SVERIGES GEOLOGISKA UNDERSÖKNING

SER. Ca AVHANDLINGAR OCH UPPSATSER I A4 NR 52

DOROTHY GUY-OHLSON

# BIOSTRATIGRAPHY OF THE LOWER JURASSIC-CRETACEOUS UNCONFORMITY AT KULLEMÖLLA SOUTHERN SWEDEN

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*This work is humbly dedicated to*
**Dr Erik Norling**
*on the occasion of his 50th birthday,*
*20th September, 1981.*

CONTENTS



**Abstract**

A biostratigraphical investigation has been made of the lowermost sediments (616.07–644.50 metres) of the Kullemölla No. 1 Bore, southern Sweden. The investigation reveals a palynological content which, though sparse and not well preserved, suggests an Early Jurassic age for the sediments 642.50–644.50 metres, and an Early Cretaceous age for the interval 616.07–642.50 metres (probably a Berriasian–Hauterivian age for 641.00–642.50 metres, a Valanginian–Hauterivian for 631.61–639.06 metres and a Hauterivian–Aptian/Albian for 616.07–623.09 metres). The palynological assemblages are compared with others of similar age which have been described from elsewhere and their biostratigraphical, tectonic and palaeoenvironmental implications are discussed.

## INTRODUCTION

The boring at Kullemölla, south-eastern Scania (Figs. 1 and 2), was drilled during 1918–1919 by the company Svenska Diamantbergborrnings AB, Stockholm, in order to assess the possibility of obtaining coal from the Jurassic coal seams underlying the Cretaceous sediments in southern Scania. A preliminary report on the results of this boring was given by Gavelin in 1919. He reported the presence of Cretaceous sediments conformably laid down to a depth of 640 metres and from 640–644.50 metres tilted (60–80°) Liassic sediments predominantly represented by dark grey to black shaly clay, sandy clay and some iron siltstone and sandstone. Grönwall (1920, p. 46) mentions that the 4.5 metres of the Liassic clay are rich in fossils. He comments that the fossils, though not investigated in detail, were shown to include representatives of the bivalve genus *Cyrena* which is regarded as a brackish water indicator. Furthermore he remarked that the core interval including the Jurassic-Cretaceous transitional beds is devoid of conglomerates. Lundegren (1934, p. 298, and 1935) noted that no fossils were recorded from the interval 590–640.00 metres, but apparently refrains from commenting on the afore-mentioned Liassic sediments. On lithological grounds it had been assumed that the Cretaceous sediments rested directly on the Liassic sequence (Chatziemmanouil 1973, p. 3).

The head of the division for Stratigraphy and Palaeontology at the Geological Survey of Sweden, Dr. Erik Norling, suggested that it would be interesting to see if there was any palynological evidence to support a Liassic age. Thus a brief preliminary palynological investigation of three samples from 635.00–644.50 metres was carried out. The palynological content of these three samples, though sparse and not so well preserved, was deemed sufficient to warrant thereafter the examination of a further eleven samples from the interval 644.22–619.06 metres.

# THE PALYNOLOGICAL INVESTIGATION

## MATERIALS AND METHODS

Samples for palynological investigation were taken from the lowermost part of the boring core (see Lundegren 1934, p. 298) at the following levels: 644.27–644.50, 644.22–644.27, 642.50–644.22 (lower), 642.50–644.22 (upper), 641.90–642.50, 641.76–644.27, 641.76–641.90, 641.30–641.76, 641.00–641.30, 635.10–639.06, 635.00–636.00, 631.61–635.10, 619.06–623.09, 616.07–619.06 metres. The core material is stored at the Geological Institute, Lund University. The lithological description of the sediments at the above levels is given in Table 1,

