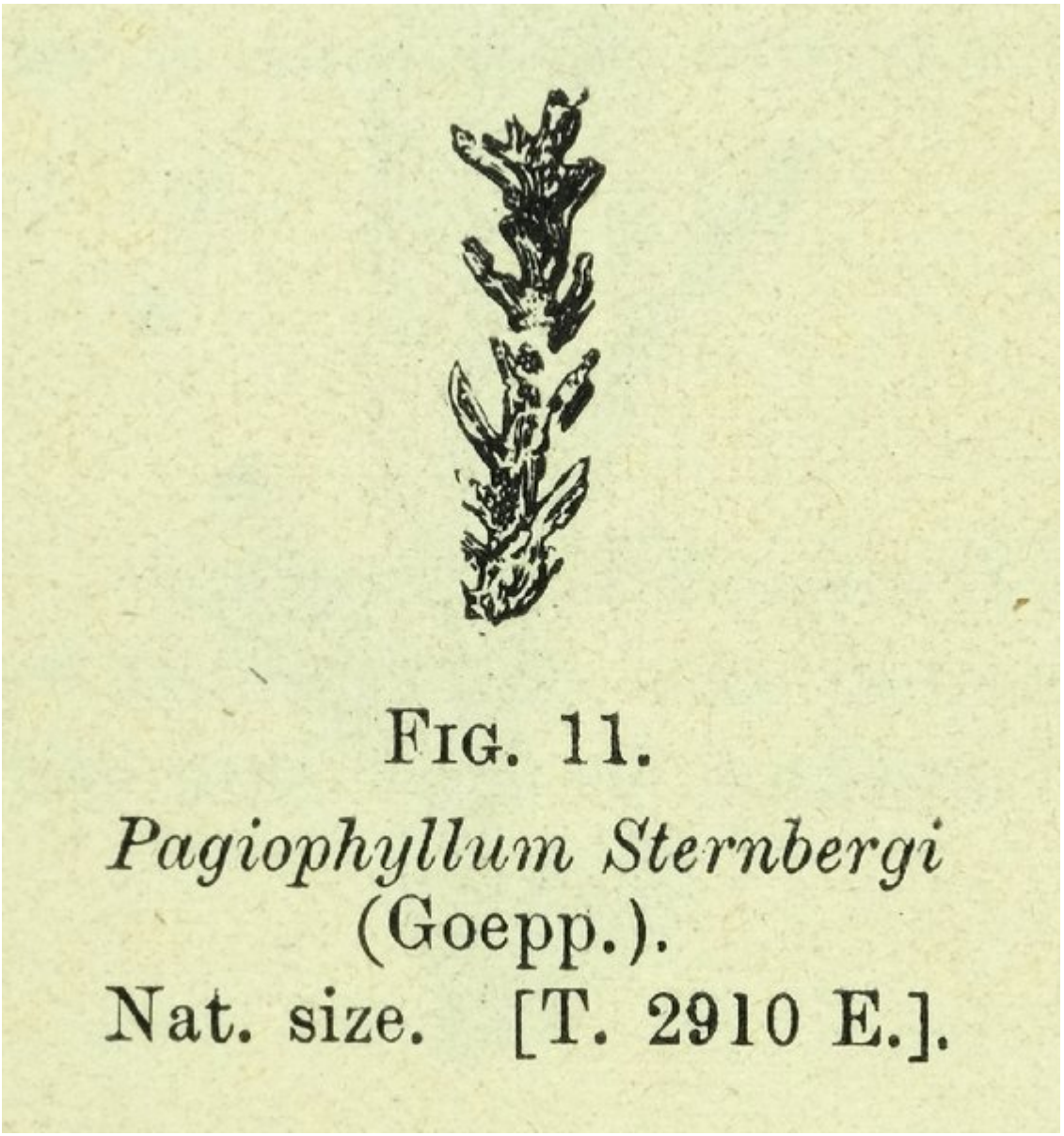


FIG. 11.

Pagiophyllum Sternbergi (Goepp.).

Nat. size. [T. 2910 E.].

(Figure 11) Pagiophyllum Sternbergi (Goepp). Nat. size. [T. 2910 E.].

