

V.—*On the Fossil Flora of the Yorkshire Coal Field.* (First Paper.)

By ROBERT KIDSTON, F.R.S.E., F.G.S. (Plates I.—III.)

(Read 15th July 1895.)

For many years the Fossil Flora of the Yorkshire Coal Field has been engaging my attention, and among the species occurring in that district are many of considerable interest. This Coal Field supplied ARTIS with the specimens which he figured and described in his *Antediluvian Phytology*.*

In 1888, at the Annual Meeting of the Yorkshire Naturalists' Union, held at Malton, a committee was formed for the investigation of the Fossil Flora of Yorkshire, and since that date four Reports have been prepared and published based upon specimens submitted to me for examination by private collectors, and from collections contained in public museums.† These Reports only contain lists of the species found, and the localities and horizons from which the specimens were derived, with any occasional short notes that might have been thought necessary.‡ All detailed descriptions or critical remarks were deferred, and the present paper is the first of what I hope may be several, dealing more in detail with the Fossil Flora of the Yorkshire Coal Field.

Of the many species occurring in this area, none are more interesting than the *Filicites plumosus*, Artis, and the *Filicites Miltoni*, Artis; and to the consideration of the former of these two species the present paper is devoted.

Filicites plumosus, Artis, is an extremely variable species, and though this fern occurs in many of the British Coal Fields, and is frequent in the Upper and Middle Coal Measures, the greater portion of the specimens described and figured in this communication have been derived from the shales associated with the *Barnsley Thick Coal*, one of the seams of the Middle Coal Measures of Yorkshire, and which is on the *same horizon* as that from which the type specimen of ARTIS was derived at Elsecar, Yorkshire. It is chiefly for this latter reason that I deal so largely with Yorkshire

* *Antediluvian Phytology*, illustrated by a collection of the Fossil Remains of Plants peculiar to the Coal Formations of Great Britain. By Edmund Tyrell Artis, F.S.A., F.G.S., London. In all the copies I have seen, the Introduction to the work is dated 1st September 1825, but the title-page bears the date 1838. This latter date is evidently that of a later issue, or second edition of the work, and may only be an alteration of the title-page of the copies subsequently issued. Each of the twenty-four plates contained in the volume bears the date of 1824. That the work was issued at least ten years before 1838 is evidenced by the fact that BRONGNIART quotes the book in his *Prodrome d'une histoire des végétaux fossiles*, published in Paris in 1828. Probably, therefore, 1825 is the true date for the first issue of the *Antediluvian Phytology*.

† The Yorkshire Carboniferous Flora—

First Report, *Trans. York. Nat. Union*, part xiv., 1890, pp. 1–64.

Second Report, „ „ „ part xviii., 1893, pp. 65–82.

Third Report, „ „ „ part xviii., 1893, pp. 83–96.

Fourth Report (with Index to the four Reports), part xviii., 1893, pp. 97–127.

‡ The names of those to whom the Committee were indebted for assistance are given in these Reports. I am however, almost entirely indebted to Mr W. HEMINGWAY for my fine series of Yorkshire specimens of *Dactylothecca plumosa*, Artis, sp., from which largely the present paper has been written.

specimens in treating of this species, though the *Radstock Series* of the Upper Coal Measures, Somerset, have yielded me my largest and finest barren specimens.

It is not necessary here to enter into the geology of the Yorkshire Coal Field. This has been fully done in the *Geology of the Yorkshire Coal Field*,* and in other works dealing with this subject. It may be simply noted that probably all the divisions of the Coal Measures are present in this Coal Field,—the Upper, the Middle, and the Lower Coal Measures, but the Upper Coal Measures are only represented by “*Red Beds*,” from which I have not yet seen any specimens, though I believe some plant remains have been found in them at Conisborough Pottery.†

The Middle and Lower Coal Measures contain all the workable seams in this Coal Field, but the great coal-yielding series of the Yorkshire Coal Field is the Middle Coal Measures.

The Coal Measures are largely worked in that portion of the county which lies around Halifax, Bradford, and Leeds, and which extends southwards to the neighbourhood of Sheffield.

In 1886‡ I united *Dactylothea (Pecopteris) dentata*, Brongt., with *Dactylothea (Pecopteris) plumosa*, Artis, sp., while preparing the Catalogue of the Palæozoic Plants in the British Museum, and I firmly held this opinion till about three years ago, when some specimens submitted to me from Yorkshire led me to believe that *Pecopteris dentata*, Brongt., was specifically distinct from *Pecopteris plumosa*, Artis, sp. §

This latter opinion I saw, very shortly after, full cause to reject; and the points connected with the fructification, on which I thought the species might be separated, and to which I shall more fully refer, were found to be entirely dependent on the position of the fruiting portions on the frond and their state or condition of development.

On the three plates accompanying this paper, figures are given of the typical plant as well as of a number of forms of *Dactylothea plumosa*, Artis, sp., to which specific names have in some cases been given. It is an extremely variable species,—the extreme forms differing so much in appearance that they have given rise to the creation of several supposed species, all of which, when one has the opportunity of studying a large series of specimens, are shown to pass into each other by insensible gradations, and which seem to represent only different portions of what must have been a very large frond.

I have therefore found it quite impossible to draw any line of demarcation between what might appear at first sight such distinct forms as *Sphenopteris crenata*, L. and H., on the one hand, and *Pecopteris dentata*, Brongt., on the other. In fact, these differences seem to depend in great measure on whether the fragment is barren or fruiting, and on the position it held on the frond of which it originally formed a part.

Several of the species here placed under the name of *Dactylothea plumosa*, Artis, sp.,

* *Memoirs of the Geological Survey of England and Wales*. By A. H. Green, R. Russell, &c. London, 1878.

† See Kidston, “On the Various Divisions of British Carboniferous Rocks as determined by their Fossil Flora,” *Proc. Roy. Phys. Soc. Edin.*, vol. xii. p. 210, 1894.

‡ *Catal. Palæoz. Plants*, p. 128.

§ *Trans. York. Nat. Union*, part xviii. p. 106, 1893.

have been previously united with one or other of the species I regard as synonymous with the Yorkshire plant :—

Dactylothea, Zeiller, 1883.

1883. *Dactylothea*, Zeiller. *Ann. d. Scienc. Nat.*, 6^e sér., 'Bot.', vol. xvi. pp. 184 and 207, pl. ix. figs. 12-15.
 1888. *Dactylothea*, Zeiller. *Flore foss. Bassin houil. d. Valenciennes*, p. 30, fig. 16.
 1891. *Dactylothea*, Kidston. *Trans. Geol. Soc. Glasgow*, vol. ix. p. 27, pl. ii. fig. 26.
 1877. *Senftenbergia*, Stur. (not Corda) (in part), *Culm Flora*, vol. ii. p. 187.
 1883. *Senftenbergia*, Stur. (not Corda) (in part), *Zur. Morph. u. Syst. d. Culm u. Carbonfarne*, p. 33 (in *Sitzb. d. k. Akad. d. Wissensch.*, vol. lxxxviii. Heft i. p. 665).

Generic description.—Sporangia exannulate, oval or oval acute, formed of elongated thick-walled cells, and attached to the secondary veins a little above their point of origin.

Remarks.—The first description of the fruit of *Pecopteris dentata*, Brongt. (= *Pec. plumosa*, Artis, sp.), is that given by ZEILLER in 1880,* but he did not till 1883 create the genus *Dactylothea* for the reception of this species.

In 1877 STUR included *Pecopteris dentata* in the genus *Senftenbergia*, Corda,† but this is clearly an error, for the chief characteristic of the genus *Senftenbergia* is the presence of a very prominent apical annulus, whereas the sporangia of *Dactylothea* are absolutely devoid of any annulus, even in its most rudimentary form.

Mons. ZEILLER has detected a longitudinal band of narrower cells in the direction in which the sporangia appear to have opened at maturity. This longitudinal band I have not observed on my specimens, but it can only be seen in one position of the sporangia.

Dactylothea is *Marattaceous*, and amongst recent ferns finds its nearest ally in *Angiopteris*.

Dactylothea plumosa, Artis, sp.

Pls. I.-III.

