

SVERIGES GEOLOGISKA UNDERSÖKNING

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HANS TRALAU

BOTANICAL INVESTIGATIONS IN THE
FOSSIL FLORA OF ERIKSDAL
IN FYLEDALEN, SCANIA



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Redaktör: Per H. Lundegårdh

DAVIDSONS BOKTRYCKERI AB, VÄXJÖ 1966

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I. ABSTRACT

Plant macrofossils from Mesozoic deposits at Eriksdal in the valley of Fyledalen, SE Scania, are described. The following taxa have been encountered: *Coniopteris hymenophylloides* (Brongniart) Seward, cf. *Eboracia lobifolia* (Philips) Thomas, *Baiera gracilis* Bunbury, *Ginkgoites Regnellii* spec. nov., *Allicospermum baierenum* spec. nov., *A. ginkgoideum* spec. nov., *Elatocladus* cf. *Johnstrupi* (Bartholin) emend. H. T., *Comites* spec., and *Pityophyllum* cf. *Lindströmi* Nathorst. Spores *in situ* have been gained from *Coniopteris hymenophylloides*. The flora is assumed as being consistent with an age between the Inferior Oolite, e. g. Bajocian, and the Oxfordian, being, perhaps, somewhat in favour of the Bajocian and Bathonian. There is striking resemblance between the present flora and that of Yorkshire.

II. INTRODUCTION

The raised coal-bearing sites of the Rödninge district in south-eastern Scania have been known from the literature since the middle of the 19th century, when Angelin (1859 and 1877) published his geological map of Scania. These deposits are situated between the Silurian and Keuper in the NE and the Cretaceous in the SW of the area. The first fossil plants of the region were found by Nathorst in 1876 in the valley of Nybroån near Kurremölla. He published his finds in 1880. Later Moberg in 1882 and 1888 mentioned a richer collection of fossil plants made by himself at Kurremölla and moreover made it clear that even the ferruginous sandstone at Rödalsberg, NW of Tosterup, contains plant fossils. Only a few years later Moberg (1893) mentioned the poorly preserved remains, which have been described as the Munka Tågarp Flora by Möller and Halle (1913). In 1938 and 1940 to 1941 the mining company Höganäs-bolaget, partly in cooperation with the Swedish Geological Survey, made two tunnels through the mainly sand and clay deposits at Eriksdal, which are owned by Fyleverken Co Ltd. Fossil plants "thrown out from the tunnel" ("material, utkört från orten", according to S. Nilsson's preliminary manuscript report, p. 4) were collected by S. Nilsson on this occasion. In a

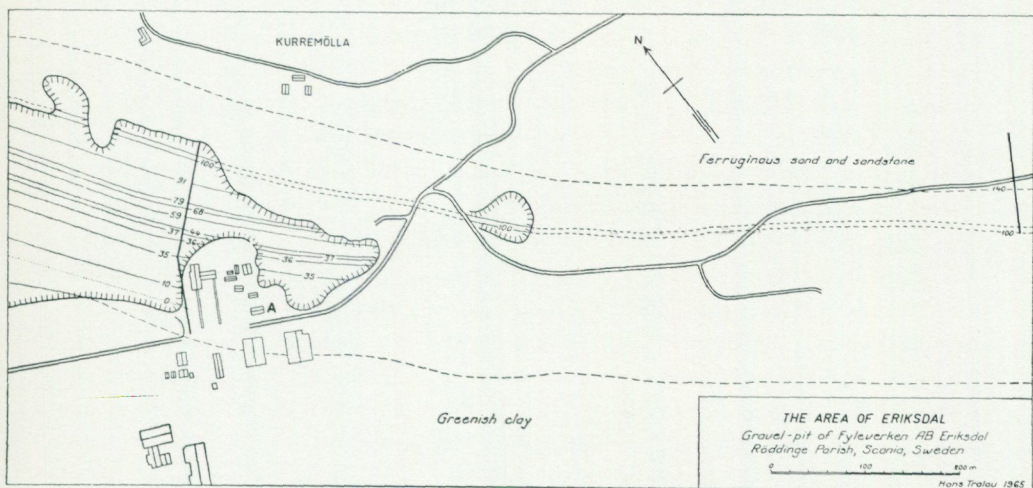


Fig. 1: Dimensions of the gravel pit of AB Fyleverken in Eriksdal, Scania, showing the exposure of strata in 1965 according to the enumeration in fig. 2. The administration building of AB Fyleverken is marked with A. (The map has been established with the aid of Mr. P.-O. Persson, mining engineer at AB FYLEVERKEN, Eriksdal.)

short manuscript he listed the plant species found, but was fully aware of the limitation in this method of investigation.

För närvarande sammanför jag hela materialet från Fyleverkens sandtag till en enda flora, kallad Eriksdalsfloran, härstammande från en 40 m mäktig lagerserie, vari dock en äldre och en yngre horisont möjligen kunna urskiljas. Fossilistorna från de båda horisonterna visa rätt stora olikheter och bland växtfossilerna från ortens inre finnas måhända flera med äldre prägel än bland dem från stora kaolinbandet, varför det är möjligt att man vid fortsatt undersökning måste skilja horisonterna åt. (S. Nilsson, Rapport angående resultaten av den preliminära bestämningen av växtfossil från Fyledalen, Stockholm 1941, p. 10.)

Even during later collection, i. e. those made by H. Horn af Rantzien in August 1956, no regard was paid to the exact position of the fossiliferous sites yielding plant fossils. Since 1961 the present author has been collecting several times at the place in question. Determinable plant remains have chiefly been gained from the lowermost part of layer no 36 (see fig. 1) i. e. within one and thirty cm stratum, lying directly upon the coal seam (layer no 37). The fossil ginkgophyte seed collected in December 1964 by Lektor Knud Jakobsen, Copenhagen, (see fig. 8) also originated from this layer, as was shown to the author by Lektor Jakobsen on June 11th, 1965, during a collecting trip to Eriksdal.

As to the age of the deposits under consideration the oldest, the so called Munka Tågarp Flora, is assumed to be Rhaetic and because of the composition of its plant species, should be referred to the upper part of this formation, according to the point of view held by Möller and Halle (1913, p. 11). The Munka Tågarp Flora is represented by three species, one of which is doubtful. The following, younger flora of Rödalsberg from rustcoloured, fairly fine grained sandstone is, likewise, according to Möller and Halle (1913, p. 19), Rhaetic or Liassic in age, being perhaps somewhat in favour of the Rhaetic. This flora contains nine species, five of which are of questionable affinity. At a distance of about 200 m the Rödalsberg Flora is followed by a *Cardium*-bed, containing a rich marine fauna, which was dated by Moberg (1888, p. 80) as belonging to the lower part of the Middle Liassic (Lias γ). Upon this *Cardium*-bed, at varying distance of about 200 m, there first follows the unpublished fossil flora from the so called "Ekströms fossiliferous layers" (according to Nilsson's concept) which is succeeded by one of the most important fossil floras of the region, known as the Kurremölla Flora. This flora has been described by Halle and Möller (1913). However, Möller and Halle (1913, p. 41) are uncertain of the age of these layers, concluding that "it cannot be denied that the flora shows a closer relation to that of Wealden than to any other flora" and after having discussed the not fully reliable stratigraphic value of the plant fossils, they found that it "is quite possible therefore, that the plant bearing beds at Kurremölla belong to the Upper Jurassic". Eighteen plant taxa are recognized

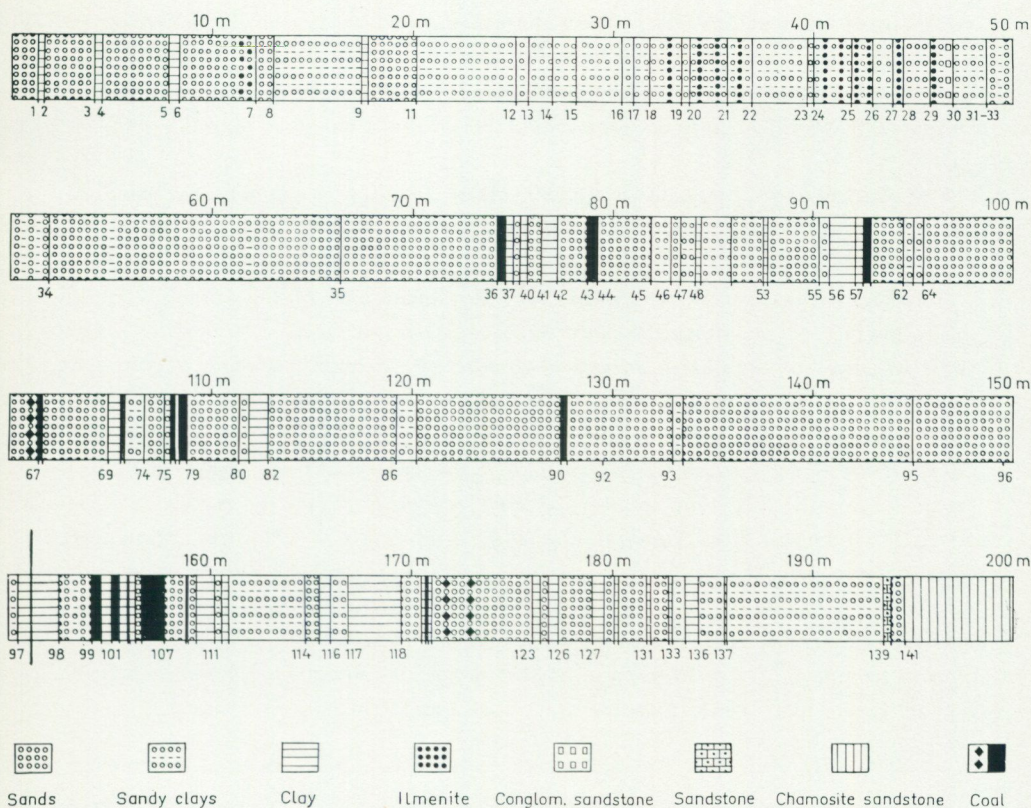


Fig. 2: Sequence of strata in the gravel pit of AB Fyleverken in Eriksdal, Scania. The strata are enumerated in descending succession (cf fig. 1). (Composed according to observations made during the years from 1961 to 1965 and partly according to a sketch on measurements done in 1938 and 1940—41 by *S. Nilsson*, SVERIGES GEOLOGISKA UNDERSÖKNING.)