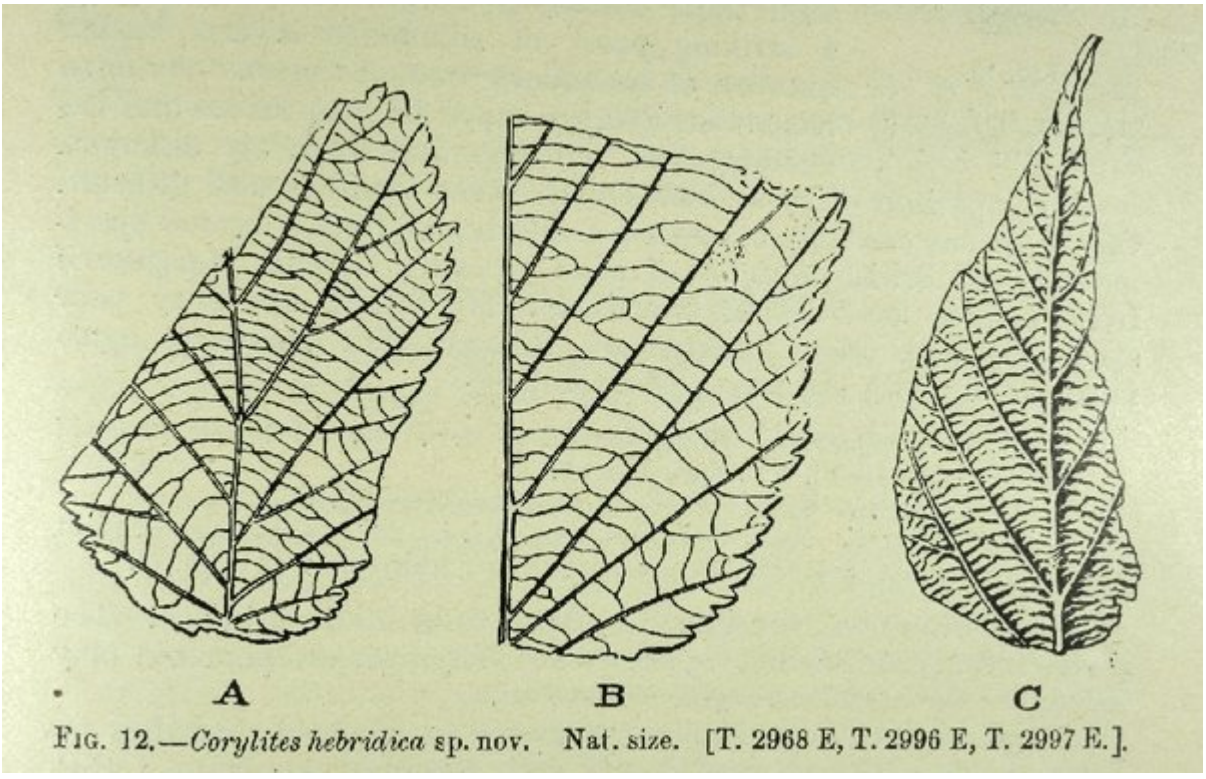


FIG. 12.—*Corylites hebridica* sp. nov. Nat. size. [T. 2968 E, T. 2996 E, T. 2997 E.].

(Figure 12) Corylites hebridica sp. nov. Nat. size. [T. 2968 E, T. 2996 E, T. 2997 E.].