1886. *Dactylothea plumosa*, Kidston. *Catal. Palæoz. Plants*, p. 128.
 1890. " " " *Trans. York. Nat. Union*, part xiv. p. 36.
 1825. *Filicites plumosus*, Artis. *Antedil. Phytol.*, p. 17, pl. xvii.
 1828. *Pecopteris plumosa*, Brongt. *Prodrome*, p. 58.
 1836. " " " *Hist. d. végét. foss.*, p. 348, pls. cxxi.-cxxii.
 1869. " " Roehl. *Foss. Flora d. Steink. Form. Westph.*, p. 88, pl. xxvii. fig. 4.
 1877. *Senftenbergia plumosa*, Stur. *Culm Flora*, Heft ii. p. 187 (293).
 1883. " " " *Morph. u. Syst. d. Culm u. Carbonfarne*, p. 44.‡
 1885. " " " *Carbon-Flora, I. Farne d. Carbon-Flora d. Schatzlarer Schichten.*, p. 92, pl. li. figs. 1-3.
 1828. *Pecopteris dentata*, Brongt. *Prodrome*, p. 58.

* *Végét. foss. du terr. houil.*, p. 87.

† Corda, *Beitr. z. Flora d. Vorwelt.*, p. 91, pl. lvii. figs. 1-6, 1867.

‡ *Sitzb. d. k. z. Akad. d. Wissensch.*, vol. lxxxviii. Abth. i. p. 633.

1835. *Pecopteris dentata*, L. and H. *Fossil Flora*, vol. ii. p. 201, pl. cliv.
 1836. " " Brongt. *Hist. d. végét. foss.*, p. 346, pls. cxxiii.-cxxiv.
 1838. " " Presl in Sternb. *Vers.* ii. p. 152.
 1869. " " Schimper. *Traité d. paléont. végét.*, vol. i. p. 508.
 1879. " " Lesqx. *Coal Flora*, vol. i. p. 240, pl. xlv. fig. 4 (?).
 1880. " " Zeiller. *Végét. foss. d. terr. houil.*, p. 87, pl. clxviii. figs. 3-4.
 1882. " " " *Flore houil. des Asturies*, p. 14.*
 1883. " " Renault. *Cours. d. botan. foss.*, vol. iii. p. 121, pl. xxi. figs. 4-5.
 1855. *Cyatheites dentatus*, Geinitz (*in part*). *Vers. d. Steinkf. in Sachsen.*, p. 26, pl. xxix. figs. 10, 12 ;
 pl. xxx. fig. 2.
 1869. " " Roehl. *Foss. Flora d. Steink. Form. Westph.*, p. 87, pl. xxvii. fig. 6.
 1869. *Cyathocarpus dentatus*, Weiss. *Flora d. jüngst. Stk. u. Rothl.*, p. 86.
 1877. *Senftenbergia dentata*, Stur. *Culm Flora*, Heft ii. p. 187 (293).
 1883. *Dactylothea dentata*, Zeiller. *Ann. d. Scienc. Nat.* 6^e sér., 'Bot.', vol. xvi. pp. 184, 207, pl. ix.
 figs. 12-15.
 1883. " " " *Bull. Soc. Géol. d. France*, 3^e sér., vol. xii. p. 201.
 1886. *Pecopteris (Dactylothea) dentata*, Zeiller. *Flore foss. Bassin houil. d. Valenciennes*, p. 196 (1888),
 pls. xxvi. figs. 1-2 ; xxvii. figs. 1-4 ; xxviii. figs. 4-5.
 1892. " " *dentata*, var. *obscura*, Zeiller. *Bassin. houil. et perm. de Brive.*, fasc. ii. ;
Flore foss., p. 26, pl. ii. figs. 1-5.
 1828. *Pecopteris triangularis*, Brongt. *Prodrome*, p. 58.
 1832. *Sphenopteris caudata*, L. and H. *Fossil Flora*, vol. i. p. 137, pl. xlvi. ; vol. ii. p. 157,
 pl. cxxxviii.
 1836. *Aspidites caudatus*, Göpp. *Syst. fil. foss.*, p. 363.
 1845. *Pecopteris caudata*, Unger. *Synop. plant foss.*, p. 97.
 1834. *Pecopteris serra*, L. and H. *Fossil Flora*, vol. ii. p. 71, pl. cvii.
 1838. " " Presl in Sternb. *Vers.* ii. p. 159.
 1869. " " Schimper. *Traité d. paléont. végét.*, vol. i. p. 504.
 1877. " " Lebour. *Illustr. of Fossil Plants*, p. 47, pl. xxiii.
 1836. *Alethopteris serra*, Göpp. *Syst. fil. foss.*, p. 302.
 1836. *Pecopteris delicatula*, Brongt. *Hist. d. végét. foss.*, p. 349, pl. cxvi. fig. 6.
 1838. " " Presl in Sternb. *Vers.* ii. p. 157.
 1869. " " Schimper. *Traité d. paléont. végét.*, vol. i. p. 510.
 1848. *Cyatheites delicatulus*, Bronn. *Index palæont.*, p. 364.
 1886. *Pecopteris (Dactylothea) dentata*, var. *delicatula*, Zeiller. *Flore foss. Bassin houil. d. Valen-*
ciennes, pl. xxviii. fig. 5, Text, p. 199, 1888.
 1890. *Dactylothea plumosa*, var. *delicatula*, Kidston. *Trans. York. Nat. Union*, part xiv. p. 36.
 1838. *Pecopteris Brongniartiana*, Presl in Sternb. *Vers.* ii. p. 160.
 1834. *Sphenopteris crenata*, L. and H. *Fossil Flora*, vol. i. p. 57, pls. c.-ci.
 1869. " " Schimper. *Traité d. paléont. végét.*, vol. i. p. 379.
 1890. " " Kidston. *Trans. York. Nat. Union*, part xiv. p. 30.
 1836. *Cheilanthes crenatus*, Göpp. *Syst. fil. foss.*, p. 248.
 1883. *Senftenbergia crenata*, Stur. *Morph. u. Syst. d. Culm u. Carbonfarne*, p. 44.
 1885. " " " *Carbon-Flora*, I. *Die Farne d. Carbon-Flora d. Schatzlarer Schichten*,
 p. 72 (pls. xlv. figs. 1, 2, and 3, figures very indistinct).
 1834. *Schizopteris adnascens*, L. and H. *Fossil Flora*, vol. i. p. 58, pls. c.-ci.
 1836. *Trichomanites adnascens*, Göpp. *Syst. fil. foss.*, p. 266.
 1838. *Aphlebia adnascens*, Presl in Sternb. *Vers.* ii. p. 113.
 1869. *Rhacophyllum adnascens*, Schimper. *Traité d. paléont. végét.*, vol. i. p. 686, pl. xlvi. figs. 1-2
 (fig. 7 (?)).
 1836. *Aspidites silesiacus*, Göpp. *Syst. fil. foss.*, p. 364, pl. xxvii. (pl. xxxix. fig. 1. (?)).
 1869. *Pecopteris silesiacus*, Schimper. *Traité d. paléont. végét.*, vol. i. p. 517.

* *Mém. Soc. Géol. du Nord*. Lille, 1882.

1877. *Pecopteris silesiaca*, var. Lebour. *Illustr. of Fossil Plants*, p. 53, pl. xxvi.
1838. *Steffensia silesiaca*, Presl in Sternb. *Vers.* ii. p. 122.
1854. *Pecopteris Glockeriana*, Ett. (Göpp. (?)). *Steinkf. v. Radnitz.*, p. 44, pl. xvii. fig. 1.
1854. *Pecopteris angustifida*, Ett. *Steinkf. v. Radnitz.*, p. 45, pl. xvi. fig. 1.

Description.—Frond very large, much divided, tripinnate or quadripinnate. Pinnæ alternate. Primary pinna broadly lanceolate. Secondary pinnæ lanceolate or linear-lanceolate, often slightly overlapping, the central portion the widest, ending in a sharp point and slightly narrowed at the base; the central portion often of about equal width for $\frac{1}{3}$ of the length of the pinna. Tertiary pinnæ linear-lanceolate, tapering to a bluntish apex, the basal portion being usually the broadest. The lower portion of the frond probably becomes quadripinnate. The large pinnæ are subtended by two stipular-like *Aphlebia* which spring from the anterior and posterior sides of the rachis. These are adpressed to the rachis, but, being directed upwards and outwards laterally, hold between them the base of the pinna they subtend. In general outline they are deltoid or sub-orbicular, and are composed of narrow much divided sharp-pointed linear segments without any apparent nervation.

Pinnules alternate, and varying much in form, size, and pinnule cutting, according to the position they hold on the frond being entire, dentate, or divided into teeth-like lobes.