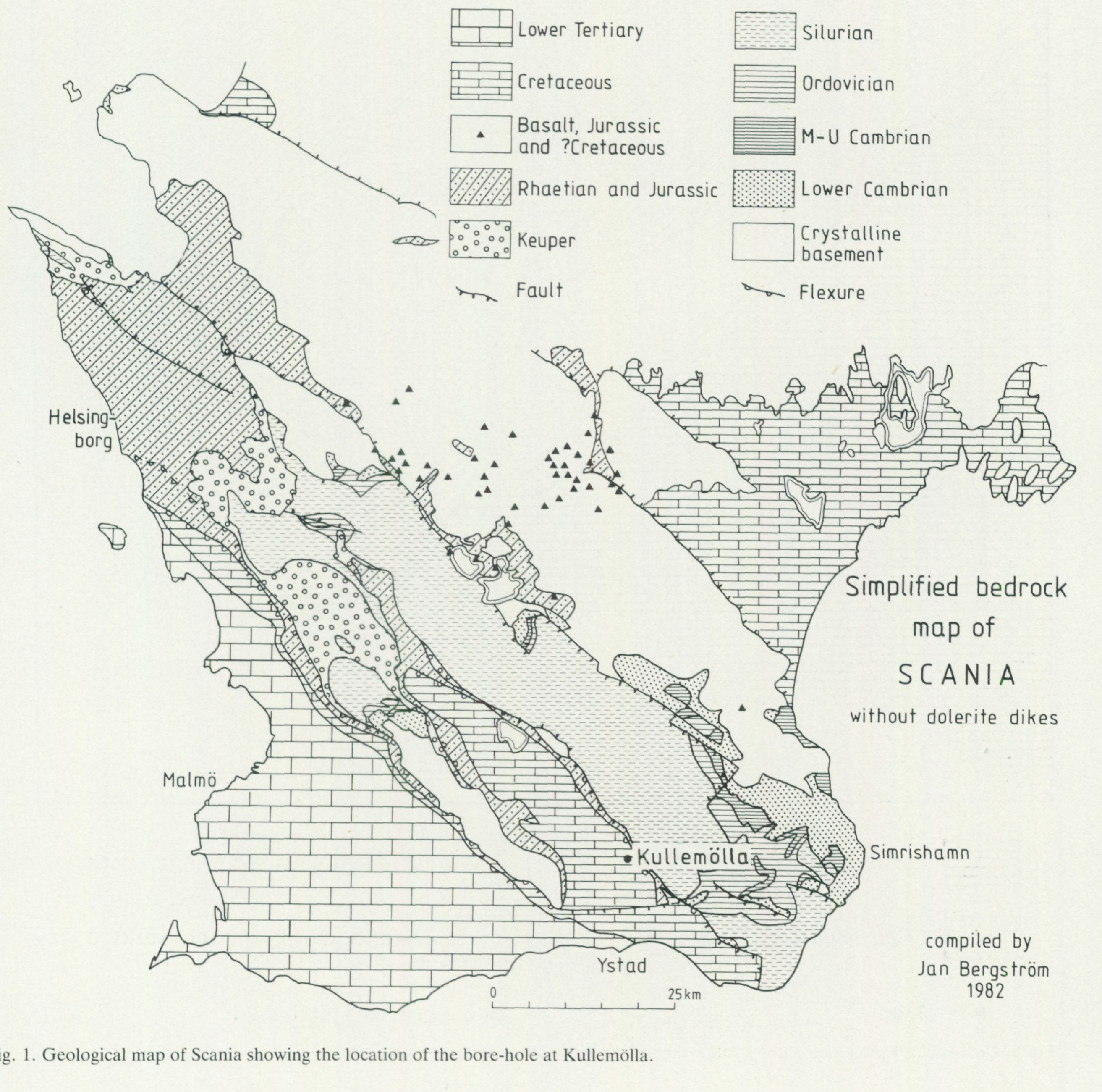


Fig. 1. Geological map of Scania showing the location of the bore-hole at Kullemölla.

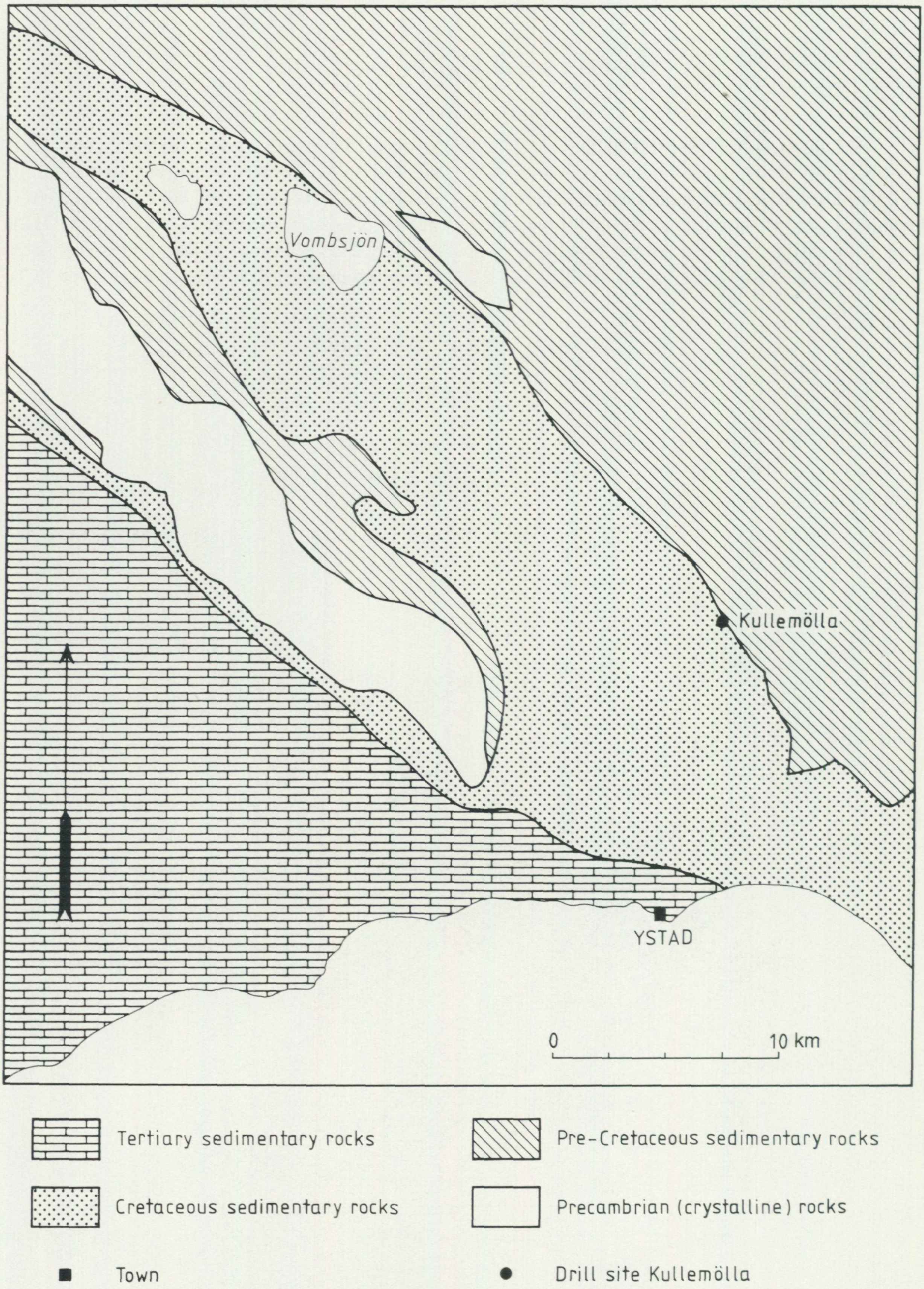


Fig. 2. Detailed geological map of the location area of the bore-hole at Kullemölla.

