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ASPECTS OF ROMANIAN EARLY JURASSIC PALAEOBOTANY AND PALYNOLOGY. PART I. IN SITU SPORES FROM THE GETIC NAPPE, BANAT, ROMANIA

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ABSTRACT. Well preserved, sterile and fertile ferns material from the Getic Nappe, Ponor Quarry, Reşiţa Basin (Banat), Romania enabled the study of in situ spores from three taxa: *Phlebopteris woodwardii*, *Aninopteris formosa* (both Matoniaceae) and *Kylikipteris arguta* (Dicksoniaceae). The material is compared to that of the same taxa from some parts of Eurasia.

KEY WORDS: Early Jurassic, in situ spores, ferns, Getic Nappe, Reşiţa Basin, South Carpathians, Romania

INTRODUCTION

The Liassic (Hettangian – Sinemurian) continental deposits of Romania belong mainly to the Getic, Danubian and Bihor units and they yield a rich compressive and permineralised flora that can be collected in more than 25 localities (Popa 1998, Popa in Stănoiu *et al*., 1997), many of them former or still functioning coal mines.

Anina occurs within the South Carpathians, being an old coal extraction locality. The Liassic deposits belong to the Reşiţa Basin, one of the six Liassic basins in the Romanian Carpathians. The Reşiţa Basin is included together with the Holbav Basin (Dragastan & Popa 1998) to the Getic Nappe, one of the most important tectonic units of the South Carpathians. The term basin is used here in its sedimentary acceptance and not in the mining exploitation sense of the word.

Anina is probably the most important Liassic plant bearing locality in Romania for several reasons:

1. the compressions show a large systematic diversity and their degree of preservation is very high.

2. the Liassic deposits offer the possibility to be studied three dimensionally in the underground mining horizons, in outcrops or in a former open cast mine, now a preserved site (Popa 1994) named Ponor Quarry SSSI (Special Site of Scientific Interest);

3. the frequency of plant remains is high.

We can study in situ spores or pollen, and any other type of compressed plant organs for these reasons, and especially because of the good preservation.

MATERIAL AND METHODS

Fertile fern material was collected from the Ponor Quarry SSSI, while recording precisely the palaeobotanical, stratigraphic and sedimentological data. The beds were counted, sampled and laterally followed to record the maximum of data.

In situ spores were extracted both in Utrecht and in Bucharest laboratories using Schultze's Reagent. So far, only light microscopy has been used for their study.

SYSTEMATICS

The in situ spores belong to ferns assigned to Matoniaceae and Dicksoniaceae.

Family Matoniaceae

Genus *Phlebopteris* Brongniart 1836

Phlebopteris woodwardii Leckenby 1864

Pl.1, figs 1–6, Pl. 2, fig. 4

1864 *Phlebopteris woodwardi*, Leckenby, p. 81, pl. 8 fig.6
1961 *Phlebopteris woodwardii*, Harris, p. 106, text-fig. 35.
1997 *Phlebopteris woodwardii*, Popa, p. 142, text-figs 15–18, pl. I, figs 5, 6.

For additional references, see Harris 1961.

DESCRIPTION

The abundance of the material permitted the study of both sterile and fertile frond fragments, including details of the spores which have not been described before. The reason for this knowledge gap is represented by the rapid maturation of the reproductive structures, a feature that is typical for the Matoniaceae and that probably had even a more pronounced character in *Phlebopteris woodwardii*, and because most of the fossil material has been preserved as charcoal.

All the collected material is represented by pinna fragments of various sizes. The pinna rachis is 1–1.5 mm wide, longitudinally ribbed. The ribs do not always occur, the rachis appearing sometimes as being smooth (this may represent the difference in lower and upper side of the rachis). The pinnules are oppositely inserted to the pinna rachis, with their whole base, perpendicularly or at 80 degree; they are lanceolate in shape. The length of the pinnules varies between 95–105 mm, being 4–5 mm in width towards the median part. The basal part of the pinnules is slightly constricted, the minimal width being located at 1.5–2 mm from the rachis, where it is 3–3.5 mm. The actual pinna bases are slightly widened again and are connected by a narrow basal lamina. The margins are parallel and they become slightly convergent through the last third of the pinnules length, towards the apex. The apex is acutely rounded. The midrib is 0.5–0.6 mm wide and is inserted to the rachis with a slender thickening.