from this site; many of them, however, are not unquestionable, as pointed out by Möller and Halle. The Kurremölla Flora is succeeded by about 200 m of chiefly sand and clay deposits, from which the Eriksdal Flora originated. Here fossil plants are known from several strata. Plant remains of layer no 36 of this sequence shall be described below. On top of the Eriksdal deposits there follows a tremendous layer of greenish clay, which belongs to the Middle Purbeck according to Oertli, Brotzen and Bartenstein (1961). From evidence of Ostracodes present in the deposits of Denmark and NW Germany, Bruun Christensen considers the clay to be Upper Kimmeridgian and Lower Portlandian in age (private communication by Dr. Ole Bruun Christensen, October 12th, 1965 and Bruun Christensen in Larsen 1965). The Danish Geological Survey, moreover, has recently encountered this so called "Fyledal clay" also by cores from bores drilled in the Öresund between Helsingör and Hälsingborg (cf Larsen 1965).

The fossil flora of Eriksdal, collected from various layers within the gravel pit and in the tunnel, was referred to Malm by Nilsson (1941), because of the fact that "the Eriksdal's Flora is a mixed-up flora, composed of species characteristic for the Dogger and Wealden. Such a flora should reasonably belong to Malm".

Eriksdalsfloran är en blandflora, sammansatt av dogger- och wealden-arter. En sådan flora måste sannolikt tillhöra Malm (Nilsson 1941, p. 11).

A species list on specimens* gained from the "inner part of the tunnel" contains the following species: *Equisetites* nov. spec., *Marattiopsis* spec., "*Nathorstia*" (*Lacopteris*?) spec., *Coniopteris hymenophylloides* (Brongniart) Seward, *Coniopteris tatungensis* Sze, *Hausmannia* spec., *Clathropteris* or *Dictyophyllum*, *Sphenopteris* (*Ruffordia*) *göpperti* Dunker, *Ctenis* spec., *Nilssonia* spec. 1—3, *Sagenopteris* spec., *Ginkgoites* spec., *Podozamites* spec., and *Carpolithus* spec. 1—3. From the gravel pit he records the following species: *Coniopteris hymenophylloides* (Brongniart) Seward, *Onychiopsis* spec., *Cladophlebis* (*Eboracia*) *lobifolia* (Phillips) Brongniart, *Cladophlebis* spec. 1—3, *Nilssonia schauburgensis* (Dunker) *forma typica*, *N. schauburgensis* (Dunker) *forma fallax* (Nathorst), *Baiera furcata* (Lindley & Hutt.) F. Braun, *Baiera gracilis* Bunbury, *Ginkgoites sibirica* f. *pusilla* (Heer) Seward, *Ginkgoites* spec., *Elatocladus* spec., *Sphenolepis sternbergiana* (Dunker) Schenk, *Pityophyllum* spec. 1—2, *Pityospermum* spec., and *Carpolithus* spec. 2.

III. THE PLANT FOSSILS FROM LAYER NO 36

Since the year of 1961 the lower part of layer 36 yielded considerable quantities of fossil plants. In the lowest, very narrow portion of the layer the sand, locally strongly intermingled with clay, lying directly upon the coal seam (layer 37), has been penetrated by roots and rhizomes now leaving long cavities only. In this part recognizable macroscopic plant remains are infrequent. They increase, however, in number upwards to about thirty cm above the coal. Most of the plant fossils have been gained from a place ENE of the administration building of the concern. A limited number of fossils has been collected from the corresponding stratum N of the administration building. Recently the same layer has also been unearthed by industrial activity several hundred meters east of the main road without, as yet, yielding any fossils with the exception of rhizome cavities similiar to those mentioned above.

* All these specimens are now the property of the Palaeontological Institute, University of Lund, Sweden.

IV. FILICALES

A. Family *Dicksoniaceae*1. Genus *Coniopteris* Brongniart

1849: Brongniart, p. 26

1961: Harris, p. 141

Nilsson (Rapport angående resultaten av den preliminära bestämningen av växtfossil från Fyledalen, p. 19 ff, 1941) mentioned two species of this genus, viz. *Coniopteris hymenophylloides* (*C. cf. burejensis*) and *C. tatungensis*. The material came from the "inner part" of the tunnel, which apparently corresponds to layers no 90 to 97. *C. hymenophylloides* has also been obtained by him from some place in the region of the Kurremölla Flora. His material was chiefly composed of sterile pinnules, except one specimen that he named as *C. cf. burejensis*. This specimen is, however, without doubt a part of a fertile pinna of *C. hymenophylloides*. The small specimen of *C. tatungensis* pictured by Nilsson is very similiar to *C. simplex* (Lindley & Hutton) Harris of Yorkshire and there is almost no doubt concerning its conspecificity with the Yorkshire material.

Coniopteris hymenophylloides (Brongniart) Seward

Figs. 3 a—e

- 1829: Brongniart, p. 189, pl. LVI, fig. 4 (Type specimen)
 1900: Seward, p. 5, fig 1
 1948: Teixeira, p. 27, pl. 12, 13 (as *Davallia delgadoi*)?
 1956: Li, p. 19, pl. VI, figs. 1—2a
 1958: Orlovskaja, p. 128, pl. I, fig. 3
 1958: Vasiljevskaja, p. 12., pl. IV, figs. 8—10, pl. V, fig 1a
 1961: Harris, p. 152, text-fig. 53, 54 (List of specimens)
 1961: Vachrameev and Doludenko, p. 52, pl. III, figs. 1—6
 1963: Samylina, p. 72, pl. VI, figs. 4, 5
 1964: White (editor), p. 46, pl. I, fig. 3

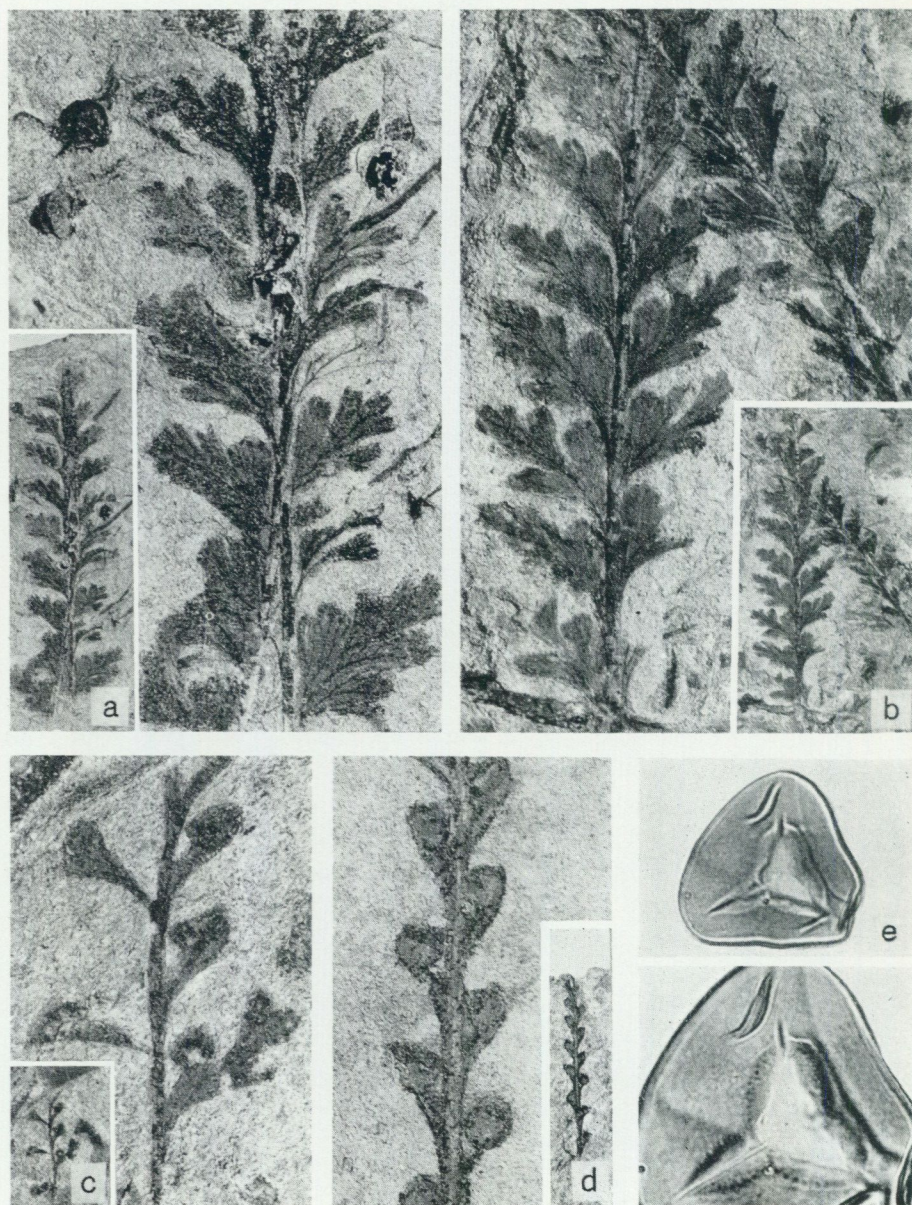


Fig. 3: *Coniopteris hymenophylloides* (Brongniart) Seward a—b: sterile pinnae, 1X and their details, 3X. c—d: fertile pinnae, 1X and their details, 3X. e: spores from the specimen shown in c, 600 and 1000X. Scania, Eriksdal, lower part of layer 36.
 ORIGINAL MATERIAL: Swedish Museum of Natural History, Stockholm 50.
 COLL: Hans Tralau
 PHOTO: K. E. Samuelsson

ORIGINAL MATERIAL: Swedish Museum of Natural History, Stockholm 50.
OCCURENCE: Scania, Eriksdal, lower part of layer no 36 and within the region of the Kurremölla Flora.

