ON THE FOSSIL FLORA OF THE SOUTHERN PORTION OF THE YORKSHIRE COALFIELD.

Part II.—NORTH DERBYSHIRE.

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(Read November 26th, 1919).

In a previous paper, published by this Society some ten years ago,† I described the fossil flora of the Middle and Lower Coal Measures in the extreme south of the Yorkshire Coalfield in Nottinghamshire and Derbyshire. In the present paper an account is given of the Middle Coal Measure flora of a region in Derbyshire further to the North, but lying to the South of Chesterfield. This district appears to be a comparatively poor collecting ground for fossil plants, with the exception of two pits at Temple Normanton—Bond's Main and Grassmoor Collieries—which in recent years have become well known on account of the excellence of their fossil floras. It is with the plants collected at these localities that the present paper is concerned.

Two lists of species occurring at Bond's Main have been already published by Horwood‡ and by Dr. Moysey.§ and the former has also added a short list from Grassmoor Colliery. Further collections from both these localities, which are now in the Sedgwick Museum, Cambridge, were formed some years ago, partly by the Author and partly by Mr. I. Rogers. They include a number of species not hitherto recorded, as well as examples of many of the plants instanced by Horwood or Moysey or both observers.

The horizon|| of the plants in question is the roof of the Silkstone seam or between the Deep Hard and the Silkstone coals. The Silkstone

* [Owing to the author's death before this paper was revised, the responsibility for any errors which it may contain rests with me. I have to acknowledge a grant from the Royal Society in aid of the preparation of this and other memoirs left by my husband in various stages of completion.—AGNES ARBER.]

† Arber (1910).

‡ Horwood (1912).

§ Moysey (1913).

|| [A later note by Dr. Arber indicates that he regarded the horizon as representing the dividing line between the Middle and Lower Coal Measures.—A. A.]

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seam occupies a considerably lower position in the Middle Coal Measures than the Top Hard and Barnsley Thick Coal from which were derived the greater number of previous determinations from this field, both in Yorkshire itself and from the southern extremity in Nottinghamshire and Derbyshire.

The following is a list of the new records :—

NAME.	Bond's Main Pits.	Grassmoor Pits.
EQUISETALES.		
<i>Calamites ramosus</i> Art.	X.	...
<i>Calamophloios verticillatus</i> (L. & H.)	X.	...
FILICALES AND PTERIDOSPERMEÆ.		
<i>Sphenopteris Potieri</i> Zeill.	X.	...
<i>S. Laurenti</i> Andrä	X.	X.
<i>S. (Zeilleria) avoldensis</i> Stur	X.	...
<i>S. (Zeilleria) delicatula</i> Sternb.	...	X.
LYCOPODIALES.		
<i>Lepidodendron lycopodioides</i> Sternb.	...	X.
<i>Sigillaria principis</i> Weiss	X.	...
<i>S. elongata</i> Brongn.	X.	...
<i>S. discophora</i> Kidst.	...	X.
<i>Lepidophloios laricinus</i> Sternb.	...	X.
CORDAITALES.		
<i>Cordaites principalis</i> (Germar)	...	X.

The following is a complete list of the species now known from Bond's Main and Grassmoor Collieries, and may be regarded as an example of the flora of the lower part of the Middle Coal Measures of the Yorkshire field.

NAME.	Authority. (*)	Bond's Main Pits.	Grassmoor Pits.
EQUISETALES.			
<i>Calamites ramosus</i> Art.	A.	X.	...
<i>C. undulatus</i> Sternb.	A.M.H.	X.	...
<i>Calamophloios verticillatus</i> (L. & H.)	A.	X.	...
<i>Annularia radiata</i> (Brongn.)	A.M.H.	X.	...
<i>Calamocladus charaeformis</i> (Sternb.)	A.M.	X.	...
<i>Pinnularia columnaris</i> (Art.)	M.	X.	...

* "A" indicates that this plant is recorded by the Author
"H" by Mr. Horwood; "M" by Dr. Moysey.