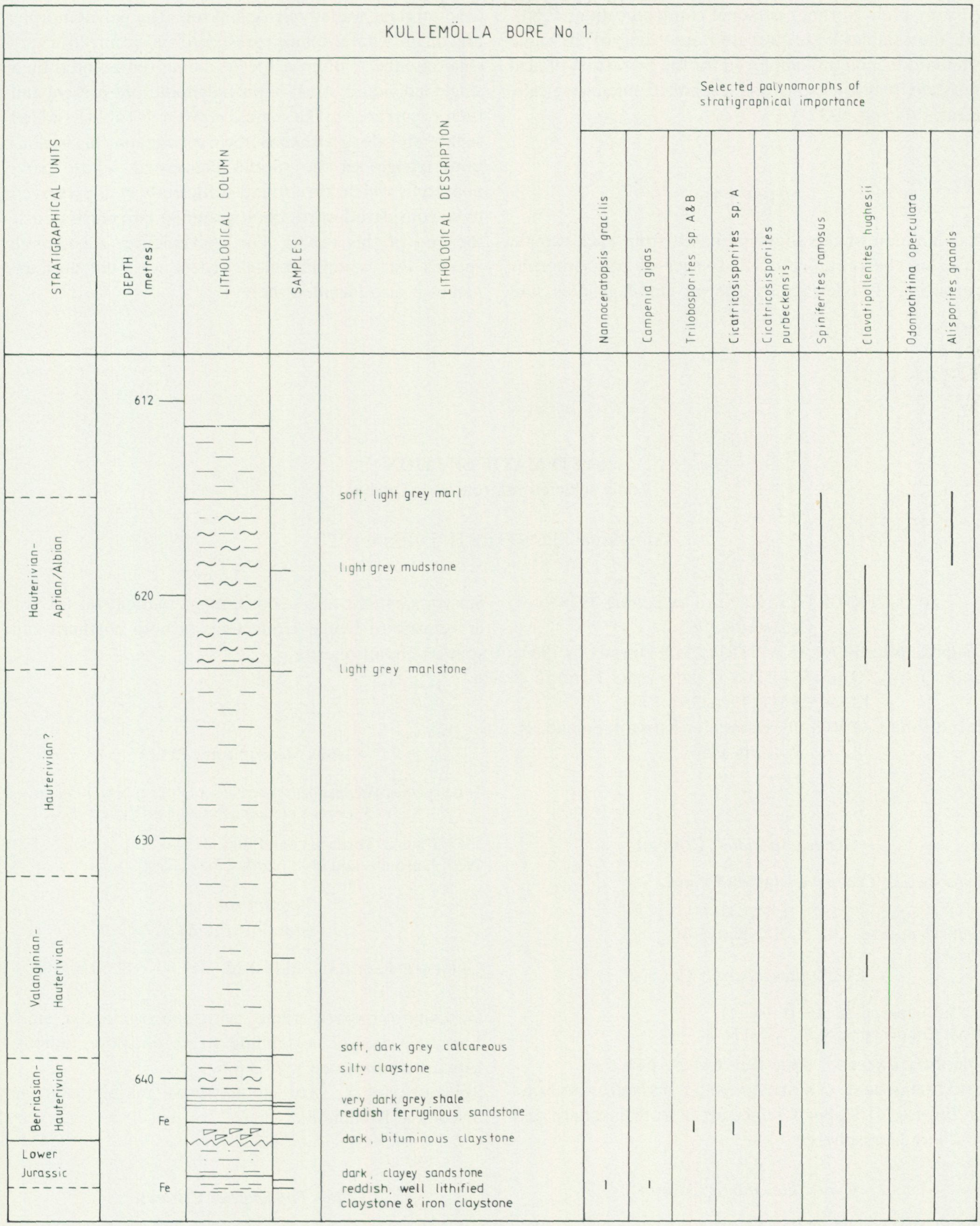


TABLE 1. The lithological description of the examined interval of the Kullemölla Bore No. 1 and the distribution within that interval of selected palynomorphs of stratigraphical importance.

(mainly after Norling, personal communication, 1980). All the samples were prepared according to the same standard techniques employed for the extraction of acid resistant palynomorphs and examined microscopically (Guy 1971, pp. 9–12).

## RESULTS

Examination of the slides prepared from each sample revealed the presence of 73 species of palynomorphs consisting of pollen grains, spores, dinoflagellates, and other organic walled microplankton. The palynomorphs are, on the whole, not well preserved and occurred in very small numbers, often a species being represented by a single individual. A list of the palynomorphs present and their occurrence in the sample is given in Table 2 (added separately) along with the known stratigraphical distributions (range) of the species concerned. Those palynomorphs which were found sufficiently well preserved to be considered worth photographing, are illustrated at the end of this report. For convenience, a complete species list (in alphabetical order) with the authors' names is also included there.

## SYSTEMATIC SECTION

(only selected references are given)

Anteturma SPORITES H. POTONIÉ 1893

Turma TRILETES (REINSCH ex SCHOPF 1938) DETTMANN 1963
Suprasubturma ACAVATITRILETES DETTMANN 1963
Subturma AZONOTRILETES (LUBER sens. POTONIÉ et KREMP 1954) DETTMANN 1963
Infraturma LAEVIGATI BENNIE et KIDSTON emend. R. POTONIÉ 1956

### Genus *Cyathidites* COUPER

Type species: *Cyathidites australis* Couper.

1953: Couper, p. 27, Pl. II, Fig. 11.
1958: Couper, p. 138, Pl. XX, Figs. 8–10.

*Cyathidites australis* COUPER

1953: Couper, p. 27, Pl. II, Fig. 11.
1958: Couper, p. 138, Pl. XX, Fig. 8.

ORIGINAL MATERIAL: slide Kul. 644.22–644.27/3.
STRATIGRAPHICAL AND GEOGRAPHICAL DISTRIBUTION: Lower Jurassic to Upper Cretaceous in both northern and southern hemispheres.

*Cyathidites minor* COUPER

1953: Couper, p. 27, Pl. II, Fig. 11.

ORIGINAL MATERIAL: slide Kul. 644.22–644.27/2.
STRATIGRAPHICAL AND GEOGRAPHICAL DISTRIBUTION: Lower Jurassic to Upper Cretaceous in both northern and southern hemispheres.