DESCRIPTION: Sterile leaves represented by isolated pinnae, to about 10 cm long and about 1.5 cm broad in their basal parts. Basal pinnules (obviously) opposite, in the middle and upper part of the pinna pinnules alternating katadromically. Lobes between 5 and 7, opposite and never overlapping, the lower, basispic, smaller than the opposite one, often deeply lobed or dentated. Lateral veins arising opposite. Midrib dividing the base of the lobe into two asymmetric parts. Epidermis unknown.

Fertile leaves represented by pinnules, about 3 cm long, reduced to midrib. A single sorus on the ends of lateral lobes. Basal lobes with two sori. Sorus about 1 mm wide, often with a cup-shaped indusium, containing many sporangia. Stalks of sori between 1 and 2 mm, with the longer ones in the basal parts of the pinnules, mostly arising at about 45° from the midrib. Midrib less than 1 mm broad.

Spores trilete, roundish triangular in polar view, $\pm 40 \mu$. Lessura triradiate. Exine smooth, but slightly granulated in small ill-defined verges bordering the lessura.

REMARKS: The present material is composed of shed fertile and sterile pinnae. No entire leaves have been encountered, but the tendency to break up is characteristic of this species. Large pieces of the leaf such as those figured by Harris (1961) are most exceptional in Yorkshire. It is thus likely that the basal pinnules are opposite, as the case is in the Yorkshire material. This is apparent from one specimen only (see fig. 3 b) but as a matter of fact, this specimen unfortunately happens to be fragmentary in the region of the right hand basal pinnule. However, the lowermost part of the pinnules is visible and, as far as I can judge, the basal pinnules arise from the same spot on the midrib. Basal amphlebiform processes, which have been observed frequently in the Yorkshire material, have not been seen in the present specimens. Both the sterile and the fertile pinnules which have been gathered are all relatively big and it can be assumed that they have been shed from leaves during autumn or otherwise adult leaves. The variation of pinnules as regards the form of the lobes etc. is considerable. It ranges between broad lobes to finely divided segments.

The spores of *C. hymenophylloides* are distinctive. The slightly granulated but ill-defined zones around the lessura distinguish this species from other ones, especially from *C. murrayana*, which otherwise is very similiar to the present species. Spores, attributed to *C. hymenophylloides* by Vachrameev and Doludenko (1961, pl. III, figs. 3, 6) do not show this character clearly as far as can be seen from the figures given by the authors. Neither do the spores, identified as belonging to *C. hymenophylloides* by Thomas (1912, pl. III, fig. 5) from southern Russia

and by Edwards (1934, p. 22, fig. 2) from New Zealand show this character reliably. Thus some doubt may be attached to the question of their affinity, or at least to their complete identity with the specimens from north-west and northern Europe.

This species becomes common in the (Upper) Lias of Bornholm and is extremely abundant in the Bathonian and Bajocian of Yorkshire.

2. Genus *Eboracia* Thomas

1911: Thomas, p. 387

A lot of fragmentary, sterile leaves of a fern, apparently belonging to *Eboracia lobifolia*, have been found in the layer investigated. According to Nilsson (Report, p. 28) this species has also been encountered among the older flora at Kurremölla. Moreover, Nilsson, referring these fossils to the genus *Cladophlebis*, mentioned three more species, "*Cladophlebis* sp. 1—3". These "species" are distinguished mainly by varying density of pinnules on the pinnae and one of the species differs from the rest by being distinctly dentated.

cf. *Eboracia lobifolia* (Phillips) Thomas

Fig. 4 a—b

1829: Phillips, p. 148, pl. VIII, fig. 13 (Holotype, sterile)

1911: Thomas, p. 387, text fig. (spores)

1953: Wilson & Yates, p. 934, text fig. 3

1961: Harris, p. 171, text figs. 62, 63 (List of specimens)

1961: Vachrameev and Doludenko, p. 58, pl. IX, figs. 1, 2 (Sterile leaves)

ORIGINAL MATERIAL: Swedish Museum of Natural History, Stockholm 50.

OCURRENCE: Scania, Eriksdal, lower part of layer 36 and within the region of Kurremölla Flora.

DESCRIPTION: Sterile pinnae, about 6.0 cm long and in its widest parts about 2.5 cm broad. Pinna rachis distinctly grooved and slightly winged between the pinnules. Pinnules katadromically attached to the pinna rachis. Lower pinnules about 1.25 cm long and about 0.5 broad, pinnules diminishing distally, outwards arising to an

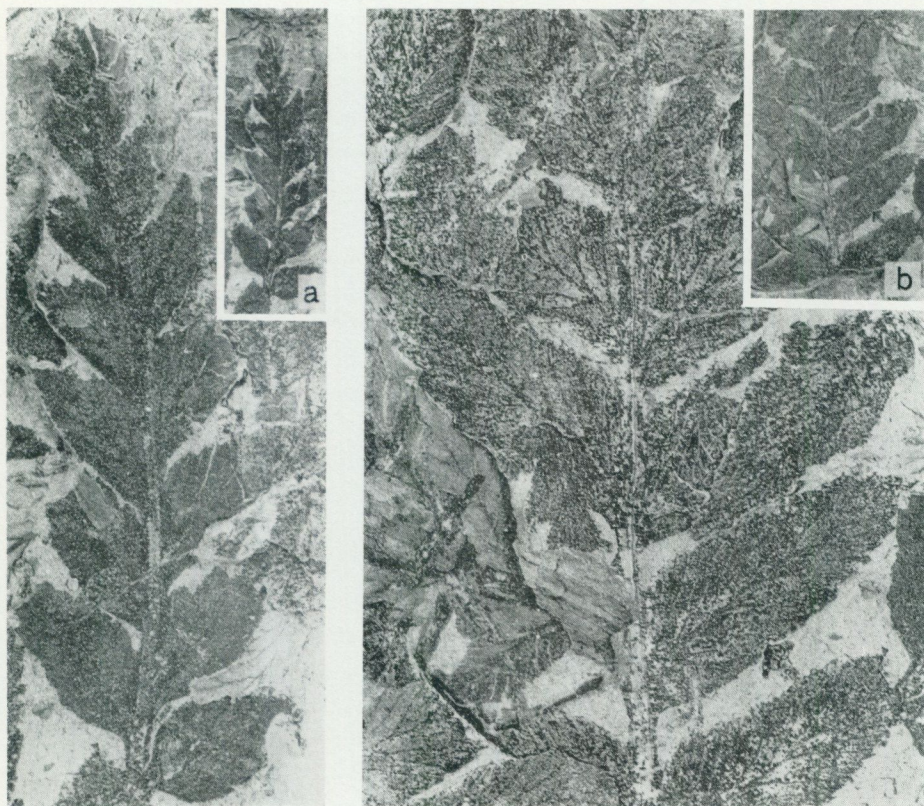


Fig. 4: cf. *Eboracia lobifolia* (Phillips) Thomas
 a—b: sterile pinnae, 1 and 3X. Scania, Eriksdal, lower part of layer 36.
 ORIGINAL MATERIAL: *Swedish Museum of Natural History, Stockholm 50.*
 COLL: *Hans Tralau*
 PHOTO: *K. E. Samuelsson*

angle of 45° . Margin of pinnules lobed or almost entire. Secondary veins arising katadromically from the main vein. Ultimate veins in the marginal region at a concentration of about 20 per cm.

Fertile leaves and spores have not been encountered.

DISCUSSION: There is doubt about this determination because, while the fragments agree perfectly as far as they go with corresponding parts of the sterile leaf of *Eboracia lobifolia*, they do not show the main diagnostic features of that species. These are the characteristic basal pinnules (in the sterile pinna), nor have we any associated pieces of the fertile leaf.

Within the family under consideration there are genera producing similiar leaf features, as for instance *Dicksonia*, *Balantium* and *Cobitium*. The differences between these genera are slight. The only definitely reliable difference between *Eboracia* and *Dicksonia* and closely related genera seems to be in the shape of the sori, which are marginal with a cylindrical indusium, surrounding an elongated placenta in *Eboracia* and broadly oval with a robust indusium, composed of two similar valves in *Dicksonia*. The sterile material, however, does not produce very distinct characteristics. Nevertheless, an eminent feature of taxonomic value seems to be the first pinnule on the basiscopic side of the pinna. The first pinnule is, according to various authors, divided into two diverging lobes, which always seems to be blunt. According to Harris (1961, p. 172) these forked lobes are to be found only in the middle of a large leaf. In upper and lower parts of large leaves, as well as throughout smaller leaves, the basiscopic pinnules are very broad, but scarcely divided into two lobes. In the present material neither lobed basal pinnules, nor very broad ones, are observed and therefore I am unwilling to identify the specimens with typical ones of this species, as described by, for instance, Phillips (1829, 1835, 1875), Lindley & Hutton (1833, 1837), Bartholin (1892), Raciborski (1894), Seward (1900, 1911), Thomas (1911), Yabe & Oishi (1933), Sze (1933), Brick (1937), Wilson & Yates (1953) and Harris (1961). If, in the future, more material will be available, the present problem may, perhaps, be solved.