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NAME.	Authority. (*)	Bond's Main Pits.	Grassmoor Pits.
SPHENOPHYLLALES.			
<i>Sphenophyllum cuneifolium</i> (Sternb.) ...	A.M.	X.	...
<i>S. cuneifolium</i> var. <i>saxifragae folium</i> Stb.)	A.	X.	...
FILICALES AND PTERIDOSPERMEÆ.			
<i>Sphenopteris Potieri</i> Zeill. ...	A.	X.	...
<i>S. furcata</i> Brongn. ...	A.M.	X.	...
<i>S. Laurenti</i> Andrä ...	A.	X.	X.
<i>S. flexuosissima</i> (Stur) ...	M.	X.	...
<i>S. (Corynepteris) Sternbergi</i> (Ett.) ...	A.M.	X.	...
<i>S. (Zeilleria) avoldensis</i> Stur. ...	A.	X.	...
<i>S. (Zeilleria) delicatula</i> Sternb. ...	A.	?	?
<i>Neuropteris heterophylla</i> Brongn. ...	A.M.H.	X.	X.
<i>N. tenuifolia</i> (Schloth.) ...	H.	X.	...
<i>N. obliqua</i> Brongn. ...	A.M.H.	X.	X.
<i>N. obliqua</i> forma <i>impar</i> (Weiss) ...	M.	X.	...
<i>Alethopteris valida</i> Boul. ...	A.H.	...	X.
<i>Mariopteris muricata</i> (Schl.) ...	A.M.	X.	X.
<i>Pecopteris Miltoni</i> (Art.) ...	A.M.H.	X.	X.
<i>P. (Dactylothea) plumosa</i> (Art.) ...	A.M.H.	X.	...
<i>Rhacophyllum crispum</i> var. <i>lineare</i> (Gtb.)	A.M.H.	X.	...
LYCOPODIALES.			
<i>Lepidodendron obovatum</i> Sternb. ...	A.H.	X.	X.
<i>L. aculeatum</i> Sternb. ...	M.	X.	...
<i>L. lycopodioides</i> Sternb. ...	A.	X.	X.
<i>L. ophiurus</i> Brongn. ...	M.H.	X.	...
<i>L. simile</i> Kidst. ...	M.	X.	...
<i>Lepidophloios laricinus</i> Sternb. ...	A.M.	X.	X.
<i>Bothrodendron minutifolium</i> (Boul.) ...	M.H.	X.	X.
<i>Sigillaria principis</i> Weiss. ...	A.	X.	...
<i>S. scutellata</i> Brongn. ...	A.H.	X.	...
<i>S. elegans</i> (? Sternb.) ...	A.M.	X.	X.
<i>S. elongata</i> Brongn. ...	A.	X.	...
<i>S. mamillaris</i> Brongn. ...	A.H.	X.	X.
<i>S. tessellata</i> (Steinh.) ...	M.	X.	...
<i>S. discophora</i> Kidst. ...	A.	...	X.
<i>S. tenuis</i> Achepohl ...	H.	...	X.
<i>S. ovata</i> Sauveur ...	M.	X.	...
<i>Lepidophyllum majus</i> Brongn. ...	M.H.	X.	X.
<i>L. lanceolatum</i> L. & H. ...	H.	...	X.
<i>Sigillariostrobus rhombibracteatus</i> (Kidst.)	H.	X.	...
CORDAITALES.			
<i>Cordaites principalis</i> (Germar) ...	A.	X.	...
<i>Artisia transversa</i> (Artis) ...	A.H.	...	X.
<i>Cordaianthus pitcairniae</i> (L. & H.) ...	A.H.	X.	X.

* "A" indicates that this plant is recorded by the Author:
 "H" by Mr. Horwood; "M" by Dr. Moysey.

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A representative collection of the species in the above list, recorded under the authority of the Author, is preserved in the Sedgwick Museum, Cambridge, Nos. 2741 to 2814 in the Carboniferous Plant Collection.

NOTES ON THE FIGURED SPECIMENS.

I append figures of some of the more interesting specimens recorded above, with some remarks upon them.

Calamophloios verticillatus (?) L. and H.

Plate XXXIX., Fig. 1 ($\frac{3}{4}$ nat. size.)

External surface of stem.