### Genus *Stereisporites* PFLUG

Type species: *Stereisporites stereoides* (POT. et VET.) PFLUG, *Sporites stereoides* POTONIÉ et VENITZ 1934.

1953: Pflug in Thomson and Pflug, p. 53.
1976: Jansonius and Hills, cards 2705–2723.

*Stereisporites* sp.
(not illustrated)

ORIGINAL MATERIAL: slide Kul. 641.90–642.50/2 (105.4/29.3).
DESCRIPTION: spore trilete, with almost circular amb. Laesurae straight, extending to ⅔ of spore radious. Equatorial diameter = 20.3 μm.
STRATIGRAPHICAL AND GEOGRAPHICAL DISTRIBUTION: in Sweden at Kullemölla.

### Genus *Todisporites* COUPER

Type species: *Todisporites major* COUPER.

1958: Couper, p. 134.

*Todisporites* cf. *minor* COUPER
(not illustrated)

ORIGINAL MATERIAL: slide 641.90–642.50/2 (92.6/31.5).
STRATIGRAPHICAL AND GEOGRAPHICAL DISTRIBUTION: at Kullemölla, Sweden.
REMARKS: the specimen is not well preserved, thus cannot with definite certainty be determined as *Todisporites minor* COUPER. Equatorial diameter of above specimen = 32.4 μm.

**Genus *Calamospora* SCHOPF**

Type species: (original designation) *Calamospora hartungiana* SCHOPF.

1944: Schopf in Schopf, Wilson and Bentall, pp. 51–52.

*Calamospora mesozoica* COUPER
(not illustrated)

1958: Couper, p. 132.
1964: Mädler, p. 92.

ORIGINAL MATERIAL: slide Kul. 641.30–641.76/2 (108.0/31.5).
STRATIGRAPHICAL AND GEOGRAPHICAL DISTRIBUTION: Triassic of eastern Australia, Lower and Middle Jurassic of Britain, Middle Jurassic of Sweden, infra-Liassic of France, Upper Triassic of Austria and Switzerland, and Middle Jurassic to Lower Cretaceous of the USSR. In Sweden at Eriksdal (Tralau 1968), Härninge, Rosenhäll (Middle Jurassic sediments, Guy-Ohlson 1978).
REMARKS: according to Lund (1977, p.53) Mädler "gave a thorough discussion of this species *(C. tener)* which is a senior synonym of *C. mesozoica* COUPER 1958".

Infraturma APICULATI BENNIE et KIDSTON emend. POTONIÉ 1956

**Genus *Concavissimisporites* DELCOURT et SPRUMONT emend. DELCOURT, DETTMANN et HUGHES**

Type species: *Concavissimisporites verrucosus* DELCOURT et SPRUMONT.

1955: Delcourt and Sprumont, pl. 2, Fig. 1a.
1963: Delcourt, Dettmann and Hughes, p. 285.

*Concavissimisporites variverrucatus* (COUPER) Brenner
Fig. 46

1963: Brenner, p. 59.

ORIGINAL MATERIAL: slide Kul. 644.22–644.27/2 (101.2/27.3).
STRATIGRAPHICAL AND GEOGRAPHICAL DISTRIBUTION: Bajocian to Aptain and Albian in England.

*Concavissimisporites informis* DÖRING
Fig. 48

ORIGINAL MATERIAL: slide Kul. 641.76–641.90/2 (108.6/21.7).
STRATIGRAPHICAL AND GEOGRAPHICAL DISTRIBUTION: Upper Jurassic to Lower Cretaceous in Germany.

**Genus *Baculatisporites* THOMSON et PFLUG**

Type species: (original designation) *Baculatisporites primarius* (WOLFF) THOMSON et PFLUG.

1953: Thomson and Pflug, p. 56.

*Baculatisporites comaumensis* (COOKSON) POTONIÉ
(not illustrated)

1956: Potonié, p. 33.

ORIGINAL MATERIAL: slide Kul. 644.22–644.27/3 (100.4/43.6).
STRATIGRAPHICAL AND GEOGRAPHICAL DISTRIBUTION: from Upper Triassic throughout the Mesozoic in Europe and Australia. In Sweden at Eriksdal (Tralau 1968), Vilhelmsfält (Guy 1971), Härninge and Rosenhäll (Middle Jurassic, Guy-Ohlson 1978) and at Valhall (Rhaeto-Liassic sediments, Guy-Ohlson 1981).

**Genus *Uvaesporites* DÖRING**

Type species: *Uvaesporites glomeratus* DÖRING.

1965: Döring, p. 39.

*Uvaesporites* sp.

ORIGINAL MATERIAL: slide Kul. 635–636/5 (93.1/35.5).
DESCRIPTION: spore with sub-circular amb, and trilete mark not markedly visible. Exine ornamented with a few irregular verrucae on the distal face. Proximal face of spore smooth. Equatorial diameter: 16.60 μm.
STRATIGRAPHICAL AND GEOGRAPHICAL DISTRIBUTION: at Kullemölla, Sweden.

### Genus *Ceratosporites* Cookson et Dettmann

Type species: *Ceratosporites equalis* Cookson et Dettmann.

1958: Cookson and Dettmann, p. 101.

*Ceratosporites* sp.
Fig. 35

Original material: slide Kul. 641.90–642.50/3 (105.2/29.3).

Description: trilete spore, with almost circular amb. Proximal surface smooth, distal ornamented with irregular blunt or sharply pointed processes, 2.4–4.8 μm in height (2.4–3.2 μm in width). Equatorial diameter: 24.3 μm.

Stratigraphical and geographical distribution: in Sweden at Kullemölla.

Remarks: *Ceratosporites spinosus* Schulz has been recorded from the Middle Jurassic of Vilhelmsfält, Sweden and the Liassic of Germany. (Schulz 1967, pp. 563–564).

### Genus *Pilosisporites* Delcourt et Sprumont

Type species: *Pilosisporites trichopapillosus* (Thiergart) Delcourt et Sprumont.