V. CYCADOPHYTA

One Cycadophyean leaf without any traces of organic patterns has been found in layer 36, but its general appearance makes it possible that the specimen may belong to *Nilssonia schauburgensis* (Dunker) Nathorst, (Dunker 1846, Nathorst 1909), the determination of which is abominably difficult and doubtful. As there is no possibility of gaining any anatomical characters of the species, the material shall therefore be left unconsidered. If, however, the species determination should happen to be correct, then the species is of considerable interest, as it can be expected to have its main occurrence in the European Wealden. In Japan this species has a wider distribution, that is from the Tetori series (Upper Jurassic) to the Ryoseki series, which correspond to the European Wealden (Oishi 1933).

Nilsson (1941) gained a greater number of specimens of Cycadophyean leaves from undistinguished layers in the "inner part of the tunnel", which apparently corresponds to layers 79 downwards to at least layer 97. These remains belong to two different, probably three, genera. The genus *Nilssonia* is present by leaves

resembling *N. schauburgensis*, as is mentioned above, *N. fallax* Nathorst (Nathorst 1909, p. 27), *N. compacta* (Phillips) (Harris 1942, p. 580), and *N. tenuinervis* (Seward) Harris (Harris 1943, p. 840).

Neither do these species have any organic patterns preserved and the question, whether the specimens really belong to different species and, moreover, to the species mentioned above, must be left aside. Maybe the genera *Nilssoniopteris* or *Taeniopteris* are present, too, according to Nilsson's opinion (p. 40).

VI. GINKGOALES

A. Foliar remains

Among the Ginkgoalean remains there are both macro- and microfossils. Very well preserved leaves appear at times in tremendous quantities in the layer under consideration. The leaves referable to the genus *Ginkgoites* were frequently associated with numerous seed remains, which doubtlessly can be referred to the Ginkgoales, as no other remains, except Ginkgoalean leaves, occur alongside these seeds. As will be seen below, there are two Ginkgoalean genera in the layer investigated, represented by foliar remains. In his short manuscript report Nilsson figured a specimen, which he determined as *Baiera furcata* (L. & H.) F. Braun, and which in general appearance agrees well with the type of *Solenites furcatus*, described by Lindley and Hutton (1837, pl. CCIX) and the Jurassic specimens of Yorkshire published by Harris (1945, p. 213 ff). The Yorkshire material is of Lower Estuarine (Lower Deltaic) age, which belongs to the Lower Bajocian. However, the cuticle of the specimen pictured by Nilsson as well as its exact origin in the Eriksdal sequence is unknown.

1. Genus *Baiera* (Braun) Florin

1843: Braun, p. 20

1935: Harris, p. 47

1936: Florin, p. 101 ff, 1936 b, p. 44

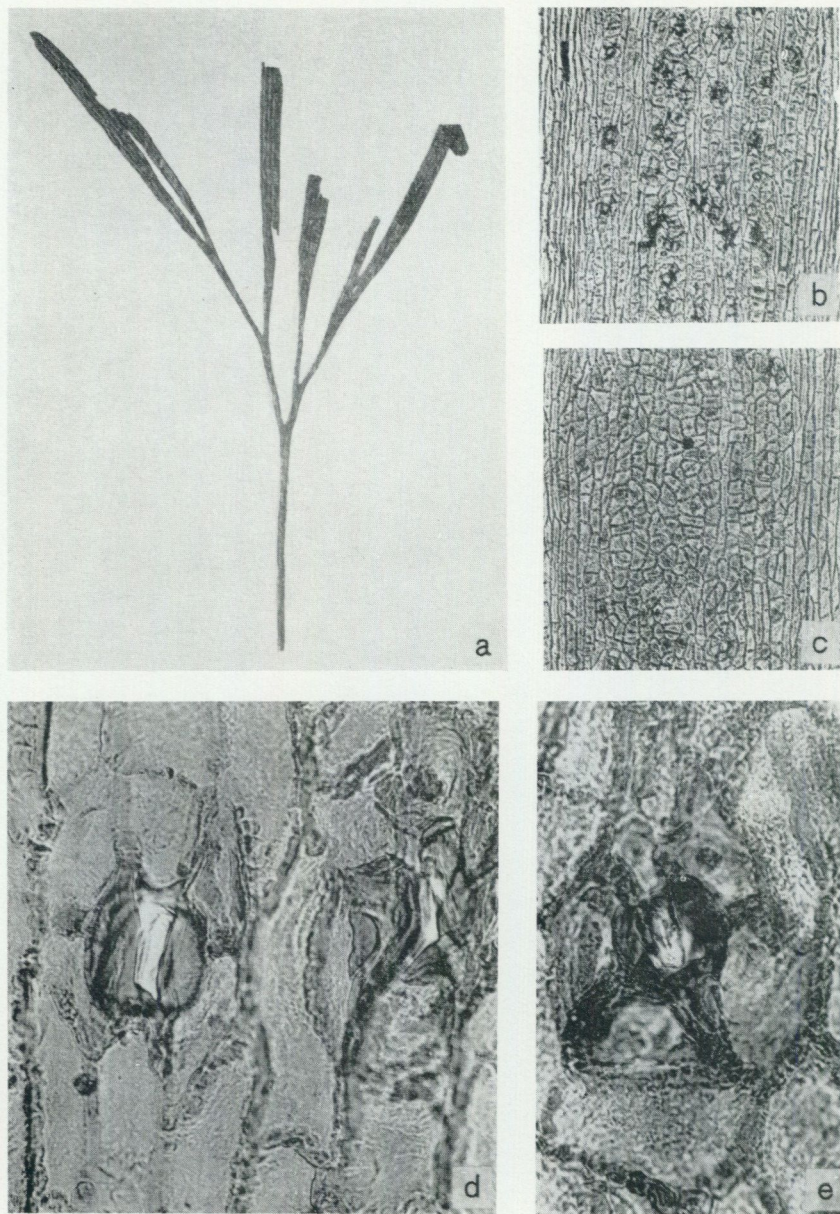


Fig.5: *Baiera gracilis* Bunbury

a: basal part of leaf with fragmentary petiole, 1X. *b*: lower cuticle from the specimen shown in *a*, 50X. *c*: upper cuticle from the specimen shown in *a*, 50X. *d*—*e*: typical stomata of lower epidermis from the specimen shown in *a*, 500X.

Scania, Eriksdal, lower part of layer 36.

ORIGINAL MATERIAL: Swedish Museum of Natural History, Stockholm 50.

COLL: Hans Tralau

PHOTO: K. E. Samuelsson

Baiera gracilis Bunbury

Figs. 5 a—e, 6 a—c

1851: Bunbury, p. 182, pl. XII, fig. 3 (Type-specimen)

1944: Harris, p. 674, figs. 4, 5 (List of specimens)

ORIGINAL MATERIAL: Swedish Museum of Natural History, Stockholm 50.

OCCURRENCE: Scania, Eriksdal, lowermost part of layer no 36.

DESCRIPTION: The occurrence of this species is less frequent in the layer in question. Two good specimens have been obtained (see figs. 5 and 6) while the others are more fragmentary.

Leaf with slender petiole. Lamina forming one third to one fourth of a circle, about 7 cm long and 9 cm broad, deeply divided into 6 to 30 (!) segments. Each segment contains between 2 to 4 veins in the upper part, apex acute. Small resin bodies recognizable especially between the veins. Upper cuticle about 4 μ thick. Trichomes absent. Stomata without general direction, occurring at a concentration of about 30 per sq. mm on the lower side, and of about 8 on the upper side of the lamina. Stomata generally with six subsidiary cells forming an irregular or sometimes an oval group. Epidermis cells elongate along the veins turning into mostly hexagonal ones in the region between the veins. Cell walls somewhat sinuate.

REMARKS: *B. gracilis* (*sensu stricto*) is described from Yorkshire but similiar leaves were "very widespread in Mesozoic times" as already pointed out by Seward (1900, p. 264). The present material differs from the Yorkshire material in having a greater amount of segments and a somewhat different structure of the cuticle. As can be seen from fig. 6 a the present specimen must have had 32 segments, a character which has never been observed in the Yorkshire material. The highest number of segments in the Yorkshire material appears to be about 20 (cf. Seward 1900, pl. IX, fig. 3). The Chinese fossils referred to this species by Sze (1933) have about 16 segments. A further difference is in the shape of the cells along the veins in the lower cuticle. Harris (1944, p. 678) described the lower cuticle as "showing narrow and ill-defined zones along the veins, without stomata, and broad intervening zones with evenly scattered stomata. Cells along the veins varying from square to moderately elongated, forming longitudinal rows". As can be seen from fig. 6 b in the present specimen the cells along the veins are strongly elongated.

Though there are slight differences observable between the Yorkshire specimens of *B. gracilis* and the present material I consider them conspecific, nevertheless, as the majority of main characters are in favour of conspecificity. The differences observed may be due to natural variation within a wide spread population.