On the abaxial surface, the midrib is pronounced. The secondary veins arise at angles of 70–90 degree to the midrib and fork at least twice. In fertile pinnules the main vein branches arch around the sori. In all cases, the tertiary veins are obliquely oriented with respect to the midrib. The sorus is rounded, 0.5–0.6 mm in diameter, situated towards the midrib, with rounded, centrally situated placenta. The sporangia are placed around the placenta; they are rounded, 0.1–0.15 mm in diameter, with a distinct annulus.

The extracted spores are 12–16 mm in diameter, trilete, triangular, with rounded apices. The laesurae are straight and extend ca. 2/3 of the spore radius. The exine is smooth, without apparent ornamentation. No perispores have been observed, with proximal and distal surfaces uniform in ornamentation.

DISCUSSION

The assignment of this fern material to *Phlebopteris woodwardii* Leckenby is not difficult, the material presenting the typical features of this species. Some taxonomical affinities of the material may be present in respect to *P. affinis* species. But in *P. affinis* the secondary veins usually fork only once, and the primary arch is flattened and bears the sorus while in *P. woodwardii* it is raised and encloses the sorus.

DISTRIBUTION

The material was collected within the Ponor Palaeobotanical Preserved Site; this site belongs both to the *Thaumatopteris schenkii* asemblage Zone (Hettangian) and *Nilssonia orientalis* assemblage Zone (Sinemurian). The frequent occurrence of this taxon was recorded within the basal succession of the Liassic deposits in the mentioned area within the *T. schenkii* zone. Probably an entire plant was buried within a possible crevasse-splay sequence, over the refractory clay bed (marking the boundary sequence between the two assemblage zones in the Reşiţa Basin). This second stratigraphic position shows the occurrence of the taxon also in the *Nilssonia orientalis* assemblage zone. The species is so far confined to Europe and its stratigraphic range is recorded from the lowermost Liassic to the Lower Cretaceous (Harris 1961).

Genus *Aninopteris* Givulescu et Popa 1998

Aninopteris formosa Givulescu et Popa 1998

Pl. 2, figs 1–3, 5

1998 *Aninopteris formosa*, Givulescu & Popa, p. 51–66, Pls 1–2, text-figs 1–6

DESCRIPTION

This species has been extensivelly discussed in the paper of Givulescu & Popa (1998) but spores extracted from the fertile material gave additional information. The main feature of the *Aninopteris formosa* is the auriculate constriction that occurs to the base of the pinnules. The rachis is stout, wide, the pinnules are very long (up to 150 mm long and 5–6 mm wide) with a prominent midrib and a typical, tree- like venation. The sori are arranged on both sides of the midrib, beginning from about the end of the first third of the pinnules length. They lack indusia. The sporangia have a large annulus and an almost circular shape.

The spores are triangular in shape, with rounded apices and a non-ornamented, psilate exine. The proximal surface has interradial thickenings and the distal surface is convex. The trilete mark has long, straight and narrow laesurae, with a regular margo. Dimensions: around 40 μm in polar diameter. No perispore was found.

DISCUSSION

The taxon has close resemblances with the genus *Phlebopteris*, from which it mainly differs in the shape its pinnule base. The spores present features close to the ones of the typical *Phlebopteris* species (see Van Konijnenburg-Van Cittert 1993).

DISTRIBUTION

The material has been collected from the Terezia Valley, within the type section of the Terezia Member belonging to the Liassic continental Steierdorf Formation (Bucur, 1991). One author (Johanna Van Konijnenburg-Van Cittert) records a similar taxon from the Liassic deposits of Iran. At Anina, the taxon also occurs with high frequency in the former Breuner extraction field, not far from the Terezia Valley. The species seems to be a rather rare taxon for the Romanian Liassic flora but frequent in Anina.