The pinnules on the middle tertiary pinnæ are oval, triangular, or broadly lanceolate, with rounded apices, united by their whole base to the rachis. The basal inferior pinnule is deltoid—rounded, generally smaller than the others, and occupies the angle formed by the insertion of the rachis of the pinna with its parent stem; it bears a distinctly marked lobe on the margin next to the parent rachis. The basal superior pinnule is oval or oval-oblong, obtuse, and is the largest pinnule on the pinna. The upper pinnules become gradually united in their basal portions and form a more or less lobed, —and finally, an entire blunt apex to the pinna. As the pinnæ are traced upwards, through the union of pinnules amongst themselves, the pinnæ become simply lobed or dentate, and in some cases assume the form of oblong or linear entire pinnules. As the pinnæ are traced downwards towards the base of the frond, the pinnules on the tertiary pinnæ become more and more distinctly lobed, till they almost assume the form of small quadripinnate pinnæ.

The lateral veins in the basal pinnules of the lower tertiary pinnæ are generally once divided,—in the pinnules of the upper portion, the veins are usually simple; frequently, in the same pinnule, the lower lateral veins are divided, while the upper are simple. In the dentate pinnules usually each lobe has a bifurcated veinlet, and in the toothed pinnules of the lower pinnæ a simple vein runs into each tooth.

The *fructification* consists of exannulate oval or oval-acute sporangia, varying in length from .50 mm. to .65 mm., and formed of coriaceous elongated cells. The sporangia are placed upon, and parallel with, the lateral veinlets at a short distance above their point of origin. Frequently the sporangia occupy the whole of the space between the midrib and the margin of the pinnule. When the fructification is copiously

produced, it results in a partial reduction of the limb of the pinnule. Upper portion of the fructifying pinnæ barren.

Rachis rough, with small points from which caducous scales have fallen.

Remarks.—The fronds of *Dactylothea plumosa*, Artis, sp., must have attained to a large size. I possess a specimen from Radstock, showing portions of two primary (?) pinnæ, neither of which is complete, but the most perfect, though it neither shows base nor apex, is about $16\frac{1}{2}$ inches long, and has a width of 12 inches, though even here the extremities of all the lateral pinnæ are broken off. Its complete width could not have been less than 18 inches, and was possibly greater. On fronds of this size the pinnule cutting must have varied greatly according to the position held by the pinnules on the frond.

The figures which accompany this communication better illustrate the various forms of pinnule cutting than could be conveyed by words. From simple pinnules, to others divided into sharp tooth-like lobes, all intermediate forms occur, which graduate into each other by insensible transitions. On some specimens, the simple undivided pinnule is found associated with those divided into prominent saw-like teeth.

To these polymorphous forms, many specific names have been given, and this is more fully referred to in the description of the specimens figured on the plates.

That these so-called species are only different portions of the same plant—and might equally well be fragments of the same frond—will, I believe, be admitted by anyone who has had the opportunity of examining such a large and fine series of specimens of *Dactylothea plumosa*, Artis, sp., which it has been my good fortune to meet with.

These various forms cannot even consistently be described as varieties, for they only represent different portions and conditions of development—barren and fruiting—of the same frond; but should it be thought desirable to distinguish the particular form found at any given locality, it can easily be done by indicating the various forms, as *forma crenata*, *forma caudata*, &c.

NOTES ON SPECIMENS FIGURED BY VARIOUS AUTHORS.

Filicites plumosus, Artis. *Antediluvian Phytology*, p. 17, pl. xvii.

ARTIS, like many of the older and, unfortunately, like some much more recent writers on Fossil Botany, gives no enlarged drawings of the details of the pinnule cutting and nervation of his *Filicites plumosus*, and his description is very meagre. Probably, this has contributed to the imperfect manner in which this fern is understood. Of the small portion of the fruiting specimen shown on the upper left-hand corner of his plate, he says, "Fructification near the margin of the leaflet." This appearance is only shown on imperfectly preserved specimens, of which I possess some similarly preserved from Cooper's Colliery, Worsborough Dale, near Barnsley,* to the small fragment figured by ARTIS.

* Collected by Mr W. HEMINGWAY. (Reg. No. 2094, &c.)

ZEILLER, in 1883,* in remarking on the polymorphic nature of *Pecopteris dentata*, points out that the *Pecopteris plumosa*, Brongt.,† was only a form of *Pecopteris dentata*, and that he was inclined to unite to the same species the *Pecopteris delicatula*, Brongt.‡ That BRONGNIART was correct in identifying and figuring the plants he named *Pec. plumosa* as ARTIS' species is beyond all doubt, and the union of BRONGNIART's figures of *Pecopteris plumosa* with the same author's *Pecopteris dentata* must carry the *Filicites plumosus*, Artis, along with it. Mons. ZEILLER, however, appears to have had some doubt as to the correctness of BRONGNIART's identification of his specimens with ARTIS' plant.

ZEILLER gives, under the name of *Pecopteris (Dactylothea) dentata*, some excellent figures of *Filicites plumosus*, Artis, in his *Flore foss. Bassin houil. d. Valenciennes*. His fig. 2, pl. xxvi., is typical of the form originally described by ARTIS. His fig. 2, pl. xxvii., is also an excellent rendering of the same form, as also are his figs. 3-4 of the same plate. His fig. 2, pl. xxvii., corresponds to my fig. 1, pl. i.

Sphenopteris caudata, L. and H. *Fossil Flora*, pls. xlvi. and cxxxviii.

This species is only one of the many forms of *Dactylothea plumosa*. I give an illustration of the same form on pl. i. fig. 3, from a specimen communicated to me by Mr JOHN WARD, Longton, from below the *New Mine Coal*, the uppermost seam of the Lower Coal Measures, Adderley Green, Staffordshire. I possess an identical form (No. 2108) from the Middle Coal Measures of Yorkshire, collected by Mr W. HEMINGWAY from the *Thick Coal* at Monckton Main Colliery, near Barnsley.

The other specimen of *Sphenopteris caudata* which forms the subject of LINDLEY and HUTTON's pl. cxxxviii., is preserved in the Hutton Collection, Newcastle-on-Tyne. It is not in a good state of preservation, but is evidently the plant named *Pecopteris dentata* by BRONGNIART. The locality given for this specimen is subject to much doubt; it more probably came from the Somerset Coal Field, as the shale on which the fossil occurs agrees with that found in Somerset, but not with the shales which are found at Jarrow Colliery, from which the specimen is stated to have come.

Pecopteris serra (?), L. and H. *Illustrations of Fossil Plants*.

Edited by G. A. LEBOUR. Pl. xxiii.

The fossil shown here is a small fragment of *Dactylothea plumosa*, with which *Pecopteris silesiaca*, Göpp., sp., the name inscribed in pencil on the original drawing, is synonymous.§

Cyatheites dentatus, Geinitz. *Vers. d. Steinkf. in Sachsen*, p. 26.

Of the various figures given by this author, some appear to be doubtfully referable to this species. On his pl. xxv. fig. 11, he shows a specimen with *Aphlebia* attached

* *Bull. Soc. Géol. d. France*, 3^e sér., vol. xii. p. 201.

† *Hist. d. végét. foss.*, pls. cxi., cxii.

‡ *Ibid.*, p. 349, pl. cxvi., fig. 6.

§ See also Crépin, *Bull. Soc. Roy. Bot. Belgique*, vol. xx. part ii. p. 25, 1881.

to the main rachis. These *Aphlebia*, which GEINITZ identifies as *Schizopteris Gutbieri-ana*, Presl, differ considerably in the wide foliaceous expansion of the segments from any *Aphlebia* of *Dactylothea plumosa* (= *D. dentata*) that I have hitherto seen. From this I am led to infer that probably the fern here figured by GEINITZ should not be identified with *Pec. dentata*.

Also his figures on pl. xxx. figs. 1, 3, and 4, if really referable to this species, are misleading and had better be excluded as references; and if his fig. 4 faithfully represents the original specimen it cannot be referred to *Pecopteris dentata*.

Schizopteris adnascens.

LESQUEREUX, in the *Coal Flora*, vol. i. p. 321, pl. lvii. figs. 9, 10, and 11, figures and describes some *Aphlebia* under the name of *Rhacophyllum adnascens*, L. and H. The specimens are, however, unassociated with the parent stem, and in this condition it appears to me unsafe to identify his specimens with those borne on the rachis of *Sphen. crenata*, L. and H., especially as his figures do not appear to represent a similar *Aphlebia*.