2. Genus *Ginkgoites* (Seward) Florin

1919: Seward, p. 10

1935: Harris, p. 47

1936: Florin, p. 101 ff, 1936 b, p. 44

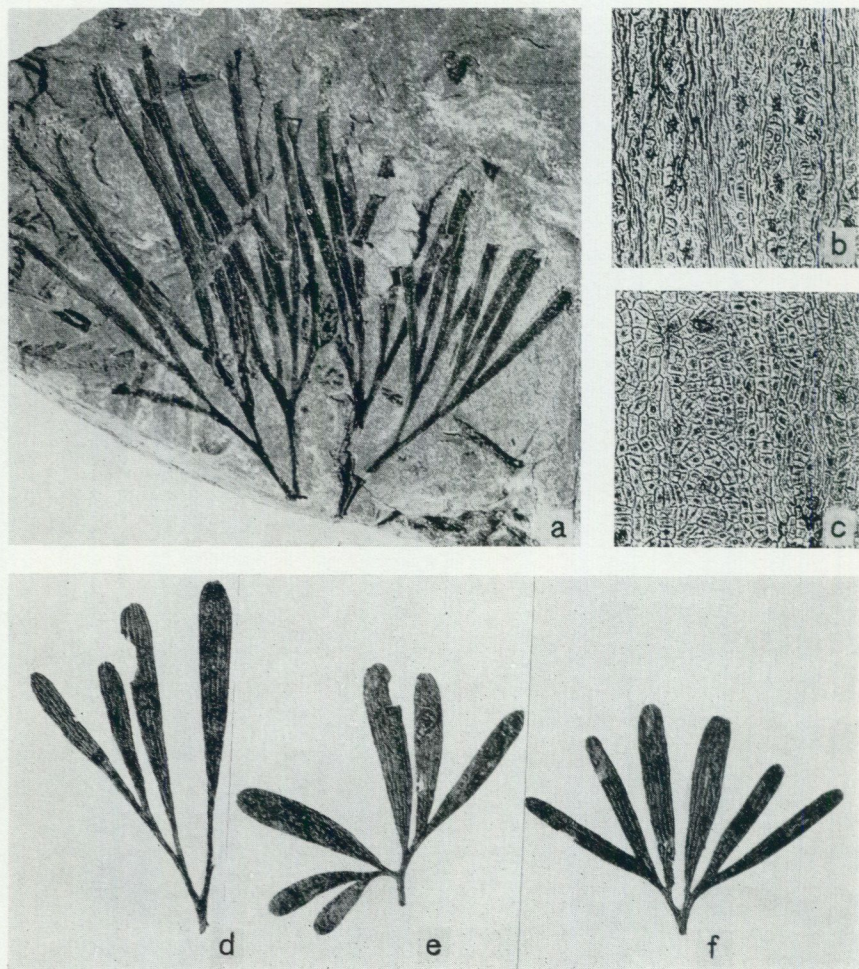


Fig. 6: *Baiera gracilis* Bunbury
 a: leaf with fragmentary petiole, 1X, b: lower cuticle from the specimen shown in a, 50X. c: upper cuticle from the specimen shown in a, 50X.

Ginkgoites Regnellii spec. nov.

d—f: variation of leaves, 1X.

Scania, Eriksdal, lower part of layer 36.

ORIGINAL MATERIAL: *Swedish Museum of Natural History, Stockholm 50.*

COLL: *Hans Tralau*

PHOTO: *K. E. Samuelsson*

Ginkgoites Regnellii sp. nov.

Figs. 6 d—f, figs. 7 a—e

TYPE: Swedish Museum of Natural History, Stockholm 50.

OCCURRENCE: Scania, Eriksdal, lowermost part of layer 36.

DIAGNOSIS: Leaf with a slender petiole, about 5 cm long in maximum size, about 1 mm in diameter. Lamina up to about 4 cm long and about 6 cm broad, forming, as a whole one half to one third of a circle, deeply divided into 6 or, less often, 8 lobes, which are always distinctly grouped into two halves. Lobes generally consisting of one primary and two secondary segments, the inner (main lobes) being broader than the outer, secondary ones, growing wider distally. Apex of lobes entire, round, sometimes with small tip. Veins dichotomizing regularly, 2 to 4 in the lower part and between 6 and 10 in the upper part of the lobe, generally in a concentration of about 14 in 1 cm. A few resin bodies present in some specimens, between veins.

Cuticle of moderate thickness. Trichomes absent. Stomata generally absent from upper cuticle, if present irregularly scattered between veins. Stomata of lower cuticle confined to strips between veins, scattered and without general direction, sometimes longitudinally orientated, occurring at a concentration of about 30 per sq. mm. Subsidiary cells of stomata mostly 4, forming a circular or oval stomatal region, surface thicker than that of ordinary epidermal cells, bearing large papillae, which are horizontally over-arching the guard cells. Epidermal cells strongly elongated along the veins, isodiametric polygonal between the veins. Cell walls mostly sinuos.

REMARKS: The various types of leaves (fig. 7 a, e, fig. 6 d, e, f) occurring in considerable quantities in the layer under consideration, have been referred to one species because they form an intergrading series of morphological and anatomical characters. The most common type is that illustrated in fig. 7 a. No important differences are notable within the material. The lamina rather constantly consists of 6 lobes, of which the two inner are primary and the outer secondary. The inner primary lobes are never divided into two sections. Resin is absent from most of the leaves. The leaves containing resin, as for instance the specimen fig. 6 e, may have been exposed particularly to sun radiation when growing and can thus be expected to have originated from the upper and outer parts of the tree. Stomata always occur on the lower side of the leaf. Some specimens have stomata on the upper part of the lamina, these leaves perhaps are derived from shaded parts of the tree.

The specimens in question are considered a new species for the following reasons. The predominant occurrence of two outer secondary and two inner primary lobes, is, as far as is known from the literature, a rare phenomenon within the genus

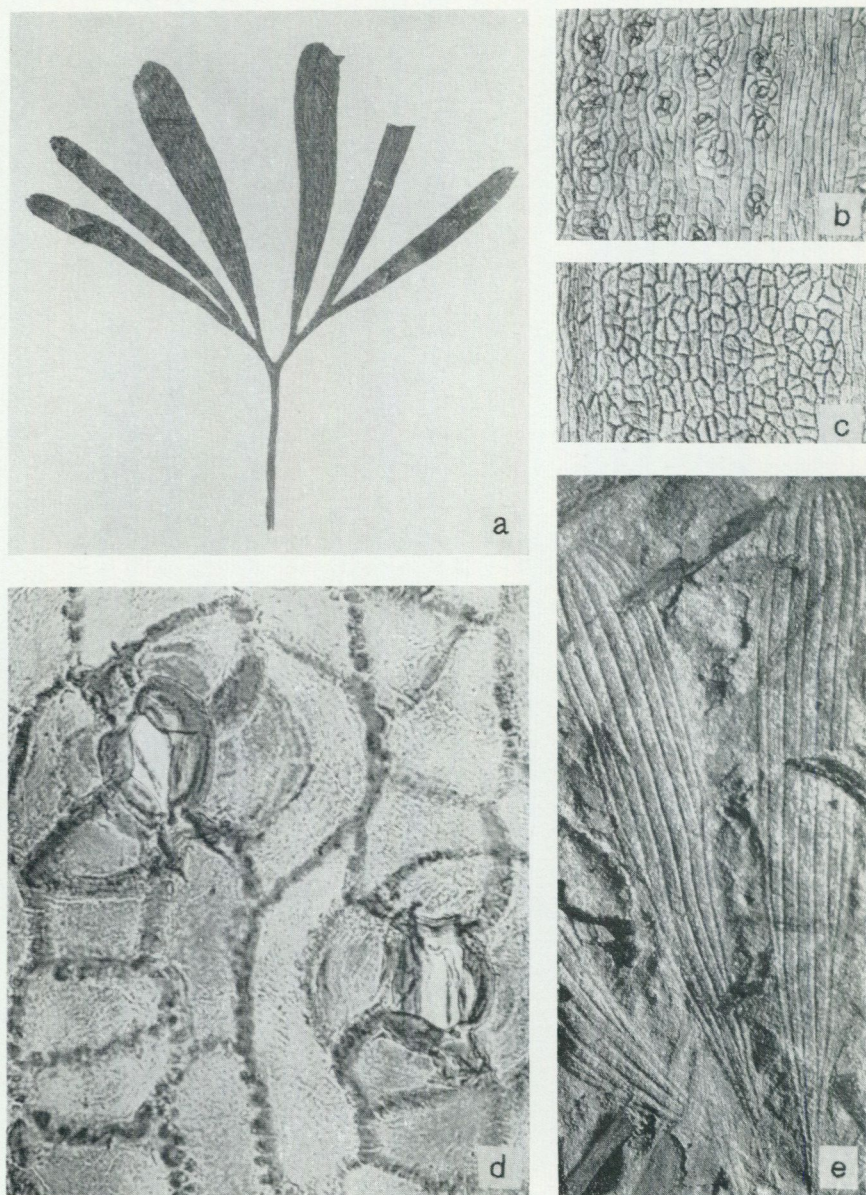


Fig. 7: *Ginkgoites Regnellii* nov. spc. (Type specimen)
 a: leaf with fragmentary petiole, 1X. b: lower cuticle from the specimen shown in a, 50X.
 c: upper cuticle from specimen shown in a, 50X. d: typical stomata of lower epidermis
 from specimen shown in a, 500X. e: impression of leaf segments showing dichotomizing
 veins, 3X.
 Scania, Eriksdal, lower part of layer 36.
 ORIGINAL MATERIAL: Swedish Museum of Natural History, Stockholm 50.
 COLL: Hans Tralau
 PHOTO: K. E. Samuelsson

Ginkgoites. This character has been observed in *Ginkgoites taeniatus* (Braun) Harris, which can be seen clearly from the pictures given by Gothan (1914, pl. XXXI—XXXII, fig. 1, here as *Baiera taeniata*) and from those published by Antevs (1919, pl. V, figs. 20—24, here as *Baiera taeniata*). Even in this species the primary inner lobes are sometimes sectioned into secondary lobes. However, there is a fundamental difference in the way of dichotomizing of the lobes within these two species under consideration. In *G. taeniatus* the outer secondary lobes divide above the lower 1/3 part of the lobe and are generally split in its apical parts (see Harris 1935, fig. 9 ff). In the present species the secondary lobes always dichotomize at the extreme base. As a rule the lamina of *G. taeniatus* is bigger than in the species under discussion. In *G. australis* McCoy (cf. Seward 1904, pl. XVIII, f. 36, 37) there are also two inner primary lobes and two outer pairs of lobes dichotomizing in the same manner as can be observed in *G. taeniatus*. The same is true for *Ginkgoites lepidus* in the sense of Samylina as is shown by an illustration given by Samylina (1963, pl. XXII, fig. 10, here as *Ginko lepida*). Contrary to Samylina's specimens obviously no primary lobes occur in Heer's specimens of this species. (Heer 1876, pl. VII, fig. 7, pl. XII, figs. 1, 2, 6, 7). *Ginkgoites flabellatus*, a species of Heer (1876, pl. VII, fig. 10, pl. XIII, fig. 3, pl. XXVIII, fig. 6) bears some resemblance to *G. Regnellii*, especially to specimens similar to that in fig. 5 b. However, *G. flabellatus* never has primary lobes and the number of secondary lobes is between 8 and 14. *G. sibiricus* (Heer 1876, Seward 1919) differs from the present species by having exclusively secondary lobes. Furthermore there is also some macroscopic similarity to *G. longifolius* (Harris 1946, p. 20—24, figs. 6, 7), a species that at present only is known from the Middle Deltaic of Yorkshire. However this similarity may be an illusion, which is due to the imperfection of the Yorkshire material. *G. longifolius* differs from the present species macroscopically by lobes being broader in its basal parts and by having "fairly numerous, round or shortly fusiform", resin bodies, by the structure of the upper cuticle, and by the absence of stomata on the upper cuticle.