Family Dicksonianceae

Genus *Kylikipteris* Harris 1961

Kylikipteris arguta (Lindley et Hutton) Harris 1961

Pl. 3, figs 1–4, Pl. 4, figs 1–5

1961 *Kylikipteris arguta*, Harris, p. 166–171, text-figs 59–61t
1994 *Kylikipteris arguta*, Popa, p. 142, text-figs 21–24, pl. 2, fig. 6.

DESCRIPTION

Both sterile and fertile material has been collected. The sterile frond fragments are represented by pinnae with normally shaped pinnules, while the fertile material is represented by pinnae fragments with modified pinnules bearing terminal cup-shaped sori.

In sterile material, the main rachis is 2–3 mm wide, flattened due to preservation and slightly striated longitudinally. The pinnae are alternately or suboppositely inserted at intervals of 7–10 mm. The secondary (pinna) rachises are 0.5–0.8 mm wide arising at around 50 to 70 degrees from the primary rachis. The pinnules are 1–2 mm wide and 3–4 mm long, they have a rectangular or subtriangular elongated shape and are attached with their entire base. Pinnules bases are connected by a narrow basal strip of their entire base. Pinnules bases are connected by a narrow basal strip of lamina. The pinnule margin is lobed, with superficial sinuses. The apex is rounded. The pinnules are oppositely or suboppositely inserted; they have a thin lamina and there is no difference between basiscopic and acroscopic pinnule shapes. The midrib is inserted between 70°–80° and is straight. The secondary veins are undivided and are obliquely inserted to the midrib.

The sterile and fertile pinnules occur in the same frond. The fertile pinules have a modified shape, indicating a metamorphosis from the sterile to the fertile state. Mature fertile pinnules have an expanded base, which functions as a tapering stalk for the sorus. The midrib is well marked, straight. The sori are spherical or elipsoidal in shape and look like being bivalved, with rounded indusia, as an effect to the distal position.

The spores are trilete, spherical, rounded or subtriangular in shape, with a rather thick exine, almost smooth or slightly punctate interradiary. Their size varies between 30–40 μm. Laesurae extend 1/2–3/4 of the spore radius. The interradial fields have a slight interradial torus. No perispore is present.

DISCUSSION

Our material fits within the variability limits of the taxon. The extracted spores are slightly smaller in size than those from the type material from Yorkshire in Middle Jurassic (Van Konijnenburg-van Cittert 1989). This Liassic record of the taxon is the oldest one.

DISTRIBUTION

Kylikipteris arguta has been collected from the Ponor Quarry SSSI, within the basal sequence of the Liassic Valea Tereziei Member, belonging to the *Thaumatopteris schenkii* zone. No other occurrence in Romania has been recorded. This taxon was originally described from the Middle Jurassic deposits of Yorkshire, at Beast Cliff (Lower Deltaic) and at Cloughton, Gristhorpe, Bransdale (Ouse Gill), in the Middle Deltaic (Harris 1961). Furthermore, it has been recorded from Kimmeridgian deposits in Sutherland, Scotland (Van Konijnenburg-an Cittert & Van der Burgh 1989).

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PLATES

Plate 1

1. *Phlebopteris woodwardii*, P40/C2/S4b/3
2. *P. woodwardii*, P44/C2/S9/29
3. *P. woodwardii*
4. *P. woodwardii*, P40/C2/S4b/3, Slide 5, × 2800
5. *P. woodwardii*, P40/C2/S4b/3, Slide 5, × 2800
6. *P. woodwardii*, P40/C2/S4b/3, Slide 6, × 2800