I also doubt the accuracy of the reference of the isolated fragment given by SCHIMPER in his *Traité d. paléont. végét.*, pl. xlvi. fig. 7, to the *Schizopteris adnascens*, L. and H.

It is also perhaps advisable to treat in the same way the specimens figured as *Schizopteris adnascens* by GEINITZ in his *Vers. d. Steinkf. in Sachsen*, p. 20, pl. xxv. figs. 7-9.

HEER figures certain ferns which he identifies as the *Cyatheites dentatus*, Brongt.* Possibly he may be correct in his identifications, but if so, the figures are not satisfactory.

FONTAINE and WHITE, in their *Perm. and Upper Carb. Flora of West Virginia and S. W. Pennsylvania*, p. 66, pl. xxii. figs. 1-5 (1880), figure and describe a fern they refer to *Pec. dentata*, Brongt. The figures 1, 2, and 4 they provisionally name var. *crenata*, and their fig. 2 var. *parva*. Their plant, though having some of the characters of *Pecopteris dentata*, Brongt., does not seem to agree well with that species. I have not seen any original specimens of their plant, and therefore do not feel justified in expressing any definite opinion on its relationship to *Pecopteris dentata*, Brongt.

Aspidites silesiacus, Göpp. *Syst. fl. foss.*, p. 364, pl. xxvii.

The fine specimen figured by GÖPPERT on his pl. xxvii. is quite indistinguishable from *Dactylothea plumosa*, Artis, sp. I possess a specimen of GÖPPERT's plant from Waldenburg, the original locality for *Aspidites silesiacus*, which was sent to me some years ago by the late Dr WEISS. One of the examples on this specimen completely agrees with the form of the plant given on my pl. ii. fig. 9, while another is similar to that shown on my pl. iii. fig. 12. The figure given by ZEILLER in the *Flore foss. Bassin houil. d. Valenciennes*, pl. xxvi. fig. 2, appears to me to be similar to GÖPPERT's *Aspidites*

* *Flore foss. Helv.*, Lief. i. p. 30, pls. xi. and xii. figs. 1-5, 1876.

silesiacus according to my specimen from Waldenburg. The enlargements given by GÖPPERT fully confirm the identity of his species with *Dactylothea plumosa*. His figs. 2, 3, and 4 correspond to the plant given on my pl. iii. fig. 12, which is a common form in Britain, intermediate in character between *Filicites plumosus*, Artis, and *Sphenopteris crenata*, L. and H. The lower part of GÖPPERT's example is quite typical, *Sphenopteris crenata*, L. and H., and the upper part cannot be distinguished from *Pec. plumosa*, Artis, sp.

Again GÖPPERT's figs. 6 and 7, especially his fig. 6, has a great similarity to the *Sphenopteris caudata*, L. and H., which is seen in my pl. i. fig. 3.

The fructification of GÖPPERT's specimen has apparently been imperfectly preserved. The only remark he makes about it is that the sori (*Fruchthaüfchen*) are borne on the middle of the straight lateral nerves. No description of the *sporangia* is given.

GÖPPERT's second specimen, given on pl. xxxix. fig. 1, is too indistinct for criticism.

The *Pecopteris silesiaca*, Lebour. Illustrations of Fossil Plants, is the form named *Sphenopteris crenata*, L. and H., and is seen in my pl. iii. fig. 11, and in the lower portion of fig. 13.

The *Aspidites Glockeri*, Göpp.,* and var. *falcatus*, Göpp.,† may very possibly belong to the *Dactylothea plumosa*, and SCHIMPER unites the type with *Pecopteris silesiacus*.‡ Whatever opinion may be held of the specific value of GÖPPERT's original specimens of *Aspidites Glockeri*, I cannot see how it is possible to regard the fern figured by ETTINGSHAUSEN as *Pecopteris Glockeriana* in his *Steinkf. v. Radnitz.*, pl. xvii. fig. 1, as other than *Dactylothea plumosa*, Artis, sp. It is to be regretted that ETTINGSHAUSEN has not given any enlarged figures of the pinnule cutting and nervation of his specimen, and the description he gives is partially adopted from GÖPPERT.

The *Pecopteris angustifida*, Ettingshausen, given on pl. xvi. fig. 1 of the same work, is evidently to be referred to *Dactylothea plumosa*, and corresponds to the form shown on my pl. i. fig. 1, but his specimen is apparently imperfectly preserved.

Pecopteris (Dactylothea) dentata, var. *obscura*, Zeiller. *Bassin houil. et perm. de Brive*, p. 26, pl. ii. figs. 1-5, 1892.

In describing this variety ZEILLER says: The chief differences between this variety and the type are that "the pinnules on the secondary middle pinnæ are slightly contracted at the base and more or less imbricated; the anterior margin of each pinnule is in part covered by the posterior margin of that which lies in front of it; and further, the medial nerve of each pinnule is clearly decurrent at the base, and the secondary nerves are almost buried in the parenchyma and difficult to discern."

"It is chiefly the two last mentioned characters—the decurrence of the medial

* *Syst. fil. foss.*, p. 375, pl. xxix. figs. 1-2.

† *Loc. cit.*, pl. xxix. figs. 3-4.

‡ *Traité d. paléont. végét.*, vol. i. p. 518.

nerve and the obscurity of the secondary veins—which distinguish this form from the normal plant. The fructification also differs very little, the limb of the fertile pinnæ and pinnules, at least on the fossil figured on pl. ii. fig. 2, is much more reduced than on the fructifying specimens which I have had from the Middle Coal Measures, but perhaps these differences depend simply on the degree of development, and possibly one should not attach too great an importance to them.”

“The sporangia are coriaceous, without any trace of an *annulus*, they possess all the characters of the genus *Dactylothea*, and they differ from the sporangia of normal *Pecopteris dentata* only in that they are broader and shorter, and, in consequence, less tapered,—they are also more numerous and more closely placed the one to the other, and they appear to be disposed without any order.”

These differences, as suggested by ZEILLER, may only represent a greater advance in maturity or a greater development of sporangia. He further refers to a similar occurrence in many species of *Asplenium*, where, when the fructification is very much developed, they cover the whole of the lower surface of the limb.*

Probably some of my Yorkshire specimens belong to the same form, such as that from which the sporangia were drawn, shown on my pl. ii. fig. 14. Here the sporangia, from their number and close position to each other, appear as if placed without order. In my figure the rows marked *a'* and *a''* probably represent the sporangia of one pinnule, and were borne on the secondary veins.

My fig. 2, pl. i., is apparently the barren condition of ZEILLER's var. *obscura*.

Corresponding with ZEILLER's figure of the var. *obscura* given on his pl. ii. fig. 2, is probably my fig. 7, pl. ii. This figure only shows a small portion of a fruiting specimen, which is the *Sphenopteris crenate*, L. and H., so far as the portion figured is concerned, but the upper barren portions of the pinnæ not shown in the figure, possess all the characters of *Dactylothea plumosa*. They are quite similar to my fig. 13, pl. iii., only not in so good a state of preservation.

Pecopteris (Dactylothea) Gruneri, Zeiller.

ZEILLER describes in his *Flore fossile: Études sur le terr. houil. de Comentry*,† a *Dactylothea* under the name of *D. Gruneri*, of which he gives drawings of both the barren and fruiting condition.

This species is certainly very closely related to *Dactylothea plumosa*, if really specifically distinct from it.

Comparing it to *Pecopteris dentata* (which is synonymous with *Pecopteris plumosa*), he says:—“*Pecopteris Gruneri*, when compared to the *Pecopteris dentata*, is distinguished by the thickness of its limb, by its pinnules less distinctly lobed, more rounded at the

* STERZEL, in *Die Flora des Rothliegenden im Plauenschen Grunde bei Dresden* (Abhandl. d. k. Sax. Gesell. d. Wissen. Math. Phys. Cl., vol. xix., Leipzig, 1893), p. 37, pl. v. figs. 1–6, describes another variety of *Pec. dentata* under the name of var. *Saxonica*.

† Page 104, pl. x. figs. 1–2, 1888.

summit, and finally by the primary pinnae being closer and narrower in regard to their length, and by the rachis being always smooth."