From *G. hermelini* (Hartz 1896, pl. XIX, fig. 1, Harris 1935, pl. I, figs. 8, 10, pl. II, figs. 5, 6, text figs. 6, 7, 8) the present species differs in having smaller leaves, in the occurrence of inner primary lobes, in the entire apex of the lobes, and in anatomical differences of the stomata.

Thus all closely related species differ in one or other respect from the present species and owing to these facts I consider the present material as representing a distinct species.

The species is named after the Scanian palaeontologist Dr. Gerhard Regnéll, professor at the University of Lund.

B. Seed remains

Two slightly different types of orthotropous seeds, which with fair certainty can be attributed to the *Ginkgoales*, have been encountered. The single seed, described below as *Allicospermum baireanum*, has been found in a sandy clay portion of layer 36, almost entirely isolated from other fossil remains. The other ones, named as *A. ginkgoideum*, were fortunately associated with considerable quantities of leaves, belonging to *Ginkgoites Regnellii*, which, save for the seeds, were the only fossils in this part of the layer under discussion. Owing to this fact and to the very close resemblance of these seeds to the seed of recent *Ginkgo biloba*, the fossils can reasonably be considered as being of Ginkgolean origin. At present none of the specimens has any stalk left. However, when collecting I gained one specimen of *Allicospermum ginkgoideum* with a fragmentary stalk attached to the seed, which almost immediately fell off, when picked up. This seed was terminally attached to the stalk in such a way that indicated the stalk having been one-seeded.

1. Genus *Allicospermum* Harris

1935: Harris, p. 121

According to the view held by Harris (1935, p. 121 ff) the form-genus *Allicospermum* includes among the recent plants the seed of *Ginkgo*, of *Cycadales*, and of some Conifers and, moreover, among the fossils, those of *Nilssonia*, *Lepidopteris*, *Stachyotaxus* and probably others. By reasons, shortly mentioned above, which, however, shall be more thoroughly elucidated below, the present specimens are assumed as being of Ginkgophytean affinity.

Allicospermum baireanum nov. spec.

Fig. 8 a—d

? 1929: Black, p. 424, text fig. 10 (as *Baiera gracilis*)

? 1941: Nilsson, p. 57 (as *Carpolithus* sp. 1)

TYPE MATERIAL: Palaeontological Institute, University of Lund.

OCCURRENCE: Scania, Eriksdal, lowermost part of layer 36.

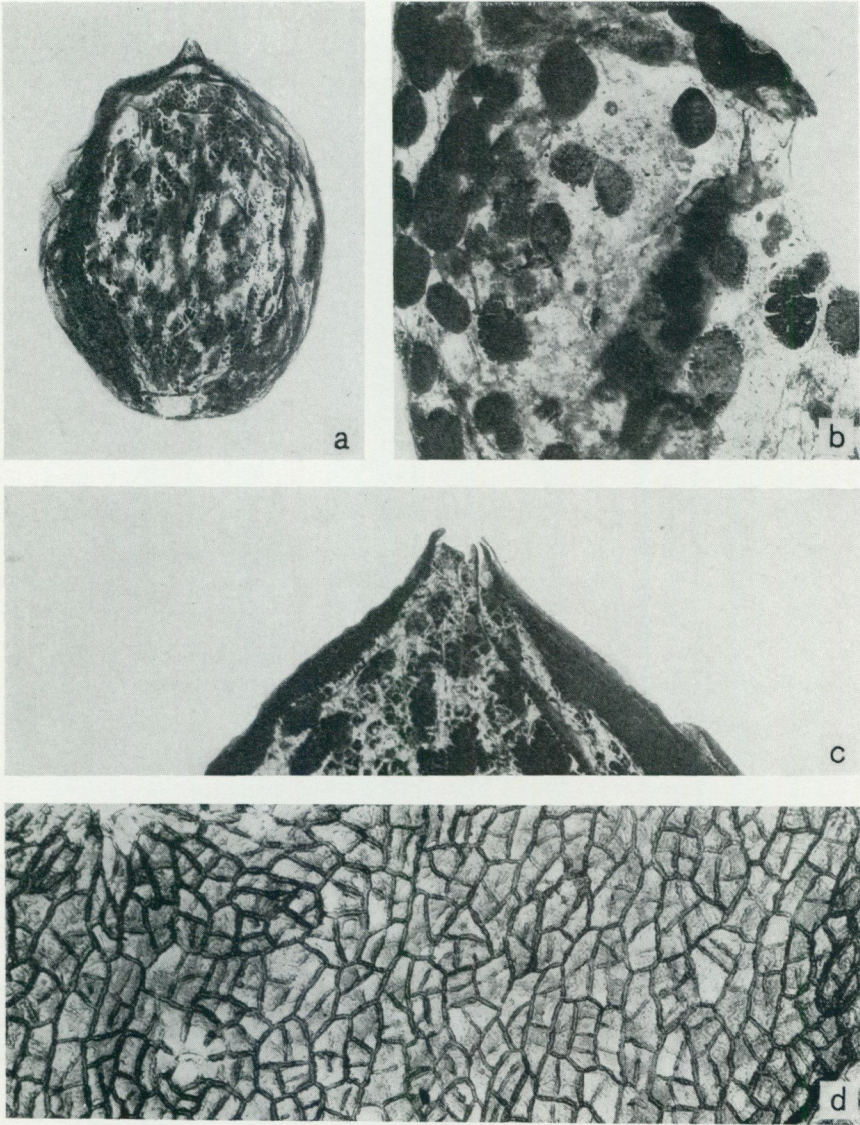


Fig. 8: *Allicospermum baierenanum* nov. spec. (Type specimen)

a: the whole seed (infrared photography) 4X. *b*: resin bodies embedded in sacrotestal patterns below the outer cuticle of the integument (infrared photography) 10X. *c*: apical part of the seed sectioned, showing the micropyle, 12X. *d*: epidermis of the outer integument, 100X.

ORIGINAL MATERIAL: Palaeontological Institute, University of Lund.

COLL: Knud Jakobsen

PHOTO: K. E. Samuelsson

DIAGNOSIS: Oval seed, 1.1 cm long and 0.8 cm broad. Surface somewhat wrinkled or partly slightly folded, due to crushing. Micropyle, forming a round hole 0.6 mm wide, distinctly protruded. Numerous flattened, chiefly elliptical resin bodies attached to the inner side of the outer cuticle of the integument, about 0.27 to 0.1 cm long, embedded in sarcotestal patterns. Outer epidermis of integument thick, showing isodiametric cells with straight and fairly thick lateral walls. Stomata irregularly scattered over all parts of the epidermis, very few. Stomata belonging to the haplocheilic type, subsidiary cells not preserved and obviously destroyed during maceration.

REMARKS: The present specimen is probably identical with *Carpolithus* spec. 1, recorded by Nilsson (1941) as a "fruit" collected in the gravel-pit of Eriksdal. It is also very likely that the oval seeds assigned to *Baiera gracilis* by Black (1929, p. 424), measuring 7 to 8 mm in length and 6.5 to 7 mm in breadth from the Upper Estuarine series of Yorkshire, are conspecific with the present specimen. They should at least be considered strikingly similiar according to the description given by Black. There is another fact in favour assuming conspecificity of the Yorkshire and Scanian specimens. For various reasons Black (op. c., p. 424) attributed the Yorkshire seeds to *Baiera gracilis*. In the Eriksdal material there are two different genera of Ginkgoalean leaves known at present in the layer under discussion, and there are also two different types of Ginkgoalean seeds, one, *Allicospermum ginkgoideum*, which will be described below, co-occurring with the leaves of *Ginkgoites Regnellii*, and the other, *A. baierenum*, apparently as rare as the leaves of *Baiera gracilis*. This fact, of course, does not prove the real connection between *B. gracilis* and *Allicospermum baierenum*, but at least makes it probable that these different organs may possibly have originated from the same taxonomic entity, maybe even having originated from the same tree.

Other carpologic remains of similiar shape, referred to the Ginkgoales, e. g. those figured by Heer (1874, pl. XXVII, f. 2, 1876, pl. X, f. 4b, 6, pl. XI, figs. 13—20 and 1880, pl. II, figs. 1, 3, pl. IV, figs. 2, 13) are not proved to belong here.

The present specimen lacks the sclerotesta, which in the specimens of *A. ginkgoideum* is present as a broken coal layer (see below). This is because it was kept in alcohol by the collector and sclerotesta fell off as small gravel-like, black pieces. The specimens of *A. ginkgoideum* were kept dry, until treated for preparation.

Allicospermum ginkgoideum nov. spec.