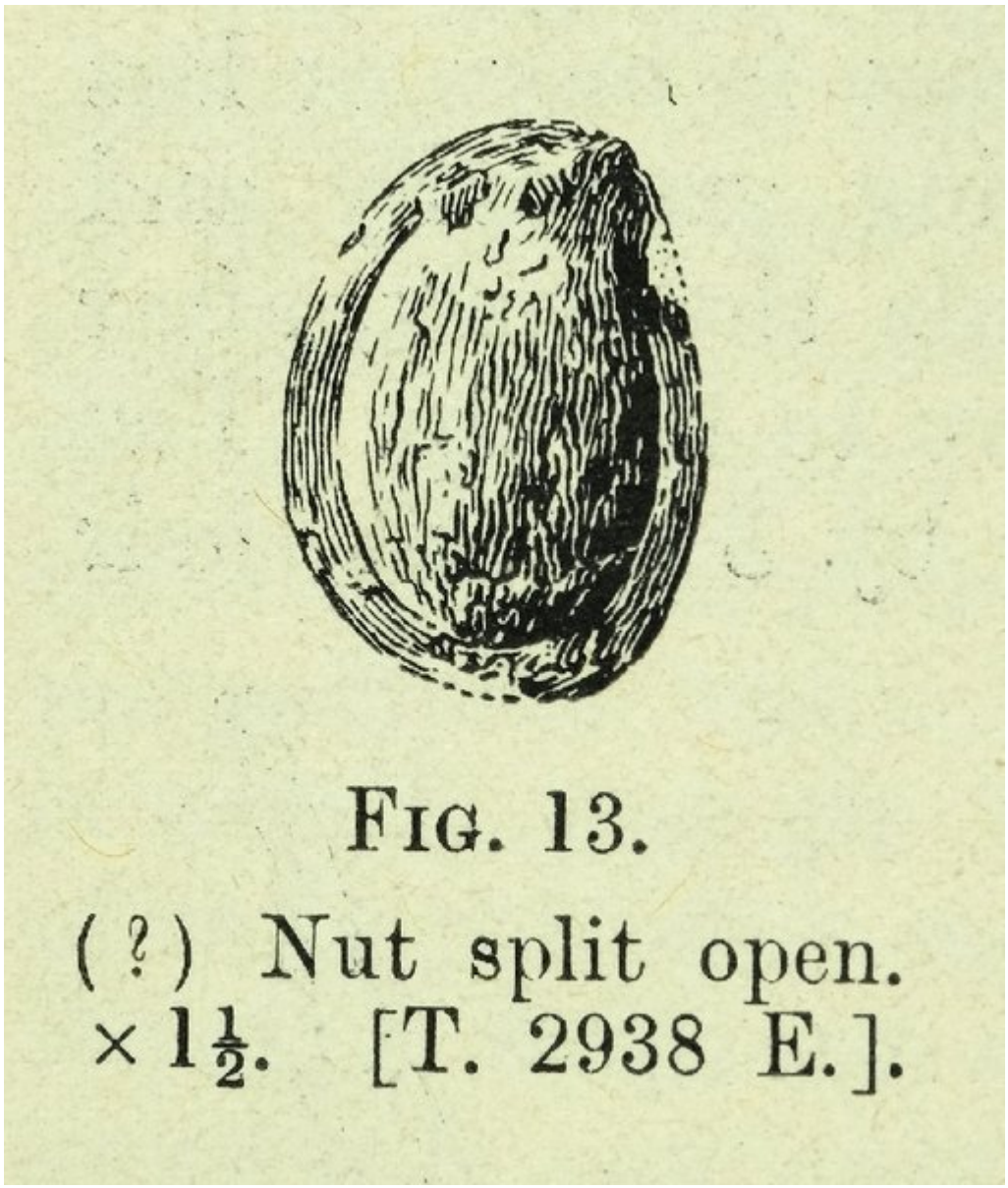
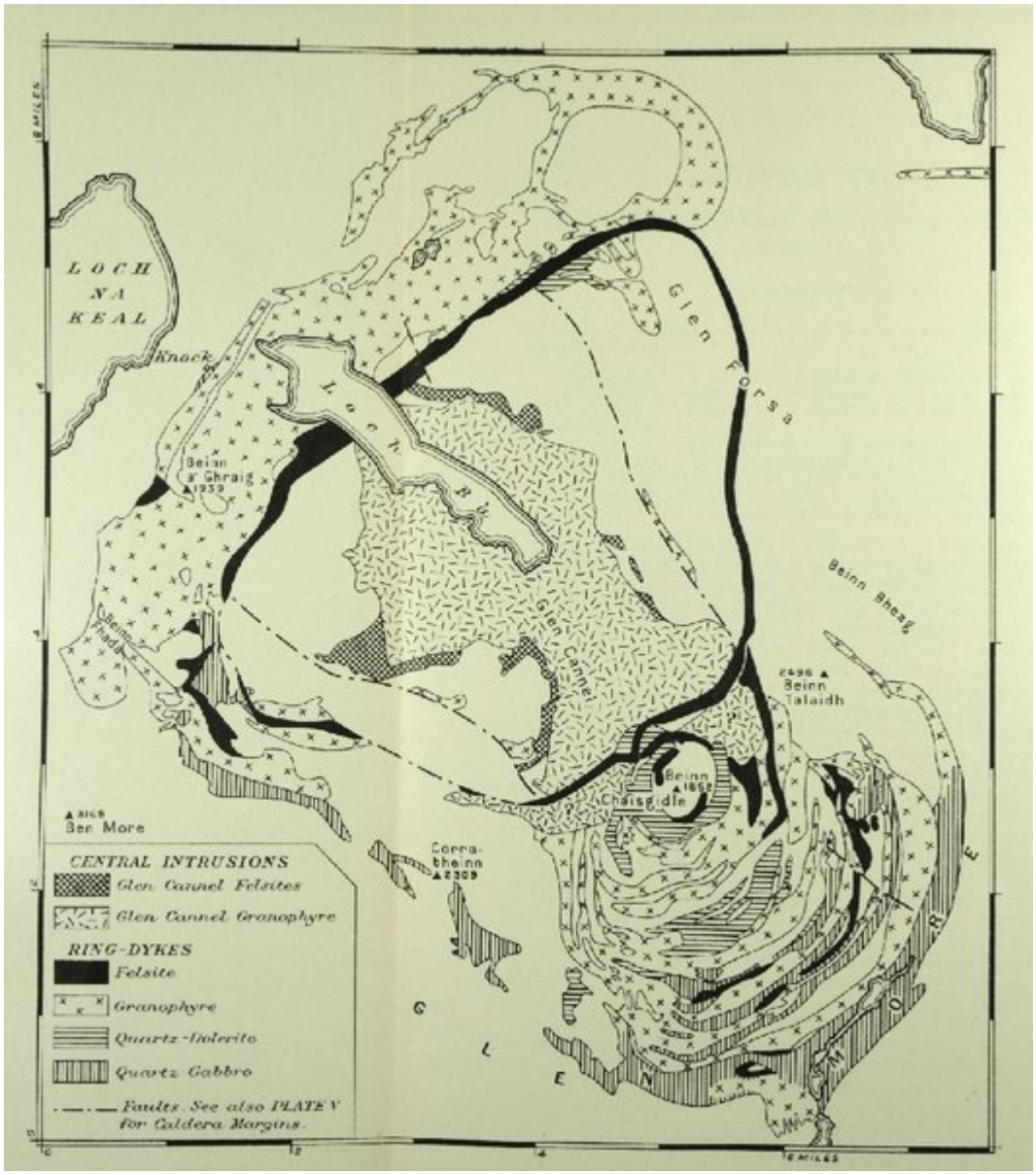