1893. *Calamitina verticillata*, Kidston, *Trans. Roy. Soc. Edinb.*, Vol. XXXVII., p. 311, pl. IV., fig. 18.

1911. *Calamites verticillatus* (pars), Jongmans, *Anleit Bestim. Karbonpfl. West-Europas.*, Vol. I., p. 61, fig. 67.

Pith-casts.

1835. *Calamites verticillatus*, Lindley and Hutton, *Foss. Flora*, Vol. II., pl. 139.

1886-88. *Calamophyllites verticillatus*, Zeiller, *Flore Foss. Bass. Houill. Valenciennes*, p. 360, pl. 57, fig. 2.

1910. *Calamites varians*, Renier, *Doc. Étude Pal. Ter. Houill.*, pl. 45.

1911. *Calamites verticillatus* (pars), Jongmans, *Anleit. Bestim. Karbonpfl. West-Europas*, Vol. I., pp. 61, 62, fig. 68.

I have recently instituted (*) the genus *Calamophloios* for the reception of specimens showing the external surface of Calamite stems as opposed to pith-casts. The specimen figured on pl. XXXIX., fig. 1, reduced in size, is an example of a rare Calamite stem showing the external surface. Several pith-casts, probably belonging to the same species, have been figured by Zeiller and Renier, and probably by Lindley and Hutton. The type of the authors last mentioned is, however, lost, but from the somewhat rough drawing which they give of it, one may conclude that the specimen was more probably a pith-cast than the external surface of a Calamite stem.

These stems belong to the *Calamitina* section of the genus, characterised by the periodic occurrence of branch scars. In this species

* Arber (1916), p. 140. See also Arber, E. A. N. and Lawfield, F. W., On the External Morphology of the Stems of *Calamites*, *Journal of the Linnean Society, Bot.* Vol. XLIV, 1920, pp. 507-530, pl. 23-25.

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the scars are very large and closely set, and the internodes are of unequal length. In the present specimen four large branch scars are seen above (*) a node. The internodes have well-marked longitudinal primary ridges, distant about 2 cm. from each other, and between these occur numerous faint and very slight secondary ridges, anastomosing with one another, and forming an elongate network. In this latter respect we have an interesting approach to the genus *Dictyocalamites* Arber (†), in which the surface reticulations are more prominent. The scar-bearing internode is about 9 cm. in length. The leaf-scars on the nodes are not clearly seen.

It is possible that the specimen which I have previously figured from Nottinghamshire (‡) may be allied to that under discussion here.

Sphenopteris Potieri Zeill.

Plate XXXIX., Figs. 2 and 3.

1886-88. *Sphenopteris Potieri*, Zeiller, *Flore Foss. Bass. Houill. Valenciennes*, p. 88, pl. 14, fig. 1.

The frond figured on pl. XXXIX., fig. 2, natural size, appears to me to be identical with Zeiller's *S. Potieri*, a very rare plant, apparently hitherto unknown from Britain, and one of which only one specimen seems to have been previously recorded. This species is characterised by the very prominent longitudinal ridges on the rachises of all orders, by the broad lobes of the pinnules with undulating but not toothed margins, and the strong "tuning fork" lateral nervation. The latter is seen in part of a pinnule enlarged three times on plate XXXIX., fig. 3.

Sphenopteris Laurenti Andrä.

Plate XL., Fig. 2.

1865. *Sphenopteris Laurentii*, Andrä, *Vorweltliche Pflanzen*, p. 39, pl. 13, figs. 1-3.

1865. *Sphenopteris stipulata*, Andrä, *ibid.*, p. 40, pl. 13, fig. 4.

1868. *Sphenopteris stipulata*, (von Gutbier), Roehl, *Palaeontogr.*, Vol. XVIII., p. 58, pl. 16, fig. 6A.

* Fig. 1, Pl. XXXIX is reversed, so that the branch scars appear to lie *below* the node. A.A.

† Arber (1912), p. 97. See also Arber and Lawfield, *l.c.*

‡ Arber (1910). *Proc. Yorks. Geol. Soc.*, Vol. XVII., p. 144, pl. XIII., figs. 1 and 2.