1949: Thiergart, p. 22.
1955: Delcourt and Sprumont, p.34.

*Pilosisporites trichopapillosus* (Thiergart) Delcourt and Sprumont
Fig. 42

1970: Kemp, p. 87.

Original material: slide Kul. 641.90–642.50/3 (91.5/30.4).

Stratigraphical and geographical distribution: in England in Lower Cretaceous sediments – from Berriasian to Lower Albian.

### Genus *Trilobosporites* Pant ex Potonié

Type species: *Trilobosporites hannonicus* (Delcourt et Sprumont) Pot., *Concavisporites hannonicus* Delcourt et Sprumont.

1954: Pant, p. 55.
1976: Jansonius and Hills, No. 3030.

*Trilobosporites* sp. A.
Fig. 37

Original material: slide Kul. 641.90–642.50/2 (92.3/34.6).

Description: trilete spore with triangular amb, sides slightly concave and angles (apices) somewhat truncated. Laesurae, long and straight almost 4/5 of spore radius. Proximal surface almost "granulose", equatorial diameter 51.0 μm.

Stratigraphical and geographical distribution: various species of *Trilobosporites* have been recorded from Lower Cretaceous sediments in Europe. This species recorded at Kullemölla appears to be identical with that recorded by Dörhöfer and Norris 1977, p. 78, as "*Trilobosporites* fsp. D" from the palynosuite "Hils 2" (Upper Berriasian).

*Trilobosporites* sp. B.
Fig. 38

Original material: slide Kul. 641.90–642.50/2 (101.0/47.0).

Description: trilete spore with triangular amb, slightly concave sides, and prominent apices. Laesurae 2/3 of spore radius. Exine surface ornamentated with low verrucae. Equatorial diameter 48.6 μm.

Stratigraphical and geographical distribution: this species at Kullemölla appears to be identical to that recorded by Dörhöfer and Norris 1977, p. 88 as "*Trilobosporites* fsp. B" from the palynosuite "Hils 1" (Upper Berriasian) of Lower Saxony, West Germany.

*Trilobosporites* sp. C.
Figs. 39 & 40

Original material: slide Kul. 619.06–623.09/2 (112.6/23.5).

Description: large trilete spore with triangular amb, slightly concave sides and prominent apices. Laesurae straight, 2/3 of spore radius. Exine ornamented with large (8.1 μm), low verrucae. Equatorial diameter: 74.5 μm.

Stratigraphical and geographical distribution: at Kullemölla, Sweden.

Remarks: similar spores are to be found in sediments not older than Valanginian in England (Batten, personal communication).

Infraturma MURORNATI POTONIÉ et KREMP 1954

**Genus *Lycopodiumsporites* (THIERGART) DELCOURT et SPRUMONT**

Type species: *Lycopodiumsporites agathoecus* (POTONIÉ) THIERGART.

1937: Thiergart, pp. 293–294.
1955: Delcourt and Sprumont, pp. 31–32.

*Lycopodiumsporites clavatoides* (COUPER) TRALAU
Fig. 10

1953: Couper, p. 19, Pl. I, Fig. 2.
1958: Couper, p. 132, Pl. XV, Figs. 10–11 (but not 12–13).
1968: Tralau, p. 49, Pl. I, Figs. 3–5.

ORIGINAL MATERIAL: slide Kul. 635–636/9 (92.7/46.8).
STRATIGRAPHICAL AND GEOGRAPHICAL DISTRIBUTION: Jurassic to Cretaceous in Eurasia and southern hemisphere.

**Genus *Cicatricosisporites* POTONIÉ et GELLETICH**

Type species: *Cicatricosisporites dorogensis* POTONIÉ et GELLETICH.

1933: Potonié and Gelletich, p. 522, Pl. I, Fig. 1.

*Cicatricosisporites brevilaesuratus* (COUPER) KEMP
Figs. 4 & 5

1970: Kemp, p. 94, Pl. 13, Figs 12–14, Pl. 14, Figs. 1–4, Text–fig. 11.

ORIGINAL MATERIAL: slide Kul. 635–636/2 (108.0/44.4).
STRATIGRAPHICAL AND GEOGRAPHICAL DISTRIBUTION: Upper Barremian to Lower Aptian. Present in both England and eastern U.S.A.

Cf. *Cicatricosisporites ludbrooki* DETTMANN

1963: Dettmann, p. 54, Pl. IX, Figs. 17–22.

ORIGINAL MATERIAL: slide Kul. 635–636/9 (111.5/22.4).
STRATIGRAPHICAL AND GEOGRAPHICAL DISTRIBUTION: Valanginian to Aptian – Albian. Present in Australia in the Otway Basin, Great Artesian Basin and E. Victoria.
REMARKS: this species has apparently not been recorded in the northern hemisphere before, but is sufficiently similar to be at least referred to this particular species.

*Cicatricosisporites purbeckensis* NORRIS
Fig. 41

1969: Norris, p. 588.

ORIGINAL MATERIAL: slide Kul. 641.90–642.50/3 (90.4/51.1).
STRATIGRAPHICAL AND GEOGRAPHICAL DISTRIBUTION: Lower, Middle and Upper Purbeck (Portlandian) of Dorset and Sussex, England.

*Cicatricosisporites* sp. A
Fig. 50

ORIGINAL MATERIAL: slide Kul. 641.90–642.50/3 (109.4/23.0).
DESCRIPTION: trilete spore with rounded triangular to subcircular amb. Laesurae difficult to see in illustrated specimen. Both distal and proximal surfaces are ornamented with narrow muri (1.6 μm) which unite at the apices. Lumina 1.6 μm wide. Equatorial diameter: 37.3 μm.
STRATIGRAPHICAL AND GEOGRAPHICAL DISTRIBUTION: at Kullemölla, Sweden.
REMARKS: this species resembles that described from Lower Cretaceous sediments in England by Kemp 1970, p. 97 as *Cicatricosisporites* sp., but differs by being somewhat smaller in overall size and in width of the lumina.