Scale bar = 1 cm

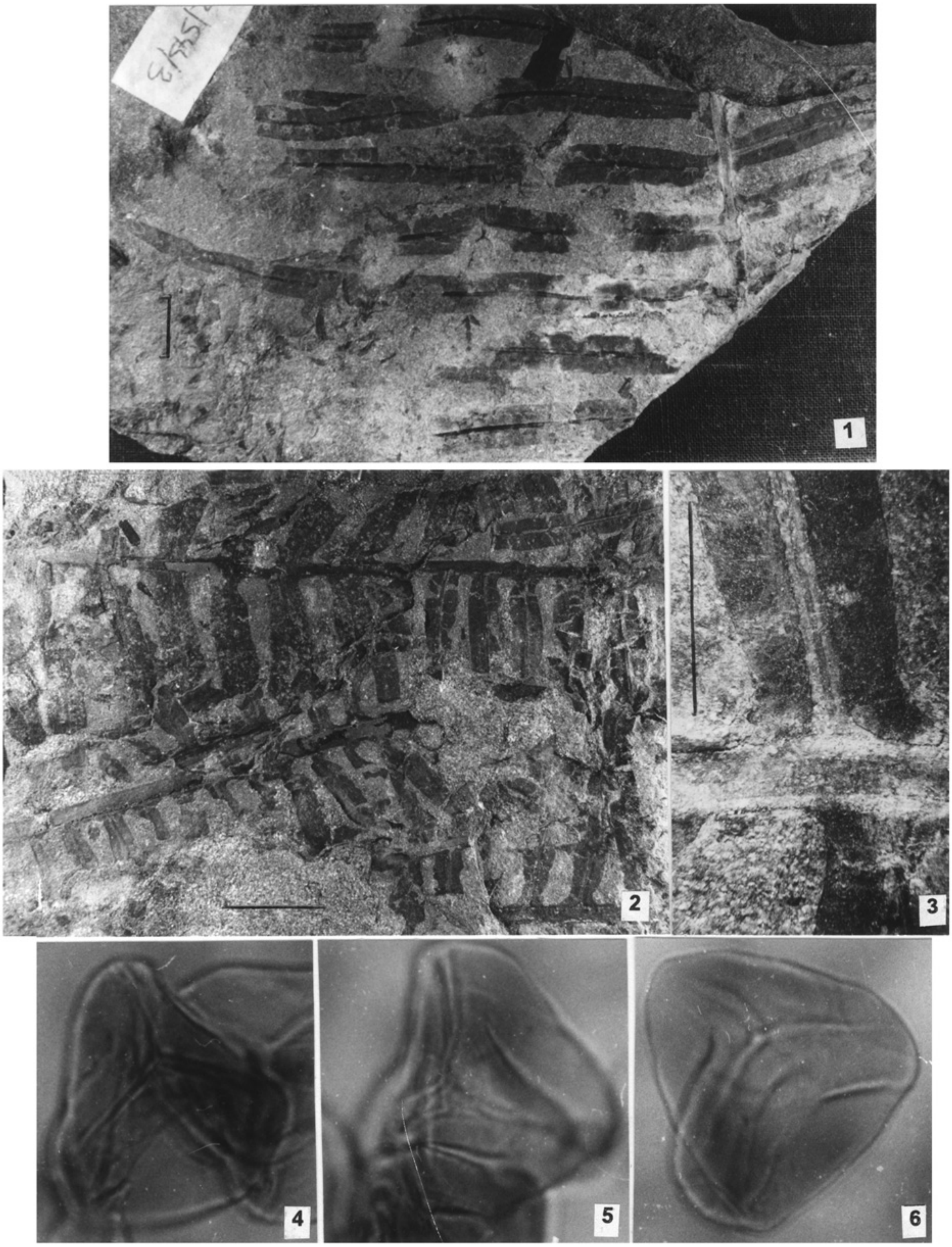
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Plate 2

1. *Aninopteris formosa*
2. *A. formosa*, Slide 4, × 1100
3. *A. formosa*, Slide 4, × 1100
4. *Phlebopteris woodwardii*, P44/C2/S9/39
5. *A. formosa*, Slide 4, × 1100