Without examining the original specimens, one is not warranted to propose the union of *Dactylothea Grunerii* with *Dactylothea plumosa*; but in this last mentioned species the pinnules are entire, dentate, or lobed, according to the position they hold on the frond, and the rachis, though typically rough with small points, is, on the specimen figured on my pl. ii. fig. 7, quite smooth on one part, whereas another portion bears the characteristic little points. On the smooth portions of this rachis the little points have probably been obliterated by pressure, but the same cause might have equally well removed all evidence of them from the whole of the rachis.

The *Pecopteris Bioti*, Brongt., as described and figured by ZEILLER in the same work, also seems to be very closely related to *Dactylothea plumosa*.*

Sphenopteris crenata, L. and H., and *Aspidites silesiacus*, Göpp.

STUR has expressed his opinion that *Sphen. crenata*, L. and H., is identical with *Aspidites silesiacus*, Göpp., in his paper entitled "*Momentaner Standpunkt meiner Kenntniss über die Steinkohlenformation, Englands.*"†

That *Pecopteris dentata* belonged to *Pecopteris plumosa* was suspected by ROEMER when he wrote his *Beitr. z. geol. Kennt. des nordw. Harzgebirges* in 1860.‡

DESCRIPTION OF SPECIMENS OF *Dactylothea plumosa*, Artis, sp., FIGURED IN THE ACCOMPANYING PLATES I.—III.§

Pl. I. figs. 1 and 1a.

Specimen from Monckton Main Colliery, near Barnsley, Yorkshire. *Horizon*.—Barnsley Thick Coal. Middle Coal Measures.||

This may be regarded as the typical form of *Filicites plumosus*, Artis. The ultimate pinnae are linear or linear-lanceolate, with alternate pinnules. The inferior basal pinnule is placed in the angle formed by the union of the rachis of the ultimate pinna with the stem from which it springs, and is always smaller than the immediately succeeding pinnules. On the lower pinnae, it is generally composed of two lobes, the foremost of which is usually sub-triangular, blunt, large, and the other—that next the stem which bears the pinna—is rounded and slightly smaller. The corresponding pinnule on the upper pinnae is sub-triangular and simple, and fills up the angle formed by the union of the rachis of the pinna to its parent rachis, being united by its base in part to both. The basal superior pinnule is large and usually slightly larger than any of the succeeding pinnules. It is oblong-lanceolate, with an acute or slightly rounded point. The

* *Loc. cit.*, p. 99, pl. ix. figs. 2-4.

† *Jahrb. d. k. k. geol., Reichsanst.*, 1889, vol. xxxix. Heft i. p. 5.

‡ *Palaeont.*, vol. ix. p. 34, 1860.

§ I have figured small specimens, to enable me to give a greater number of forms.

|| The same horizon as that from which the type of *Filicites plumosus* was derived.

pinnules are directed slightly forward, and are entire or slightly crenulate at the margin (fig. 1*a*). The pinnules are rarely free, being generally united below. The lateral veins of the lower pinnules usually divide once; those of the upper pinnules are simple. The degree of distinctness with which the veins are visible depends in great measure on the condition of preservation of the fossil, but they appear to have been somewhat immersed in the parenchyma of the limb.

Pl. I. figs. 2, 2*a*, and 2*b*.

From the same *Horizon* and *Locality* as fig. 1.

This specimen appears to be the same type as that figured by ZEILLER as var. *obscura*.* The pinnules are broader in proportion to their length, and placed close together; the anterior border of the pinnule in its lower portion has a tendency to overlap the posterior margin of the pinnule in front of it. The pinnules are oblong-triangular, with rounded apices (fig. 2*a*), or oblong-linear, with sharp points. Their form alters according to the position they hold on the pinna, and whether the pinnae belong to a higher or lower portion of the frond. The lateral veins are simple or bifurcated, according to the position of the pinnules on the pinna. The superior and inferior basal pinnules (fig. 2*b*), in their position and shape, conform to the characteristics which mark the type.

Pl. I. figs. 3 and 3*a*.

From Adderley Green, near Longton, Staffordshire. *Horizon*.—Below the New Mine Coal, which is the uppermost seam in the Lower Coal Measures of the Potteries Coal Field.

This is the *Sphenopteris caudata*, L. and H. *Fossil Flora*, vol. i. pl. xlviii. The other specimen which they figure under the same name in vol. ii. pl. cxxxviii., is, I think, the *Pecopteris dentata*, Brongt., but the original, which is contained in the "Hutton Collection," is badly preserved.

The penultimate pinnae are linear-lanceolate and slightly overlapping. The ultimate pinnae are narrow linear-lanceolate, distant from each other, and especially so in the upper portion of the penultimate pinnae.

The pinnules are sub-triangular, directed forwards, and united to each other below. The inferior basal pinnule is smaller than the superior basal one (fig. 3*a*), which is always the largest and longest on the pinna.

The form and direction of the pinnules give a saw-like appearance to the pinnae. The nervation is not shown.†

Pl. I. figs. 4, 4*a*, and 4*b*.

From Monckton Main Colliery, near Barnsley, Yorkshire. *Horizon*.—Shale over Barnsley Thick Coal. Middle Coal Measures.

This interesting specimen shows in the pinnae of the upper portion the typical form of pinnule and nervation of *Filicites plumosus*. The lower pinnae, on the other hand,

* *Bassin houil. et perm. de Brive.*, p. 26, pl. ii. figs. 1-5.

† My thanks are due to Mr JOHN WARD, Longton, for this specimen.

seem indistinguishable from *Asplenites ophiodermaticus* of GÖPPERT, as figured on his plate xvii. figs. 1–2.* My enlarged fig. 4a seems similar to his enlarged fig. 2. The ultimate pinnæ are linear, alternate; the pinnules are bluntly oval, or shortly pointed. The pinnules on the basal part of the pinnæ are almost upright on the rachis; those about two-thirds up, and above this point, are directed slightly forwards towards the apex of the pinnæ. The pinnules are very closely placed, and the anterior margin of the pinnule slightly overlaps the posterior margin of the pinnule in front of it. They are united to each other at their bases, and this united portion forms a narrow wing along the rachis. The posterior basal pinnule is smaller than the others, and occupies the angle caused by the union of the pinna and its parent rachis (fig. 4a); the superior basal pinnule is, on the other hand, the largest on the pinna. By a gradual diminution of the lobing as the pinnæ recede from the basal portion of the specimen towards the apex, we find the position of the compound pinnæ (a) (on fig. 4), taken by small simple pinnæ (b) (on fig. 4), bearing first lobed or dentate (b'), and then entire pinnules (fig. 4b), having all the characters of typical *Filicites plumosus*. These upper pinnules are homologous with the ultimate pinnæ of the lower part of the specimen. The rachis is rough.

STUR,† among other species, unites with *Asplenites ophiodermaticus*, the *Sphenopteris caudata*, L. and H., pl. xlviii. This last-mentioned plant is certainly to be referred to *Filicites plumosus*, and very probably so should GÖPPERT's *Asplenites ophiodermaticus*, but not having seen any authentic specimens of GÖPPERT's plant, I prefer, in the meantime, to leave the union of this plant with *Filicites plumosus* an open question.

Perhaps BRONGNIART's fig. 3, pl. cxxiii.,‡ is the same form of the species as that given here on my pl. i. fig. 4.

Pl. II. figs. 5, 5a, and 5b.

From Woolley Colliery, Darton, near Barnsley, Yorkshire. *Horizon*.—Barnsley Thick Coal. Middle Coal Measures.

This specimen is the *Sphenopteris crenata*, L. and H. The fossil shows the upper surface of the frond, but, at parts where the carbonaceous film is removed, the fructification is very beautifully shown. The pinnules are divided into narrow obtuse teeth-like lobes, as seen in the enlarged fig. 5a, the nervation of which is obscure.

The sporangia are beautifully preserved; one is shown magnified 26 times at fig. 5b. They exhibit no indication of an annulus.

The sporangia are placed so close together on the pinnules that they seem to occupy the whole of the dorsal surface, and frequently the two halves of the pinnule are con-duplicately bent upon each other, in which case it is impossible to discover the original position of the sporangia, but they appear to have been placed almost parallel with the veins. The sporangia are about 0.65 mm. in length.

* *Syst. fil. foss.*, p. 280, 1836.

† *Die Carbon-Flora d. Schatz. Schichten*, p. 78, 1885.

‡ *Hist. d. végét. foss.*

Pl. II. fig. 7.

From Monckton Main Colliery, near Barnsley, Yorkshire. *Horizon*.—Barnsley Thick Coal. Middle Coal Measures.