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1885. *Haplopteris Laurentii*, Stur, *Abhandl. K. K. Geol. Reichs. Wien*, Vol. XI., p. 36, pl. 44, figs. 5-6.
 1886-88. *Sphenopteris Laurenti*, Zeiller, *Flore Foss. Bass. Houill. Valenciennes*, p. 85, pl. 6, fig. 3; pl. 9, fig. 4.
 1899. *Sphenopteris (Renaultia) Laurenti*, Zeiller, *Mém. Soc. Géol. France (Pal. Mém.)*, VIII., 21, p. 16, pl. 1, fig. 16.
 1909. *Sphenopteris Laurenti*, Behrend in Potonié, *Abbild. und Beschr. Foss. Pflanz.*, Lief. VI., No. 105.
 1910. *Sphenopteris Laurenti*, Renier, *Doc. Étude Pal. Terr. Houill.* pl. 65.
 1912. *Sphenopteris Laurenti*, Vernon, *Quart. Journ. Geol. Soc.*, Vol. 68, p. 620, pl. 57, fig. 2; pl. 59, fig. 7.
 1913. *Sphenopteris (? Renaultia) Laurenti*, Gothan, *Abhandl. k. Preuss. Geol. Landesanst.*, N. F. Heft 75, p. 134, pl. 17, fig. 3.

This species, which is not very abundant in Britain, is one of the most easily recognised members of the genus. The pinnules are small, distant from one another, the lobes being relatively broad, the margins usually undulating, or slightly crenate, and the lateral nerves very distant from one another, with a few very wide dichotomies.

Neuropteris obliqua Brongn.

Plate XLI, Figs. 1, 2, 3.

1832. *Pecopteris obliqua*, Brongniart, *Hist. Végét. Foss.*, p. 320, pl. 96, fig. 1-4.
 1837 ? *Neuropteris heterophylla*, Lindley and Hutton, *Foss. Flora*, Vol. III., p. 90, pl. 183.
 1882. *Odontopteris binervosa*, Achepohl, *Niederrh.-Westfäl. Steinkohlengebirge, Essen und Leipzig*, Lief. 7, p. 118, pl. 36, fig. 5.
 1886-88 ? *Neuropteris obliqua*, Zeiller, *Flore Foss. Bass. Houill. Valenciennes*, p. 284, pl. 48, figs. 1, 2 (? fig. 3), figs. 4-7.
 1886-88. *Neuropteris acuminata*, Zeiller, *ibid.*, p. 255, pl. 41, fig. 4.
 1893. *Neurodontopteris impar*, Potonié, *Jahrb. k. Preuss. Geol. Landesanst. für 1892*, p. 1, pl. 1, figs. 1, 2, 4.
 1906. *Neurodontopteris obliqua*, Gothan in Potonié, *Abbild. und Beschr. Foss. Pflanzen.*, Lief. IV., No. 68, text figs. 2 (B), 4, 5; pl. 1B.
 1907. ?*Mixoneura obliqua*, Zalessky, *Bull. Com. Géol. St.-Pétersbourg*, No. 134. Vol. XXVI., p. 404, pl. 15, figs. 11, 12 and 16.

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1907. *Mixoneura obliqua*, Zalessky, *ibid.*, No. 135, Vol. 26, p. 479, pl. 19, figs. 1-10.
 1911. *Neuropteris impar*, Kidston, *Mém. Mus. R. Hist. Nat. Belgique*. Vol. IV., p. 83, pl. VIII., figs. 1, 2, 3 and 3A.
 1913. ? *Neuropteris obliqua*, Gothan, *Abhandl. k. Preuss Geol. Landesanst.*, N. F. Heft 75, p. 207, ?pl. 50, fig. 5.

Neuropteris obliqua is a plant of very variable habit, wide variations occurring in the size, shape and insertion of the pinnules in different parts of the same frond. The pinnæ of this species occurring at Bond's Main are the small-pinnuled forms, which in my experience are very rare in Britain. The minor pinnules of this plant were first figured by Brongniart, and there can be no doubt that the examples illustrated here on plate XLI., figs. 1, 2 and 3, are identical with the continental specimens described by Brongniart, and by others more recently.