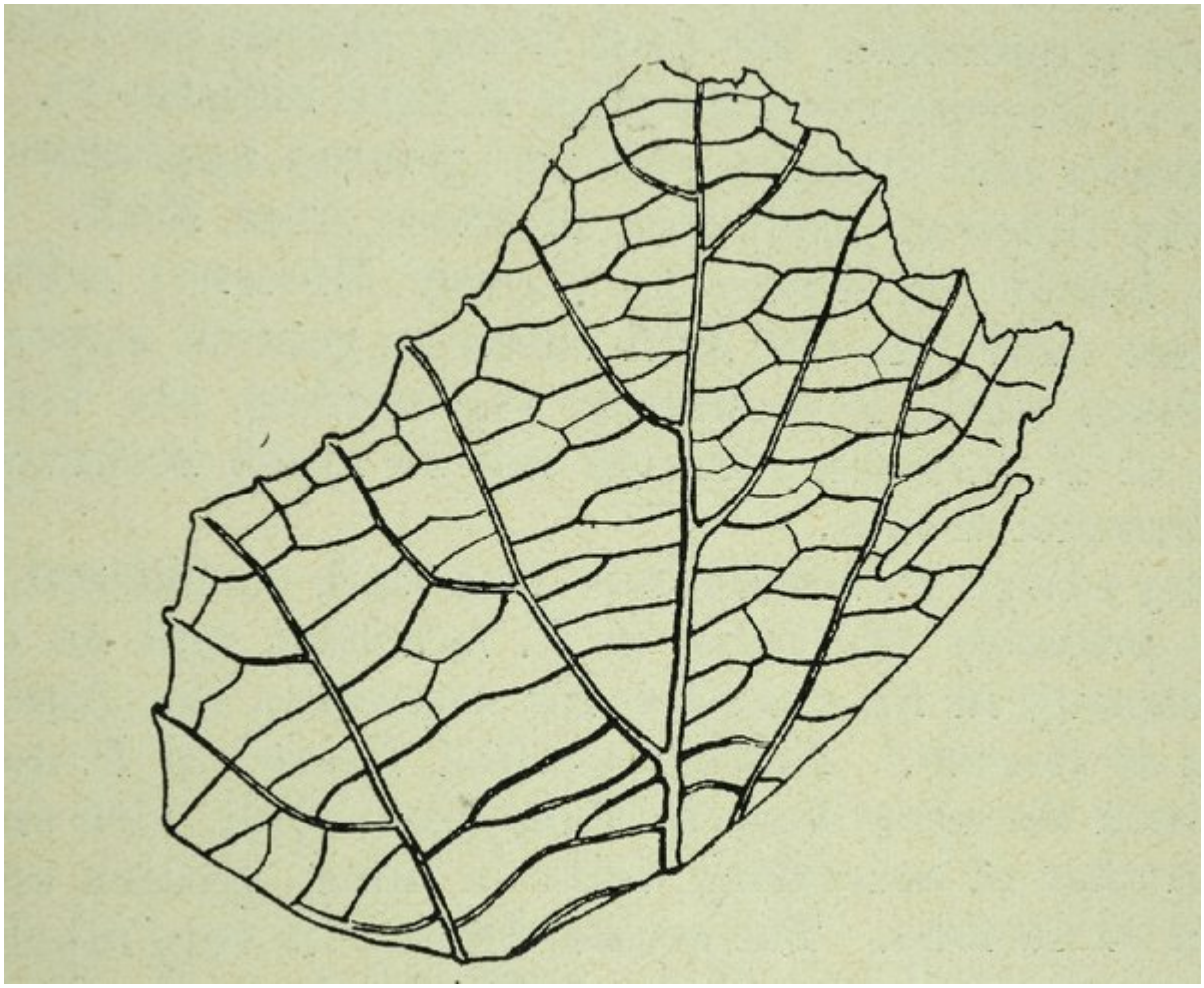
FIG. 13.