Fig. 9 a—f, 10 a—e

TYPE MATERIAL: Swedish Museum of Natural History, Stockholm 50.

OCCURRENCE: Scania, Eriksdal, lowermost part of layer 36.

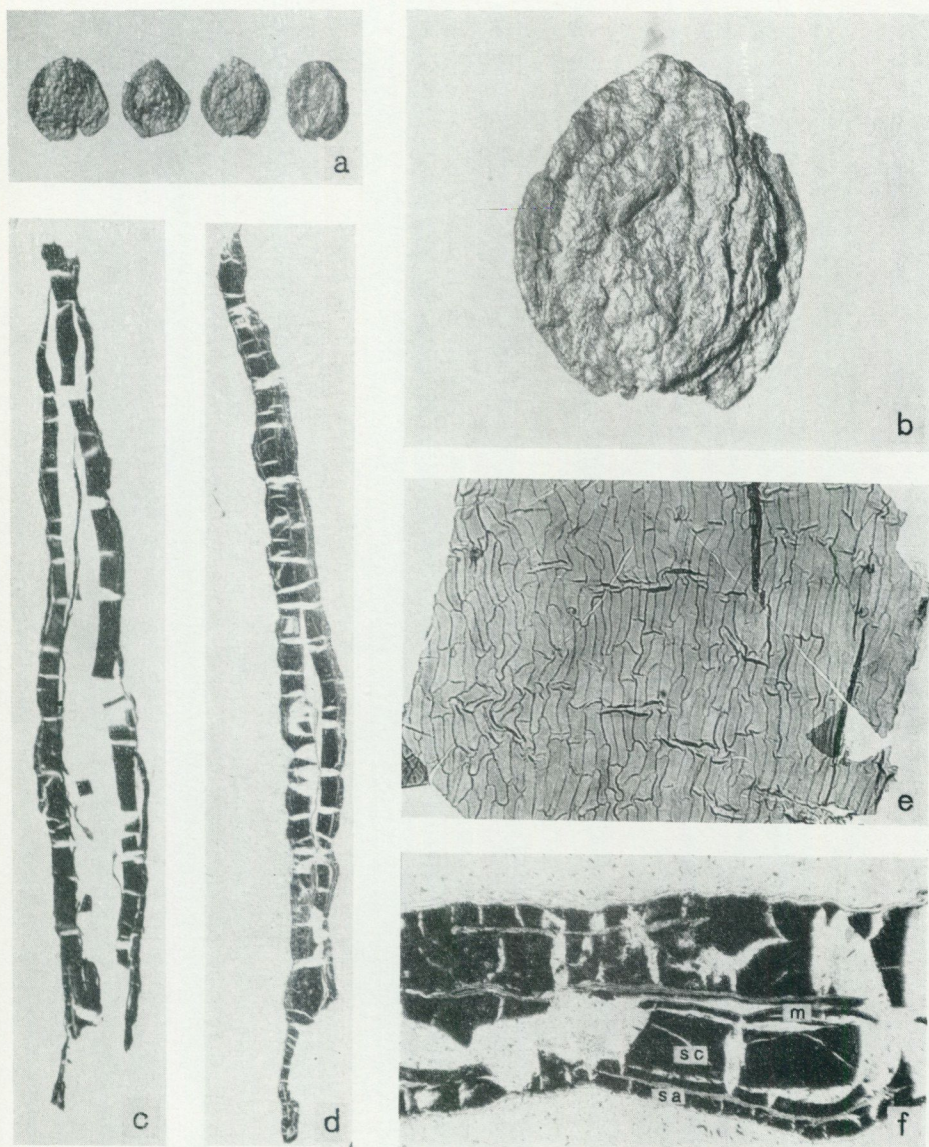


Fig. 9: *Alliospermum ginkgoideum* nov. spec. (Type specimen, b)

a: Compressed seeds. 1X. *b*: seed, third from the left shown in fig. *a*, showing small elevating protuberances, which indicate the position of the resin bodies below the epidermis. 4X. *c* and *d*: median sections through two different specimens, from base to apex (cf also fig. *f*), 10X. *e*: macrospore membrane, 50X. *f*: median section, showing macrospore membrane with adhering patterns (*m*), sclerotesta (*sc*) and sacrotesta (*sa*), 50X.

ORIGINAL MATERIAL: Swedish Museum of Natural History, Stockholm 50.

COLL: Hans Tralau

PHOTO: K. E. Samuelsson

DIAGNOSIS: Subcordate to almost globular (round) seeds, 0.9 to 1.1 cm long and about 1.0 cm broad. Micropyle and chalaza not projecting and not visible without



Fig. 10: Leaves of *Ginkgoites Regnellii* associated with seeds of *Allicospermum ginkgoideum*, two of which (at *a* and *b*) are to be found in pairs, making likely an attachment to a stalk. IX.

ORIGINAL MATERIAL: Swedish Museum of Natural History, Stockholm 50.

COLL: Hans Tralau

PHOTO: K. E. Samuelsson

preparation. Surface wrinkled, showing distinctly small, elevating protuberances, which indicate the position of resin bodies, and folded mainly at the edges from base to apex. Resin bodies numerous, round to elliptical 0.1 and 0.05 cm. Outer epidermis of integument thick, having isodiametric cells with straight and thick lateral walls. Rather few stomata, scattered all over the epidermis without being arranged in any special direction. Micropyle a round hole of about 0.05 cm in width, not exceeding the sacrotesta. Sclerotesta, often apart from the sacrotestal patterns, between 0.02 and 0.03 cm. Megaspore membrane delicate, consisting of elongated, straight-walled, rectangular cells.

REMARKS: There are strong reasons for regarding *A. ginkgoideum* as the seeds of *Ginkgoites Regnellii*. First because they have been gained from layers entirely composed of leaves of *G. Regnellii* (see fig. 10) and second because of their close resemblance to the seed of recent *Ginkgo. Allicospermum ginkgoideum* also compares closely with *A. xystum* of the fossil flora of Scoresby Sound, East Greenland (Harris 1935, pl. IX, figs. 1—10, 13, 18, text fig. 46), which has been regarded as the seed of *Ginkgoites taeniata* by Harris. The present species, however, is distinguished from *A. xystum* by not being as circular (globular) as the latter and therefore should be considered a different species. A somewhat similar seed from Jurassic deposits of Siberia has been referred to *Baiera longifolia* (Heer 1880, pl. II, fig. 6; cf. also Sprecher 1907, p. 184, fig. 211 b). The affinity of this specimen is no doubt uncertain.

A. ginkgoideum is represented by eight specimens from layer no 36. All of the specimens agree well with each other. None of them is attached to any stalk, but one of the specimens has been found on a fragmentary stalk, which unfortunately fell off, when the specimen was picked up. Two specimens were found in pairs, (see fig. 10, at a and b), making likely an attachment to a stalk, as observable in *Ginkgo*. There is, however, no real evidence that the two seeds originally have been connected to the same stalk, as in fact the stalk has been lost and no traces of it are visible.

The abundance of sclerotestal patterns, represented by a coal layer in the seeds is remarkable. In *A. baierianum* the sclerotesta was unfortunately destroyed by the treatment it received after being collected so we do not know about it.

VII. CONIFERALES

Macroscopic coniferous remains are rather sparse within the deposits under consideration at Eriksdal though, according to unpublished evidence from microscopic

remains, the proportion of coniferous taxa can be expected to be considerable. Nilsson (1941) recorded four organ-genera, i. e. *Elatocladus* sp., *Sphenolepis sternbergiana* (Dunker) Schenk, *Pityophyllum* sp., and *Pityospermum* sp. from different parts of the gravel pit, of which *Elatocladus* sp. (Nilsson 1941, fig. 38) differs from the present specimen by having longer leaves. *Sphenolepis sternbergiana*, the origin of which is unknown within the area of Eriksdal, has not been encountered later. *Pityophyllum* occurs here and there in layer 36 in remarkable quantities, but *Pityospermum* has not been gained by other collectors except by Nilsson himself.

1. Genus *Elatocladus* (Halle) Harris

1913: Halle, p. 83

1935: Harris, p. 60

Elatocladus cf. *Johnstrupi* (Bartholin) emend. H. T.

Fig. 11 a

? 1892—94: Bartholin, p. 36, pl. VI, XIV, figs. 3—5

? 1903: Möller, p. 34, pl. VI, figs. 2—3

? 1962: Rosenkrantz, p. 19, fig. 21:2

ORIGINAL MATERIAL: Swedish Museum of Natural History, Stockholm 50.

OCCURRENCE: Scania, Eriksdal, lower part of layer no 36 and possibly also present in the deposits at Bagå, Isle of Bornholm.

DESCRIPTION: Leafy twig about 3.8 cm long, with an axis of about 1 mm thickness. Leaves inserted spirally, all lying in a horizontal plane, almost at right angles to the axis. Leaves acicular, dorsiventral, single-veined, rapidly contracting to acute apex, base contracted to a minute stalk, about 5 mm in length and 1.5 mm in breadth. Epidermis not preserved.