In these pinnæ the higher pinnules are oblong, attached by their whole base, decurrent, and the nervation arises directly from the rachis, there being no true median nerve.

In these characters these pinnules agree remarkably with members of the genus *Odontopteris*. But the pinnules situated lower on the rachis tend to become Neuropteroid, being more oval in form, contracted at the base to a point of attachment and not decurrent. These pinnules also possess a more distinct median nerve. The larger or major pinnules of the same plant, which, however, have not been found at Bond's Main, are also more Neuropteroid than Odontopteroid, hence the species is retained in the genus *Neuropteris*.

The specimen figured in Plate XLI., fig. 2, shows a pinna composed of small pinnules, part of which is seen enlarged on fig. 3 of the same plate. An enlarged view of the nervation of another specimen is shown on fig. 1.

There is also a more common British plant which I believe has often been mistaken for *N. obliqua*, but which I think is a distinct type. I have figured examples of this from Kent* and from Cumberland,† and I regard the frond to which Kidston and Jongmans‡ have attributed a large seed as another specimen of the same plant, which I propose shortly to redescribe under a new specific name.

* Arber (1909), p. 26, pl. I., fig. 3.

† Arber (1903), p. 4, pl. I., fig. 2.

‡ Kidston and Jongmans (1912), p. 25, pl. (unnumbered), fig. 3.

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Stigmaria ficoides Sternb.

Plate XL., Fig. 1, and Plate XLI., Fig. 4.

1902. *Stigmaria ficoides*, Kidston, *Proc. Yorks. Geol. and Polyt. Soc.*, Vol. XIV., pt. III., p. 357, pl. 52, fig. 3.

1911. *Stigmaria ficoides*, Kidston, *Mém. Mus. R. Hist. Nat. Belgique*, Vol. IV., p. 212 (contains a full synonymy).

The specimen figured on Plate XL., fig. 1, and enlarged on Plate XLI., fig. 4, represents a very rare state of preservation of this very common fossil plant, of which casts of the external surface are the most abundant of plant remains in the Coal Measures. The specimen consists of a longitudinal impression of the woody cylinder seen in tangential section.

The transversely oblong areas, seen especially at the sides of the specimen, are the woody bundles frequently anastomosing with one another, and in many cases broken off short, since the plane of the impression does not coincide with the planes of the bundles. In the enlarged figure (plate XLI., fig. 4), these oblong areas are seen to possess a delicate but distinct and close ribbing. These ribs are, of course, the impressions of the tracheids themselves.

Kidston (see above) has figured a similar specimen from Lanarkshire, which, however, has split along a radial plane, and shows a cast of the pith cavity. In the present case the pith cast lies behind the impression of the woody bundles figured here.

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EXPLANATION OF THE PLATES.

(All the figures are from specimens from above the Silkstone Coal Bond's Main Colliery, Temple Normanton, Derby, now in the Carboniferous Plant Collection, Sedgwick Museum, Cambridge; the numbers following the specific names are the numbers allotted to them in that Collection. All the figures are from photographs by Mr. W. Tams, Cambridge).

Plate XXXIX.

- Fig. 1.—*Calamophloios verticillatus* (L. & H.), No. 2741, $\times \frac{3}{4}$. [This figure is upside down].
- Fig. 2.—*Sphenopteris Potieri* (?) Zeill., No. 2766, natural size.
- Fig. 3.—*Sphenopteris Potieri* (?) Zeill., No. 2770, $\times 3$.

Plate XL.

- Fig. 1.—*Stigmaria ficoïdes* Sternb., No. 2745, natural size. See also Pl. XLI., Fig. 4.
- Fig. 2.—*Sphenopteris Lauren'i* Andrä, No. 2779, natural size.

Plate XLI.

- Fig. 1.—*Neuropteris obliqua* Brongn., No. 2798, $\times 2\frac{1}{2}$.
- Fig. 2.—*Neuropteris obliqua* Brongn., No. 2793, natural size.
- Fig. 3.—*Neuropteris obliqua* Brongn., No. 2793, $\times 2\frac{1}{2}$.
- Fig. 4.—*Stigmaria ficoïdes* Sternb., No. 2745, $\times 3$. See also Pl. XL., Fig. 1.