The specimen shows portion of a primary (?) pinna, and the fragment preserved is 26 cm. long. The rachis at its thickest part is about 7 cm. broad.

At certain parts of the rachis the little rough points are almost entirely effaced—probably from pressure—which, at other portions, are distinctly preserved, and this shows how much the absence or presence of such characters depends on the condition of preservation.

The plant is the *Sphenopteris crenata*, L. and H., but is not so well preserved, as far as the lateral pinnæ are concerned, as those shown at figs. 5 and 13. The specimen is a fruiting one, of which only a portion is shown natural size. It is similar to the fossil given at fig. 13. The upper ultimate pinnæ (not shown in the figure) are barren, and bear simple pinnules, of which some have simple and others bifurcated veins, identical with those shown at fig. 1a, fig. 4b, and fig. 13a, and which are typical *Filicites plumosus*. It is, therefore, seen that under certain conditions, when the *sporangia* are copiously produced, it results in the limb of the pinnules being more or less reduced. In the case of fig. 5, and in certain of the pinnæ of figs. 7 and 13, the reduction of the limb has reduced the pinnules to narrow teeth-like lobes, leaving only that portion of the *limb* on which the *sporangia* themselves are placed. This example also shows very beautifully the *Aphlebia* (originally supposed by LINDLEY and HUTTON to be a parasite, and named by them *Schizopteris adnascens*), arising from the rachis at the points where the pinnæ are given off.

Mons. ZEILLER has shown,* from specimens collected at Larche, that the *Aphlebia* which occur on the rachis are disposed in pairs at the origin of the *Aphlebia* bearing pinnæ,—one on the anterior, and the other on the posterior face of the rachis. They may thus be compared to two wing-like structures that arise from the back and front of the rachis, and bending upwards and outwards embrace the base of the pinna they subtend between them.

The *Aphlebia* are bipinnately divided into sharp-pointed lanceolate segments.

ZEILLER has observed a similar arrangement of the *Aphlebia* on *Diplothmema Zeilleri*, Stur.†

Pl. II. fig. 6.

From the same *Locality* and *Horizon* as the last.

This fossil shows an early state of development of several pinnæ,—what might be called the “*Spirorbis*” condition of the plant,—where the pinnæ are still spirally coiled. The *Aphlebia*, however, appear to be fully developed, and therefore probably acted as protective organs to the more tender and immature portions of the frond.

* *Bassin houil. et perm. de Brive.*, p. 26, pl. ii. figs. 3–4.

† *Flore foss. Bassin houil. d. Valenciennes*, pl. xvi. fig. 1.

Pl. III. fig. 10.

This example, from the Barnsley Thick Coal, near Barnsley, shows natural size some of the largest *Aphlebia* of *Filicites plumosus* which I have yet seen. Their surface is finely striated in the direction of growth, but there is no clear indication of any nervation.

Pl. III. figs. 13, 13*a*, 13*b*, and 13*c*.

From Monckton Main Colliery, near Barnsley, Yorkshire. *Horizon*.—Barnsley Thick Coal. Middle Coal Measures.

This specimen combines in the same example the characters of *Sphenopteris crenata*, L. and H., and *Filicites plumosus*, Artis. The upper part is the *Filicites plumosus*, Artis (fig. 13*a*), while its lower portion is the *Sphenopteris crenata*, L. and H. (figs. 13*c* and 13*b*).

The fossil is a fruiting example; but as only the upper surface of the pinnules is exhibited, the presence of the sporangia are only shown indistinctly through the tissue of the pinnules. This example corresponds to one of the lateral pinnæ, the basal portions of which only are shown on pl. ii. fig. 7, but it is much better preserved in regard to the minute structure of the pinnules. Fig. 13*a* shows two pinnules from the upper barren pinnæ, which are entire with simple veins.

It cannot be doubted that these dentate pinnules are formed by a reduction of the tissue of the limb through the development of a copious fructification. Were the upper portion of this specimen separated from the lower part, the upper would, without doubt, be labelled *Pecopteris plumosa*, whilst the lower portion would be named *Sphenopteris crenata* by those who regard these two as distinct species. The rachis is roughened by the customary little points.

Pl. III. figs. 11, 11*a*, and 11*b*.

From Shropshire. Middle Coal Measures. (Exact *Locality* and *Horizon* unknown.)

This fossil is the *Sphenopteris crenata*, L. and H. On the other hand, it approaches somewhat, in the small lobes of the long narrow pinnules, to the *Sphenopteris caudata* of the same authors (vol. i. pl. xlviii.).* The specimen is well preserved and shows the nervation in some of the pinnules. In the basal lobes the vein bifurcates, or the lobe has a central vein giving off lateral branchlets (fig. 11*b*). In the upper lobes the veins are simple (fig. 11*a*). The specimen exhibits the upper surface of the frond, and shows no indication of bearing sporangia, though the form of the pinnules is that which is frequently associated with fructification in this species.

The basal pinnæ have six or seven pairs of rounded lobes and a long tapering blunt apical lobe (fig. 11*a*), but the upper pinnæ have only a few pairs of rounded lobes at their base, while the uppermost ones are entire.

Pl. III. figs. 12, 12*a*, and 12*b*.

From South Kirby Colliery, near Pontefract, Yorkshire. *Horizon*.—Barnsley Thick Coal. Middle Coal Measures.

* See also my fig. 3, pl. i.

This is one of those forms which stands intermediate in character between *Sphenopteris crenata*, L. and H., and *Pecopteris plumosa*, Artis, and which it is very difficult to refer to either one or the other, but, in its general aspect, it has perhaps a greater similarity to *Sphenopteris crenata*. The rachis is roughened with small points.

On the ultimate pinnæ the inferior basal pinnule is very small and composed of two lobes,—a larger subtriangular one, with a smaller lateral rounded lobe next to the main rachis. The basal superior pinnule is longer than the succeeding pinnules, and on the lower pinnæ bears several pairs of rounded lobes (fig. 12*b*). The corresponding pinnule on the upper pinnæ bears a few lobes at the base (fig. 12*a*). A central vein gives off lateral veinlets to each lobe.

Pl. II. fig. 14 $\times 28$.

From Monckton Main Colliery, near Barnsley, Yorkshire. *Horizon*.—Barnsley Thick Coal. Middle Coal Measures.

This figure shows a few *sporangia* magnified 28 times, from another specimen belonging to the *Sphenopteris crenata* form of the same species. This specimen shows how the *sporangia* are placed on the pinnules. Each of the small lobes had a row on each margin, the *sporangia* lying at right angles to the midrib. Thus, in fig. 14, the central vein ran between the two rows marked *a'* and *a''*, but most probably the *sporangia* were placed on lateral veinlets, which sprang from this central vein, and which have now disappeared. I think this is shown from the nervation preserved in figs. 11*a* and 11*b*, pl. iii.

The *sporangia* drawn show some groups from which all trace of the limb has been removed, and which have probably adhered to the counterpart of the block containing the fossil, thus leaving only the *sporangia* attached to the matrix of the specimen in my possession.

The *sporangia*, which are beautifully preserved and show well the cell structure, are oval in form, and measure on an average about 0.50 mm. in length. They are absolutely devoid of all trace of an annulus. Had an annulus been present even in a most rudimentary form, from the excellent state of preservation of the *sporangia* on this and on several other examples in my possession, it could not have escaped observation.

The *sporangia* on all my specimens are more oval than those described by ZEILLER in the *Flore foss. Bassin houil. de Valenciennes*, pl. xxvi. fig. 2, and in the *Ann. d. Scienc. Nat.*, 6^e sér. 'Bot.', vol. xvi. pl. ix. figs. 12–15, 1883, but they agree in form with those of his *Dactylothea dentata*, var. *obscura*.^{*} The general character of Zeiller's fig. 2, pl. ii.,^{*} in the copious manner in which the *sporangia* have been produced and the absence of the limb, shows a great resemblance to such specimens as those figured on my pl. ii. figs. 5, 7, and 14.

Pl. II. figs. 9, 9*a*, 9*b*, and 9*c*.

From Monckton Main Colliery, near Barnsley, Yorkshire. *Horizon*.—Barnsley Thick Coal. Middle Coal Measures.

^{*} *Flore foss. Bassin houil. et perm. de Brive*, p. 26, pl. ii. figs. 2, 2*a*, 2*b*, and 2*c*.