REMARKS: Though somewhat differing in size the present specimen seems to be conspecific with *Elatocladus* sp., reported from the gravel pit of Eriksdal by Nilsson (1941, p. 50). There is also some evidence to consider the Bornholm specimens, occurring in great quantities in the white clay at Bagå (cf. Möller 1903, p. 34) described as *Pagiophyllum Johnstrupi* (Bartholin 1892—94), being identical with

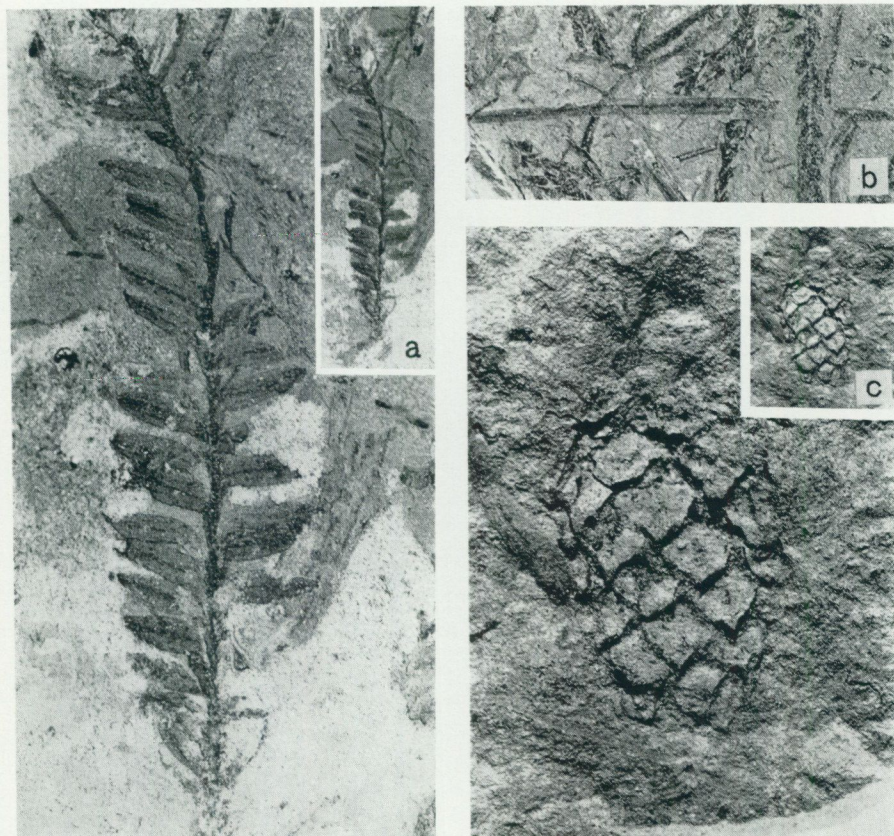


Fig. 11: *Elatocladus* cf. *Johnstrupi* (Bartholin) emend.
 a: leafy twig, 1 and 3X.

Pityophyllum cf. *Lindströmi* Nathorst
 b: detached leaf, 1X.

Conites sp.

c: female cone impression, 1 and 3X.

ORIGINAL MATERIAL: *Swedish Museum of Natural History, Stockholm 50, a and c; Geological Survey of Sweden, Stockholm 50, b.*

COLL: *Hans Tralau*

PHOTO: *K. E. Samuelsson*

the present species. Unfortunately the strata on the SW coast of Bornholm are markedly disturbed and partly concealed and accordingly the plant collections in the museums mixed up with plants belonging to different horizons.

Neither the present material, nor that of Nilsson, has any traces of organic patterns left. Comparison with coniferous species, based on cuticles from the Bornholm strata (Florin 1958, p. 334 ff) is therefore impossible.

2. Genus *Conites* Rossmuessler non Sternberg

1840: Rossmuessler, p. 40

Conites spec.

Fig. 11 c

ORIGINAL MATERIAL: Swedish Museum of Natural History, Stockholm 50.

OCCURRENCE: Scania, Eriksdal, lower part of layer 36.

DESCRIPTION: Isolated female cone, ovoid, 1.5 cm in length and 0.9 cm in breadth. Cone scales rather loosely arranged, about 4 mm long and between 2 and 3 mm wide, with acute apex.

REMARKS: The present specimen is preserved as an impression in the clay only, no organic patterns being preserved. It has neither been found before in Eriksdal, nor in corresponding layers on the isle of Bornholm and, as far as I know from the literature, the species has never been gained elsewhere. Among the female cones of recent conifers it mostly resembles those of *Tsuga*, although there hardly is any doubt that the present cone does not belong to this recent genus. According to the point of view held by Florin (1963), the oldest finds of *Tsuga* are from the Eocene period.

The delicacy of the twig of *Elatocladus* cf. *Johnstrupi* as well as the delicate size of the cone may favour the assumption of a former specific connection of these two remains.

VIII. PLANTAE INCERTAE SEDIS

1. Genus *Pityophyllum* Nathorst

1897: Nathorst, p. 18

1899: Nathorst, p. 19

In his manuscript report Nilsson (1941) mentioned two different "species" or "types" of leaves referable to *Pityophyllum* within the fossil flora of Eriksdal. One of them, *Pityophyllum* sp. 2, is without any doubt identical with the material described

below. The other one, *Pityophyllum* sp. 1, is represented by two specimens characterized by being markedly curved and almost 1.0 mm broad. This organ-genus is generally assumed as being of coniferous origin. However, there is no reason to suppose that such leaves are Coniferous. They could for example be detached leaves of *Neocalamites*, as pointed out to the present author by Prof. Tom M. Harris, Reading.

Pityophyllum cf. *Lindströmi* Nathorst
Fig. 11 b

1897: Nathorst, p. 67

ORIGINAL MATERIAL: Geological Survey of Sweden, Stockholm 50.

OCCURRENCE: Scania, Eriksdal, lower part of layer no 36 and in the Upper Jurassic deposits at Advent Bay, Spitsbergen.

DESCRIPTION: Detached acicular, single-veined leaves with acute or semiacute apex, about between 1.3 to 2.0 mm broad and up to 70 mm long (sometimes probably longer). Vein commonly distinct. Epidermis not preserved.

REMARKS: The present specimens resemble *P. Lindströmi* (Nathorst 1897, p. 67, pl. V, figs. 13—15, 18—31, pl. VI, figs. 17, 18) from the Upper Jurassic beds at Advent Bay, Spitsbergen. They differ slightly from the Spitsbergen material by being somewhat broader as a rule, and, perhaps, by being somewhat shorter. *Pityophyllum* has not been encountered from corresponding layers on the isle of Bornholm (cf. Möller 1902, 1903, Florin 1958) but otherwise these leaves often appear in Mesozoic fossiliferous deposits.

IX. CONCLUSIONS

The present flora of macrofossils, though restricted as regards its number of species, gives good evidence concerning the age. The bulk of species indicates a Middle to lower Upper Jurassic age.

Two areas with deposits, containing both similar types of floral composition and mainly identical plant species, are to be considered regarding the age of the present flora. The first area is known from the SW coast of the isle of Bornholm and the second one concerns the Middle Jurassic deposits of Yorkshire.

The hitherto described plant fossils from the SW coast of Bornholm (Bartholin 1892, 1894), Hjorth (1899), Möller (1902, 1903), and Florin (1958) are highly mixed-up, partly owing to the fact that the strata of the region are markedly disturbed and often concealed and partly owing to intermingling of the museum specimens.

However, at Bagå there are similarly sedimentated strata, containing almost the same quality of sands as those known from Eriksdal. In these deposits plant species characteristic to the flora of Eriksdal are also to be found. Although a lot of Möller's material originated from older strata, (cf. Grönwall in Grönwall & Milthers 1916, p. 111), some of his specimens obviously come from layers corresponding to those of Eriksdal. Unfortunately the stratigraphy of the Jurassic deposits of the Bagå—Rønne—Korsodde region is not sufficiently enough comparable with that of the Eriksdal region.

According to Hansen ([1939] 1940, p. 459 ff) the Bornholm Jurassic beds in question are to be divided as follows:

3. Upper fresh water division, from Lias δ to Wealden,
2. Marine division, Lias γ and δ (partly),
1. Lower fresh water division, Lias α and β

Division 1, of which no trace is to be found in Eriksdal, partly corresponds to the famous *Thaumatopteris*-flora, (Lower Helsingborg stage = Lias α), which according to Troedsson (1959) is exclusively confined to Lias α . The second division is also absent in Eriksdal. The third, the upper fresh water division, ranges through a considerable stratigraphic region, from Lias δ to Wealden. As already pointed out, plant fossils are known here from sedimentary sequences similar to those of Eriksdal. Florin (1958, p. 334) investigated the coniferous plant remains of these Bornholm sites. Owing to their similarity to the Yorkshire material, he considered these particular fossiliferous deposits on the isle of Bornholm as probably being Bajocian in age.

The Yorkshire Deltaic Series (cf. Black 1929, 1934), which formerly also were called "Estuarine Series", according to a scheme of classification proposed by Hemingway (1949) and since applied by Harris (1952 ff) and Couper (1958), are to be divided into the following series:

8. Upper Deltaic Series,
7. Grey Limestone Series (marine),
6. Gristhorpe Sub-series of Middle Deltaic Series,
5. Millepore Series (marine),
4. Sycarham Sub-series of Middle Deltaic Series,
3. Eller Beck Bed (marine),
2. Lower Deltaic Series,
1. Dogger (marine).

According to evidence hitherto encountered from the flora of Eriksdal, there is good reason to assume its geologic age as ranging within the Yorkshire sequences.

The flora of Eriksdal can moreover be expected to be between Bajocian and Bathonian in age.

Coniopteris hymenophylloides, which becomes common in the Lower Deltaic, is the most characteristic species of this stratigraphic range.

Further investigations of plant microfossils are expected to settle the problem definitely.

X. ACKNOWLEDGEMENTS

The laboratory work of the present investigation has almost exclusively been carried out at the Swedish Museum of Natural History, Section for Palaeobotany, Stockholm 50. The head of the palaeobotanical section, Professor Olof H. Selling, has most generously put all essential facilities for the work at my disposal. Chief of Office, Mr. F. Brotzen, D. Sc., of the Geological Survey of Sweden, who took the initiative in this work, has repeatedly given his support in various ways. Professor Gerhard Regnéll, University of Lund, has kindly put the samples from Eriksdal in the older collection of his institute at my disposal for the purpose of comparison, and Professor Tom. M. Harris, undertook the task of proofreading the manuscript before printing.

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