*Cicatricosisporites* sp. B
Fig. 51

ORIGINAL MATERIAL: slide Kul. 631.61–635.10/2 (101.0/45.0).
STRATIGRAPHICAL AND GEOGRAPHICAL DISTRIBUTION: at Kullemölla, Sweden.
REMARKS: this particular specimen is not so well preserved, but is reminiscent of that recorded from Lower Cretaceous sediments by Dörhöfer and Norris 1977, p. 88 as *Cicatricosisporites sp.* (pl. I, fig. 25).

*Cicatricosisporites* sp. C
Fig. 49

ORIGINAL MATERIAL: slide 616.07–619.06/2 (105.3/35.1).
DESCRIPTION: trilete spore with rounded triangular to sub-circular amb. Laesurae straight, almost 4/5 of the spore radius. Muri of variable width (1.6–3.2 μm) ornamented on both proximal and distal exine surfaces. Lumina ca 0.8 μm. Equatorial diameter: 45.4 μm.
STRATIGRAPHICAL AND GEOGRAPHICAL DISTRIBUTION: at Kullemölla, Sweden.
REMARKS: the diversity of form shown by the genus *Cicatricosisporites* is characteristic for Lower Cretaceous sediments.

**Genus *Contignisporites* DETTMANN**

Type species: *Contignisporites glebulentus* DETTMANN.

1963: Dettmann, pp. 73–74.

*Contignisporites* sp.
(not illustrated)

ORIGINAL MATERIAL: slide Kul. 644.22–644.27/3 (112.0/40.0).

DESCRIPTION: trilete spore (laesurae straight) with amb triangular to subcircular. Distal exine shows bilaterally symmetrical sculpture with parallel bifurcating muri, 3–4 µm in breadth. Equatorial diameter 44.55 µm. Specimen rather badly preserved, difficult to focus and not suitable for photography.

STRATIGRAPHICAL AND GEOGRAPHICAL DISTRIBUTION: many different species of *Contignisporites* have been recorded in both the northern and southern hemispheres in Upper Triassic to Lower Cretaceous sediments. In Sweden, *Contignisporites problematicus* (COUPER) DÖRING has been recorded in Jurassic sediments at Eriksdal (Tralau 1968) and Vilhelmsfält (Guy 1971), and also at Sandåkra and Höör (Nilsson 1958), *Contignisporites dunrobinensis* (COUPER) SCHULZ has been recorded at Pålsjö (Nilsson 1958), Vilhelmsfält (Guy 1971) and Härninge (Guy-Ohlson 1978).

Subturma ZONOTRILETES WALTZ 1935

Infraturma AURICULATI SCHOPF emend. DETTMANN 1963

**Genus *Matonisporites* (COUPER) DETTMANN**

Type species: *Matonisporites phlebopteroides* COUPER.

1958: Couper, p. 139.
1961: Sukh Dev, pp. 45–46.
1963: Dettmann, p. 58.

*Matonisporites* sp.
(not illustrated)

ORIGINAL MATERIAL: slide Kul. 642.50–644.22/3 (91.6/45.2).

DESCRIPTION: trilete spore with triangular amb. Laesurae long. Exine differentially thickened, specially at the equatorial region (3.2 µm) where the apices appear extra thickened (5–8 µm). Exine almost completely smooth. Equatorial diameter: 72.9 µm.

STRATIGRAPHICAL AND GEOGRAPHICAL DISTRIBUTION: at Kullemölla. In Sweden two species of *Matonisporites* have been described from the Middle Jurassic of Vilhelmsfält (Guy 1971, pp. 32–33).

REMARKS: above specimen not illustrated as it is partly obscured in the slide by other palynomorph material.

**Genus *Ischyosporites* BALME**

Type species: *Ischyosporites crateris* BALME.

1957: Balme, p. 24.

*Ischyosporites* sp.
Fig. 58

ORIGINAL MATERIAL: slide Kul. 641.90–642.50/3 (104.0/35.0).

DESCRIPTION: trilete spore with long laesurae extending almost to the equator. Proximal face, apparently smooth and lacking the gross reticulum which sculptures the distal face. Reticulum (walls varying in width from 1.6–3.2 µm) consists of irregularly shaped pits varying in length from 3.2–5.6 µm. Equatorial diameter: 28.4 µm.

STRATIGRAPHICAL AND GEOGRAPHICAL DISTRIBUTION: at Kullemölla.

REMARKS: this specimen, though similar in many respects to *Ischyosporites variegatus* (COUPER) SCHULZ recorded from the Middle Jurassic of Vilhelmsfält and Härninge (Guy 1971, Guy-Ohlson 1976 & 1978) differs considerably from it by its smaller size.

Infraturma TRICRASSATI DETTMANN 1963

**Genus *Gleicheniidites* ROSS**

Type species: *Gleicheniidites senonicus* ROSS.

1949: Ross, p. 31.

*Gleicheniidites senonicus* (ROSS) SKARBY
(not illustrated)

1949: Ross, p. 31.
1964: Skarby, pp. 59–77.

ORIGINAL MATERIAL: slide Kul. 642.50–644.22/2 (95.6/27.6).

STRATIGRAPHICAL AND GEOGRAPHICAL DISTRIBUTION: Upper Triassic to present time in both northern and southern hemispheres.

**Genus *Coronatospora* DETTMANN**

Type species: *Coronatospora perforata* DETTMANN.

1963: Dettmann, p. 67, Pl. 13, Figs. 17–25.

*Coronatospora valdensis* (COUPER) DETTMANN
Fig. 9

1958: Couper, p. 146, Pl. 24, Figs. 6, 7.
1963: Dettmann, p. 67.

ORIGINAL MATERIAL: slide Kul. 635–636/8 (100.7/29.2).
STRATIGRAPHICAL AND GEOGRAPHICAL DISTRIBUTION: in Wealden – Aptian sediments in England.

**Genus *Patellasporites* (GROOT et GROOT) KEMP**

Type species: *Patellasporites tavaredensis* GROOT.