This example shows the arrangement of the sporangia on the pinnules. In this specimen the pinnules are oblong, obtuse, and entire, and placed close to each other. The nervation is obscure, but apparently the lateral veins have bifurcated, and each arm has borne a sporangium (figs. 9*a* and 9*b*). On these smaller pinnules the sporangia occupy the whole space between the midrib of the pinnule and its margin, and were parallel with the course of the lateral veinlets—in fact, were placed on them.

The sporangia are oval, but the apex is slightly more pointed than the base. They measure about 60 μ m. long. Their walls are composed of elongated coriaceous cells without any indication of an annulus. Fig. 9*c* shows a sporangium magnified 25 times.

Pl. II. figs. 8 and 8*a*.

From the same *Locality* and *Horizon* as the last.

This small specimen shows the barren condition of the form usually associated with the name of *Pecopteris dentata*, Brongt., and is similar to that given by ZEILLER in his *Flore foss. Bassin houil. d. Valenciennes.*, pl. xxvi. fig. 1. The basal inferior pinnule is small and lobed, and occupies the angle formed by the union of the rachis with the parent stem. The superior basal pinnule is, on the other hand, the largest on the pinna. The nervation is not well shown, and seems to be immersed in the tissue of the pinnule. The rachis is rough.

SPECIMENS FROM COOPER'S COLLIERY, WORSBOROUGH, NEAR BARNSELY, YORKSHIRE.

Horizon.—Barnsley Thick Coal. Middle Coal Measures (Reg. Nos. 2093–2100).

These specimens occur on a light grey coloured shale, but are not so well preserved as those already described. They exhibit a slightly larger form of the plant, and the sporangia are slightly longer and proportionally narrower than those shown in my figures. They are not, however, so sharply pointed as those given by ZEILLER in the original description of his genus *Dactylothea*. It was upon these differences that I presumed that *Pecopteris plumosa* might be specifically distinct from *Pecopteris dentata*, but I have since seen that what I thought might prove a distinguishing character does not hold, as these slight variations in the size and form of the sporangia appear to depend on the position of the pinnules and pinnae on the frond on which the sporangia occur.

DISTRIBUTION IN BRITAIN.

Dactylothea plumosa occurs in the Upper, Middle, and Lower Coal Measures. It attained its maximum period of development in the Upper Coal Measures, and though less frequent in the Middle Coal Measures it is still comparatively common. In the Lower Coal Measures, however, it has all but disappeared, and from this division I only know of four specimens, two of which are those figured by LINDLEY and HUTTON,—one as *Sphenop-*

teris crenata (pl. xxxix.), and the other as *Sphenopteris caudata* (pl. xlvi.). The two remaining Lower Coal Measure examples are one from Fife and the other from the Potteries Coal Field, North Staffordshire (Pl. I. fig. 3.)

SCOTLAND.

Lower Coal Measures.

Fife :—

Locality.—East Wemyss. (*Forma crenata.*) (J. Kirkby.)

Horizon.—Lower Coxtool Coal.

ENGLAND.

Upper Coal Measures.

Somersetshire :—*

Localities.—Kilmersden Pit, near Radstock.

Braysdown Colliery, near Radstock.

Tynning Pit, Radstock.

Wellsway Pit, Radstock.

Upper Conygre Pit, Timsbury.

Lower Conygre Pit, Timsbury.

Old and New Pits, Camerton.

Horizon.—Radstock Series.

Middle Coal Measures.

Lancashire :—

Locality.—St Helens. (Rev. H. H. Higgins.)

Horizon.—Ravenhead Coals.

Locality.—Dixon Fold, Stoneclough, near Manchester. (J. W. Croston.)

Horizon.—A little above Doe Mine.

Locality.—Ashton, near Manchester. (Brongniart.)

Horizon.—(?).

Locality.—Oldham. (Brongniart.)

Horizon.—(?).

Locality.—Worsley.

Horizon.—Bassey Mine. (28 yds. above Ramshorn Mine.)

Locality.—Oldham Edge, Oldham. (J. Nield.)

Horizon.—“Forest bed.” (16 yds. below Hollingworth Mine of Oldham.)

Derbyshire :—

Locality.—Claycross. (Rev. J. M. Mello.)

Horizon.—(?).

* The *forma dentata* is much more common than any other in the Upper Coal Measures.

South Staffordshire. (Dudley Coal Field):—

Locality.—Doulton's Marl Pit, Netherton, near Dudley. (H. W. Hughes.)

Horizon.—Blue Measures. (6 ft. above Fire Clay Coal.)

Locality.—Russell's Hall, Dudley. (H. W. Hughes.)

Horizon.—Roof of Fire Clay Coal.

Yorkshire :—

Localities.—Monckton Main Colliery, near Barnsley. (*Type and forma dentata*.) (W. Hemingway.)

East Gawber Colliery, near Barnsley. (*Type and forma dentata and crenata*.) (W. Hemingway.)

Woolley Colliery, Darton, near Barnsley. (*Type and forma crenata*.) (W. Hemingway.)

Elsecar, Wentworth. (Type of Artis.)

Horizon.—Barnsley Thick Coal.

South Kirby Colliery, near Pontefract. (*Forma dentata and type*.) (W. Hemingway.)

Horizon.—Barnsley Thick Coal.

Locality.—Cooper's Colliery, Worsborough, near Barnsley. (W. Hemingway.)

Horizon.—Rock over Barnsley Thick Coal.

Locality.—Wheatley Wood Colliery, near Barnsley. (W. Hemingway.) (*Forma crenata*.)

Horizon.—Winter Coal.

Worcestershire :—*

Localities.—Railway Cutting, immediately west of Dowles, Railway Bridge, Forest of Wyre. (T. C. Cantrill.)

Horizon.—(?).

Cooper's Mill, Dowles Valley, Forest of Wyre. (T. C. Cantrill.)

Horizon.—(?).

Lower Coal Measures.

Durham :—

Localities.—Jarrow Colliery. (Type of *Sph. crenata*, L. and H., pl. xxxix., also of *Pec. caudata*, L. and H., pl. xlviii.).†

Horizon.—Bensham Seam.

North Staffordshire (Potteries Coal Field):—

Localities.—Adderley Green, near Longton. (*Forma caudata*.) (J. Ward.)

Horizon.—Below the New Mine Coal.

* I have also seen the *crenata* form from the Forest of Wyre, but do not know the exact locality from which the specimen was collected.

† Note.—The other specimens of *Sphenopteris crenata*, L. and H. (pls. c.-ci.), came from the Whitehaven Coal Field, but I have hitherto been unable to visit this Coal Field, so can express no opinion as to their age.

EXPLANATION OF PLATES.

PLATE I.

Fig. 1. *Dactylothea plumosa* Artis, sp. (*Typical form*). Loc. Monckton Main Colliery, near Barnsley, Yorkshire. Hor. Barnsley Thick Coal. Middle Coal Measures. Natural size. W. HEMINGWAY, Collector. Reg. No. 2107. See p. 213.

Fig. 1a. Two pinnules, $\times 4$.

Fig. 2. *Dactylothea plumosa*, Artis, sp. (*Pecopteris dentata*, Brongt.). Loc. Monckton Main Colliery, near Barnsley, Yorkshire. Hor. Barnsley Thick Coal. Middle Coal Measures. Natural size. W. HEMINGWAY, Collector. Reg. No. 2112. See p. 214.

Fig. 2a and 2b. Pinnules, $\times 4$.

Fig. 3. *Dactylothea plumosa*, Artis, sp. (*Pecopteris caudata*, L. and H.). Loc. Adderley Green, near Longton, Staffordshire. Hor. Below New Mine Coal.—The uppermost seam in the Lower Coal Measures. Natural size. J. WARD, Collector. Reg. No. 357. See p. 214.

Fig. 3a. Pinnule, $\times 4$.

Fig. 4. *Dactylothea plumosa*, Artis, sp. Loc. Monckton Main Colliery, near Barnsley, Yorkshire. Hor. Shale over Barnsley Thick Coal. Middle Coal Measures. Natural size. W. HEMINGWAY, Collector. Reg. No. 2111. See p. 214.

Fig. 4a. Portion of pinna, $\times 4$.

PLATE II.

Fig. 5. *Dactylothea plumosa*, Artis, sp. (*Sphenopteris crenata*, L. and H.). Fruiting specimen. Loc. Woolley Colliery, Darton, near Barnsley, Yorkshire. Hor. Barnsley Thick Coal. Middle Coal Measures. Natural size. W. HEMINGWAY, Collector. Reg. No. 1215. See p. 215.