Scale bar = 1 cm

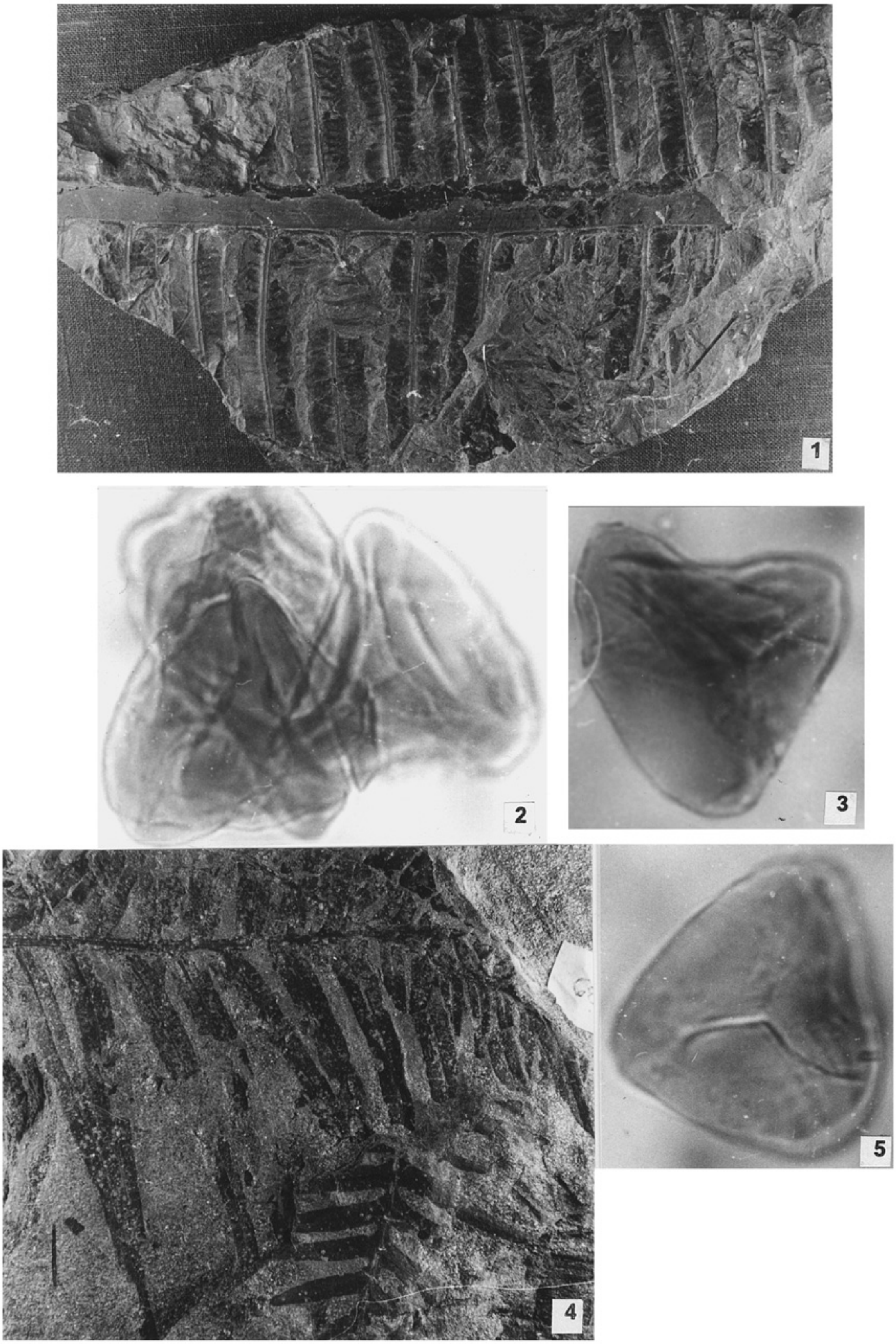
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Plate 3

1. *Kylikipteris arguta*, P40/C2/14
2. *K. arguta*, P40/C2/2A
3. *K. arguta*, P40/C2/S4b/1C
4. *K. arguta*, P40/C2/12