1962: Groot and Groot, p. 152.
1970: Kemp, p. 108.

*Patellasporites* sp.
Fig. 43

ORIGINAL MATERIAL: slide Kul. 641.90–642.50/3 (104.0/33.2).
DESCRIPTION: trilete spore with rounded triangular to subcircular amb. Central body enclosed by a patina which extends to equatorial regions and is thickest there (4.9 µm). Laesurae not distinct. Proximal exine more or less smooth, distal exine dissected by narrow canals. Total equatorial diameter: 30.0 µm.
STRATIGRAPHICAL AND GEOGRAPHICAL DISTRIBUTION: *Patellasporites tavaredensis* GROOT et GROOT has been recorded from the Cenomanian of Portugal. *Patellasporites* sp. cf. *P. distaverrucosus* (BRENNER) KEMP has been recorded in Lower Cretaceous sediments in England (Kemp 1970, p. 109).

Suprasubturma PERINOTRILETES (ERDTMAN) DETTMANN 1963

**Genus *Densoisporites* (WEYLAND) DETTMANN**

Type species: *Densoisporites velatus* WEYLAND et KRIEGER.

1953: Weyland and Krieger, p. 12, Pl. 4, Figs. 12–14.

*Densoisporites velatus* WEYLAND et KRIEGER
Fig. 17

1953: Weyland and Krieger, p. 12, Pl. 4, Figs. 12–14.

ORIGINAL MATERIAL: slide Kul. 635–636/10 (94.0/47.8).
STRATIGRAPHICAL AND GEOGRAPHICAL DISTRIBUTION: Lower Liassic to Upper Cretaceous in Eurasia, North America and Australia.

Turma MONOLETES IBRAHIM 1933
Suprasubturma ACAVATOMONOLETES DETTMAN 1963
Subturma AZONOMONOLETES LUBER 1935

Infraturma LAEVIGATOMONOLETI DYBOVA et JACHOWICZ 1957

**Genus *Laevigatosporites* IBRAHIM**

Type Species: *Laevigatosporites vulgaris* (IBRAHIM) IBRAHIM.

1970: Kemp, p. 111.

*Laevigatosporites* cf. *ovatus* WILSON et WEBSTER
(not illustrated)

1946: Wilson et Webster, p. 273.

ORIGINAL MATERIAL: slide Kul. 641.90–642.50/2 (97.9/43.2).
STRATIGRAPHICAL AND GEOGRAPHICAL DISTRIBUTION: Upper Mesozoic sediments of S.E. Australia (see Dettmann 1963, p. 86).

Infraturma PSILAMONOLETI van der HAMMEN 1955

**Genus *Marattisporites* COUPER**

Type species: *Marattisporites scabratus* COUPER.

1958: Couper, p. 133.

*Marattisporites scabratus* COUPER
(not illustrated)

ORIGINAL MATERIAL: slide Kul. 641.90–642.50/2 (106.4/29.2).
STRATIGRAPHICAL AND GEOGRAPHICAL DISTRIBUTION: Lower Jurassic to Lower Cretaceous in Europe. In Sweden, previously recorded at Härninge, Rosenhäll (Guy-Ohlson 1978), Eriksdal (Tralau 1968) and Vilhelmsfält (Middle Jurassic, Guy 1971) and at Valhall (Rhaeto-Liassic sediments, Guy-Ohlson 1981).

Anteturma POLLENITES Potonié 1931

Turma SACCITES Erdtman 1947
Subturma MONOSACCITES (Chitaley 1951) Potonié et Kremp 1954

Infraturma SACCIZONATI Bhardwaj 1957

**Genus *Cerebropollenites* Nilsson**

Type Species: *Cerebropollenites mesozoicus* (Couper) Nilsson.

1958: Nilsson, p. 72.
1970: Pocock, p. 97.

*Cerebropollenites mesozoicus* (Couper) Nilsson
Fig. 24

1958: Nilsson, pp. 72–73, Pl. 6, Figs. 10–12.

Original material: slide Kul. 635–636/6 (94.8/47.3).
Stratigraphical and geographical distribution: Jurassic to Lower Cretaceous sediments in Eurasia and western Canada.

**Genus *Callialasporites* Sukh Dev**

Type species: *Callialasporites trilobatus* (Balme) Sukh Dev.

1961: Sukh Dev, p. 48 (see Paleobotanist, 8, (1, 2) 43–56).

*Callialasporites dampieri* (Balme) Sukh Dev
Fig. 47

Original material: slide Kul. 641.90–642.50/2 (92.8/30.0) and slide Kul. 641.30–641.76/2 (92.7/36.8).
Stratigraphical and geographical distribution: Middle Jurassic to Upper Cretaceous sediments. Found in both the northern and southern hemispheres. In Sweden, previously recorded at Härninge, Rosenhäll (Guy-Ohlson 1978), Eriksdal (Tralau 1968) and Vilhelmsfält (Middle Jurassic sediments, Guy 1971).

*Callialasporites* sp.
Fig. 59

Original material: slide Kul. 619.06–623.09/2 (113.1/34.3).
Description: monosaccate pollen grain with almost circular amb, and convolute folding prominent. Corpus outline also almost circular, but not so easy to distinguish. No trilete mark could be detected. Dimensions of illustrated specimen – diameter (including saccus): 41.3 μm, central body diameter: 33.2 μm, thus the corpus diameter is ¾ of the total diameter.
Stratigraphical and geographical distribution: at Kullemölla, otherwise not previously recorded in Sweden.
Remarks: the above illustrated specimen bears resemblance to both *Callialasporites segmentus* (Balme) Srivastava and to *Callialasporites minus* (Tralau) Guy, but is somewhat smaller than both of them and combines the two characteristics of convolute exoexinal folding with that of a corpus/total diameter ratio of ¾. (see Filatoff 1975, pp. 82–83).

Subturma DISACCITES Cookson 1947

**Genus *Podocarpidites* Cookson**

Type species: *Podocarpidites ellipticus* Cookson.