(?) Nut split open.
× 1½. [T. 2938 E.].

(Figure 13) (?) Nut split open 1½. [T.2938 E].



(Plate 6) Map showing ring-dykes



(Figure 14) Platanus hebridica (Forbes). Nat. size. [T. 3022 E.]

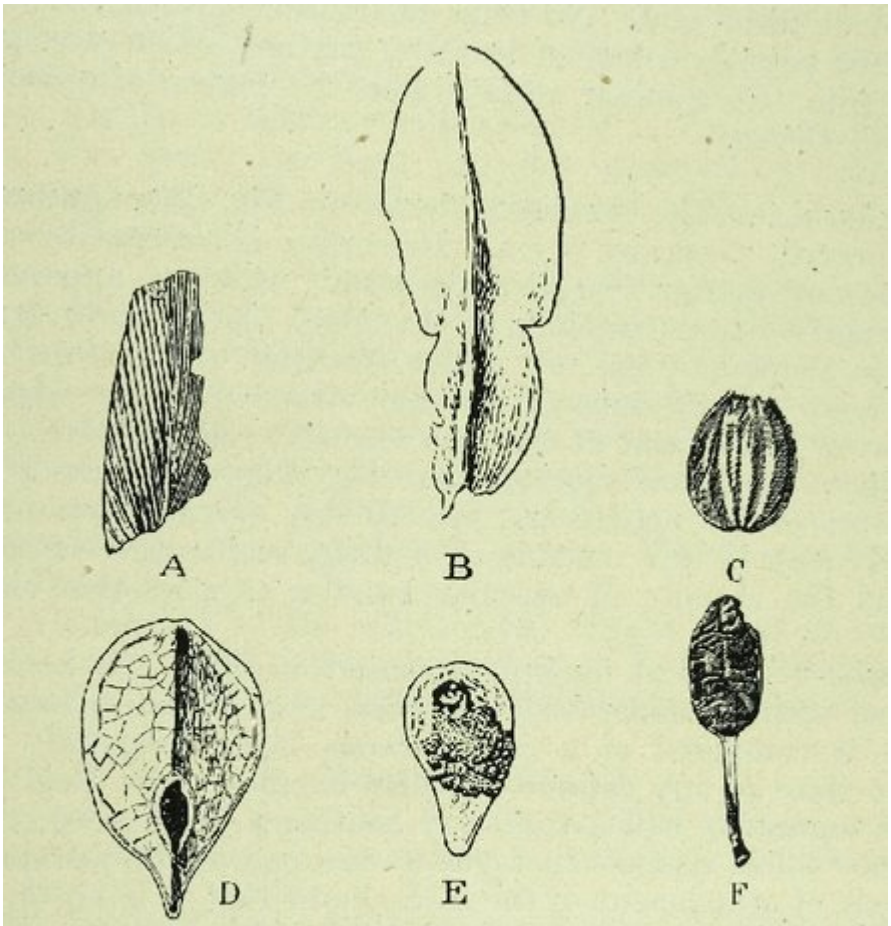


FIG. 15.—*Plantæ Incertæ Sedis.*

Specimen A. Part of a Lamina. × 1½. [T. 2055 D.].
Specimen B. Nat. size. [T. 2068 D.]
Specimen C. × 2. [T. 2893 E.].
Specimen D. × 3. [T. 2895 E.].
Specimen E. × 6. [T. 2045 D.].
Specimen F. Nat. size. [T. 2945 E.].

(Figure 15) Plantae Incertae Sedis. Specimen A. Part of a Lamina. x 1½ [T. 2055 D.]. Specimen B. Nat. size. [T. 2068 D.] Specimen C. x 2. [T. 2893 E.]. Specimen D. x 3. [T. 2895 E.]. Specimen E. x 6. [T. 2045 D.]. Specimen F. Nat. size. [T. 2945 E.].