Fig. 5a. Pinnule, $\times 4$.

Fig. 5b. Sporangium, $\times 26$.

Fig. 6. *Dactylothea plumosa*, Artis, sp. Circinately coiled up specimen showing the *Aphlebia*. (*Schizopteris adnascens*, L. and H.). Loc. Monckton Main Colliery, near Barnsley, Yorkshire. Hor. Barnsley Thick Coal. Middle Coal Measures. Natural size. W. HEMINGWAY, Collector. Reg. No. 1212. See p. 216.

Fig. 7. *Dactylothea plumosa*, Artis, sp. (*Sphenopteris crenata*, L. and H., and *Schizopteris adnascens*, L. and H.). Portion of a large specimen showing the *Aphlebia* attached to the rachis at the point of insertion of the pinnae. Loc. Monckton Main Colliery, near Barnsley, Yorkshire. Hor. Barnsley Main Coal. Middle Coal Measures. Natural size. W. HEMINGWAY, Collector. Reg. No. 1210. See p. 216.

Fig. 8. *Dactylothea plumosa*, Artis, sp. Loc. Monckton Main Colliery, near Barnsley, Yorkshire. Hor. Barnsley Thick Coal. Middle Coal Measures. Natural size. W. HEMINGWAY, Collector. Reg. No. 2105. See p. 219.

Fig. 9. *Dactylothea plumosa*, Artis, sp. Fruiting specimen. Loc. Monckton Main Colliery, near Barnsley, Yorkshire. Hor. Barnsley Thick Coal. Middle Coal Measures. Natural size. W. HEMINGWAY, Collector. Reg. No. 2088. See p. 218.

Fig. 9a. Two pinnules, showing the arrangement of the sporangia.

Fig. 9b. Another pinnule, showing the sporangia.

Fig. 9c. A sporangium, $\times 25$.

Fig. 14. *Dactylothea plumosa*, Artis, sp. Sporangia, $\times 28$ from another specimen which shows the *Aphlebia* attached to the rachis. Loc. Monckton Main Colliery, near Barnsley, Yorkshire. Hor. Barnsley Thick Coal. Middle Coal Measures. W. HEMINGWAY, Collector. Reg. No. 2092. See p. 218.

PLATE III.

Fig. 10. *Dactylothea plumosa*, Artis, sp. *Aphlebia* (*Schizopteris adnascens*, L. and H.). Loc. Near Barnsley, Yorkshire. Hor. Barnsley Thick Coal. Middle Coal Measures. Natural size. W. HEMINGWAY, Collector. Reg. No. 2110. See p. 216.

Fig. 11. *Dactylothea plumosa*, Artis, sp. (*Sphenopteris crenata*, L. and H.). Loc. Shropshire. Hor. Middle Coal Measures. Natural size. Reg. No. 966. See p. 217.

Fig. 11a. Ultimate pinna, $\times 4$.

Fig. 11b. Two pinnules, showing nervation more highly enlarged.

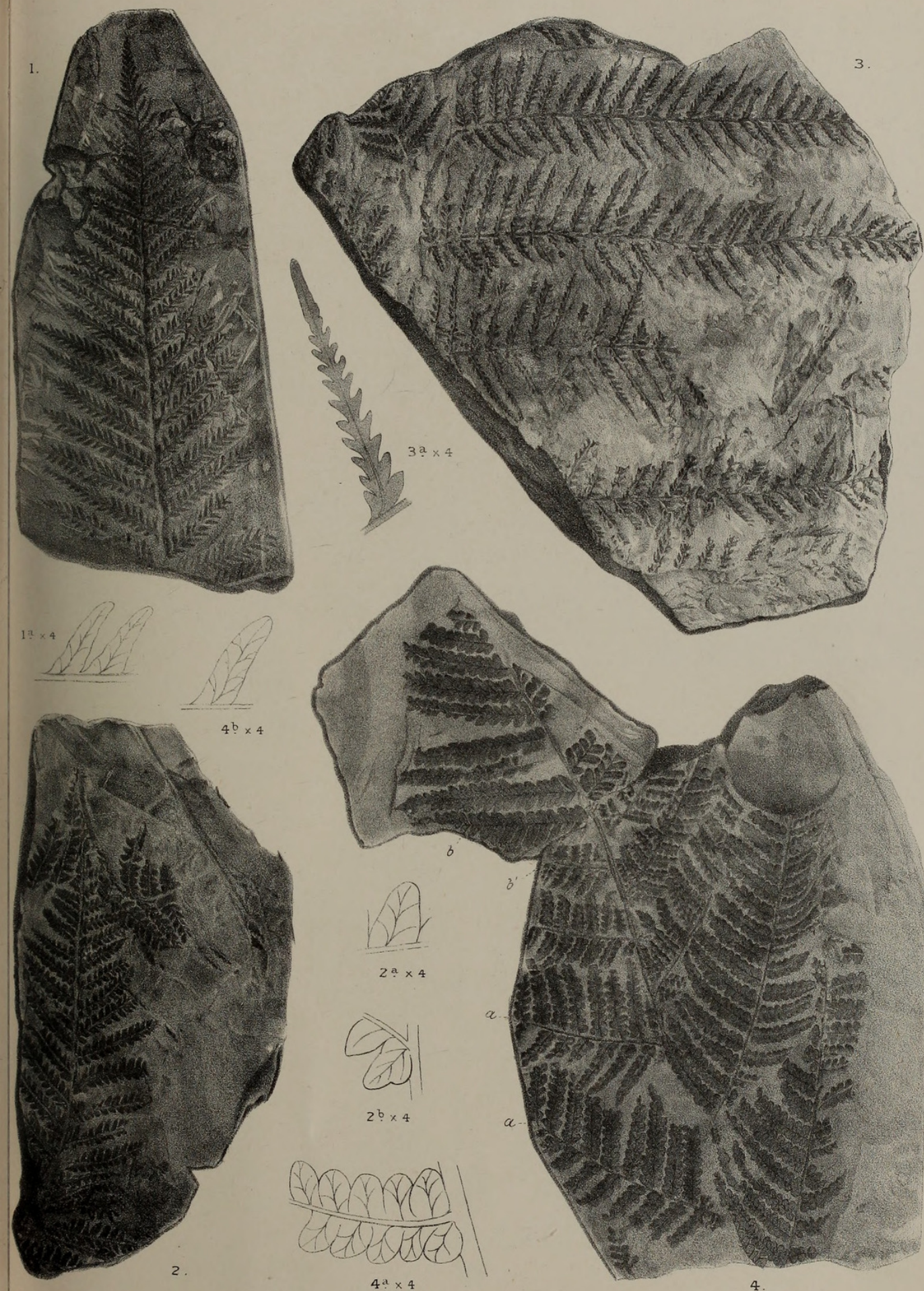
Fig. 12. *Dactylothea plumosa*, Artis, sp. (Approaching the form named *Sphenopteris crenata*, L. and H.). Loc. South Kirby Colliery, near Pontefract, Yorkshire. Hor. Barnsley Thick Coal. Middle Coal Measures. Natural size. W. HEMINGWAY, Collector. Reg. No. 2109. See p. 217.

Fig. 13. *Dactylothea plumosa*, Artis, sp. Portion of a specimen, showing the organic union of typical "*Filicites plumosus*, Artis," and *Sphenopteris crenata*, L. and H. Loc. Monckton Main Colliery, near Barnsley, Yorkshire. Hor. Barnsley Thick Coal. Middle Coal Measures. Natural size. W. HEMINGWAY, Collector. Reg. No. 2101. See p. 217.

Fig. 13a. Two pinnules from the upper portion of the specimen corresponding to the "*Filicites plumosus*, Artis," $\times 4$.

Figs. 13b and c. Two pinnules from a lower part of the specimen corresponding to the *Sphenopteris crenata*, L. and H.

Note.—All the figured specimens are in the author's collection.





KIDSTON, ON THE FOSSIL FLORA OF THE YORKSHIRE COAL FIELD. Pl. II.



Kidston.

DACTYLOTHECA PLUMOSA, Artis sp.

F. Huth. Lith^r Edin^r



KIDSTON, ON THE FOSSIL FLORA OF THE YORKSHIRE COAL FIELD. Pl. III.



DACTYLOTHECA PLUMOSA, Artis sp.





Kidston, Robert. 1896. "On the fossil flora of the Yorkshire coal field, first paper." *Transactions of the Royal Society of Edinburgh* 38(5), 203–224.

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