Scale bar = 1 cm

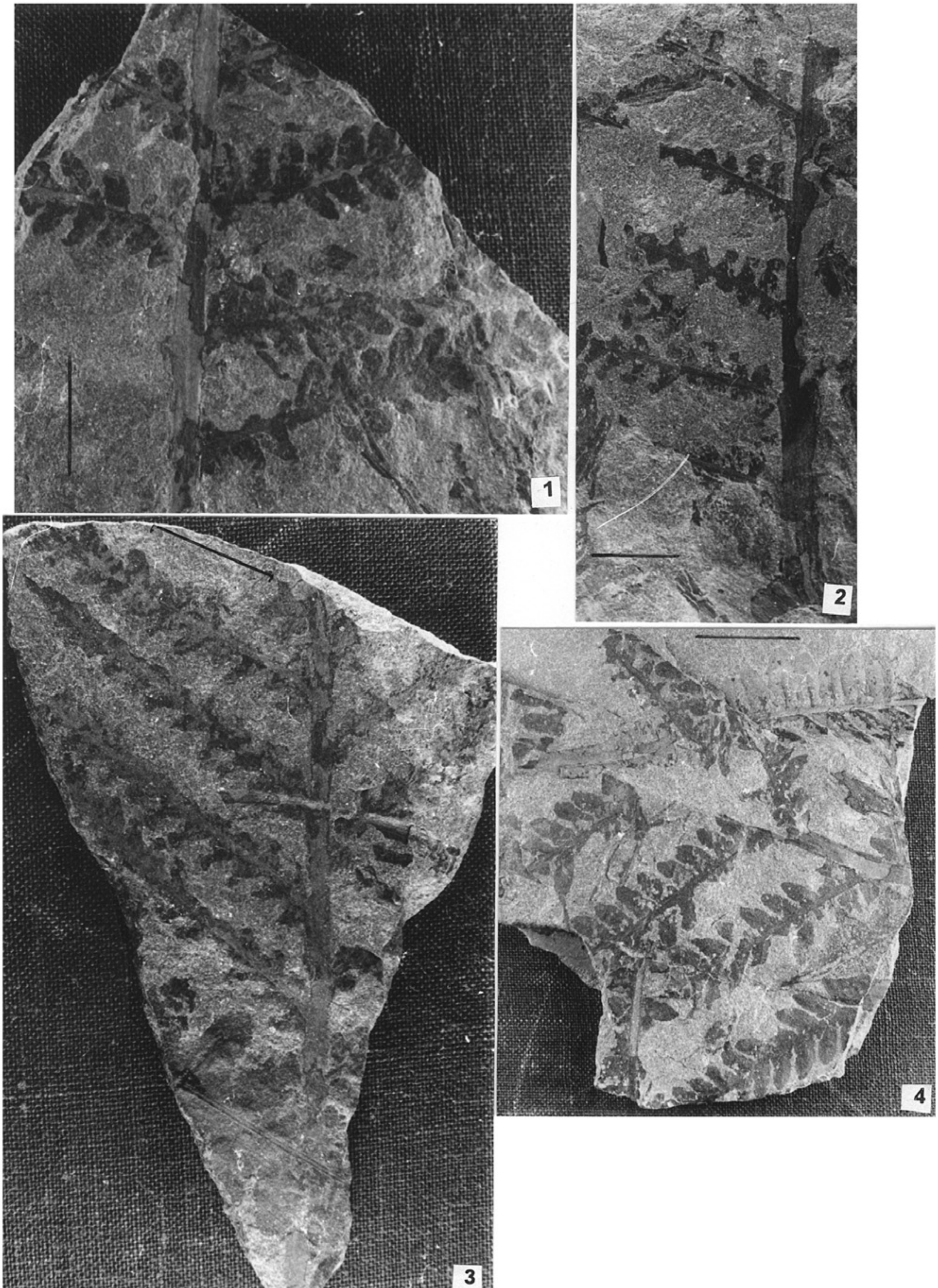
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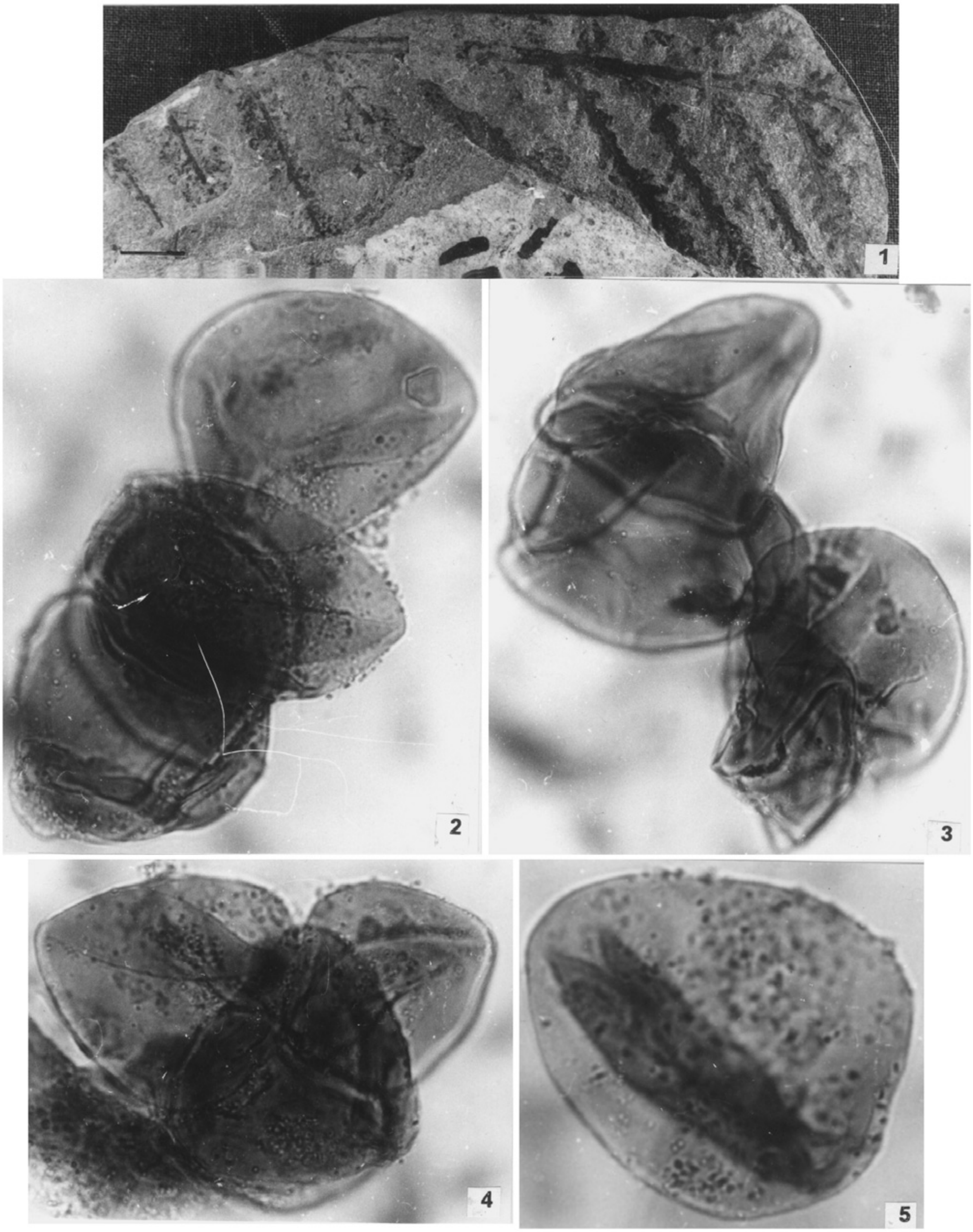
Plate 4

1. *Kylikipteris arguta*, P40/C2/S4b/1A
2. *K. arguta*, P40/C2/S4b/1A, Slide 1, × 1600
3. *K. arguta*, P40/C2/S4b/1A, Slide 1, × 1600
4. *K. arguta*, P40/C2/S4b/1A, Slide 2, × 1600
5. *K. arguta*, P40/C2/S4b/1A, Slide 2, × 2100

Scale bar = 1 cm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