1947: Cookson, pp. 131–132.
1958: Potonié, p. 68.
1970: Pocock, p. 88.

*Podocarpidites* sp.
Fig. 29

Original material: slide Kul. 644.22–644.27/2 (107.8/49.0).
Description: bisaccate pollen grain. Corpus circular to oval. Sacci of variable size and with a microreticulum difficult to distinguish. Dimensions of illustrated specimen (according to Dettmann 1963, p. 17): Breadth, overall: 48.6 μm, corpus: 21.8 μm, saccus: 24.3 μm. Length of saccus: 24.3 μm, length of corpus: 17.8 μm.
Stratigraphical and geographical distribution: at Kullemölla, Sweden.

### Genus *Parvisaccites* Couper

Type species: *Parvisaccites radiatus* Couper.

1958: Couper, p. 154.

*Parvisaccites radiatus* Couper
Fig. 1

1958: Couper, p. 154, Pl 29, Figs. 5–8, Pl. 30, Figs. 1, 2.

Original material: slide Kul. 635–636/2 (103.8/38.4).
Stratigraphical and geographical distribution: Wealden, Aptian – Albian in England.

### Genus *Cedripites* Wodehouse

Type species: *Cedripites eocenicus* Wodehouse.

1933: Wodehouse, pp. 489–490, Fig. 13.

*Cedripites cretaceus* Pocock
Fig. 14

1962: Pocock, p. 63, Pl. 9, Figs. 145–146, Pl. 10, Figs. 147–148.

Original material: slide Kul. 635–636/10 (97.4/29.8).
Stratigraphical and geographical distribution: in Neocomian, Albian to? Cenomanian sediments in western Canada.

*Cedripites canadensis* Pocock
Fig. 13

1962: Pocock, pp. 63–64, Pl. 10, Figs. 149–150.
1967: Norris, p. 102, Pl. 15, Figs. 3–4.

Original material: slide Kul. 635–636/10 (104.4/39.4)
Stratigraphical and geographical distribution: Barremian to? Cenomanian sediments in Canada.

### Genus *Alisporites* (Daugherty) Nilsson

Type species: *Alisporites opii* Daugherty

1941: Daugherty, p. 98.
1958: Nilsson, p. 81.

*Alisporites thomasii* (Couper) Nilsson
Fig. 12

1958: Couper, p. 150, Pl. 26, Figs. 10–11 *(Pteruchipollenites thomasii)*.
1958: Nilsson, p. 83, Fig. 1.

Original material: slide Kul. 635–636/7 (111.0/33.3).
Stratigraphical and geographical distribution: Lower Jurassic – Lower Cretaceous in England, western Canada and? Australia.
Remarks: see Pocock 1962.

*Alisporites bilateralis* Rouse
Fig. 30

1969: Norris, Pl. 109.

Original material: slide Kul. 644.22–644.27/2 (109.4/24.2).
Stratigraphical and geographical distribution: Upper Jurassic to Lower Cretaceous in Canada.

*Alisporites grandis* (Cookson) Dettmann
(not illustrated)

1963: Dettmann, p. 102.

Original material: slide Kul. 616.07–619.06/2 (95.0/49.2).
Stratigraphical and geographical distribution: in the Upper Jurassic and Lower Cretaceous of western Australia and Canada and also in Upper Mesozoic sediments of South Eastern Australia.

### Genus *Rugubivesiculites* Pierce

Type species: *Rugubivesiculites convolutus* Pierce.

1961: Pierce, p. 39, Pl. II, Fig. 57.

*Rugubivesiculites rugosus* Pierce
Fig. 23

1961: Pierce, p. 40, Pl. II, Figs. 59–60.
1967: Norris, p. 104, Pl. 16, Figs. 6–7.

Original material: slide Kul. 635–636/10 (102.0/45.9).
Stratigraphical and geographical distribution: recorded in ? Cenomanian sediments of Minnesota and late Middle Albian sediments of Alberta, Canada.

### Genus *Vitreisporites* Leschik

Type species: (original designation) *Vitreisporites pallidus* (Reissinger) Nilsson *(= Vitreisporites signatus* Leschik).

1955: Leschik, p. 53.
1958: Nilsson, pp. 77–78.

*Vitreisporites pallidus* (Reissinger) Nilsson
(not illustrated)

1950: Reissinger, p. 109 *(Pityosporites pallidus)*.
1958: Couper, p. 150 *(Caytonipollenites pallidus)*.
1958: Nilsson, pp. 78–79.

ORIGINAL MATERIAL: slide Kul. 641.90–642.50/2 (90.5/22.2).
STRATIGRAPHICAL AND GEOGRAPHICAL DISTRIBUTION: Rhaeto-Liassic to Lower Cretaceous. Eurasia, western Canada and Australia. In Sweden, previously recorded at Eriksdal (Tralau 1968), Vilhelmsfält (Guy 1971), Härninge and Rosenhäll (Middle Jurassic sediments, Guy-Ohlson 1978) and at Valhall (Rhaeto-Liassic sediments, Guy-Ohlson 1981).

Turma ALETES IBRAHIM 1933
Subturma AZONALETES (LUBER) POTONIÉ et KREMP 1954

Infraturma PSILONAPITI ERDTMAN

**Genus *Inaperturopollenites* PFLUG ex THOMSON et PFLUG emend. POTONIÉ**

Type species: *Inaperturopollenites dubius* (POTONIÉ et VENITZ) THOMSON et PFLUG.

1953: Thomson and Pflug, p. 64.

*Inaperturopollenites dubius* (POTONIÉ et VENITZ) THOMSON et PFLUG
Fig. 11

1934: Potonié and Venitz, p. 17, Pl. 2, Fig. 21 *(Pollenites magnus dubius)*.
1953: Thomson and Pflug, p. 65, Pl. 4, Fig. 89, Pl. 5, Figs. 1–13.

ORIGINAL MATERIAL: slide Kul. 635–636/9 (99.7/23.5).
STRATIGRAPHICAL AND GEOGRAPHICAL DISTRIBUTION: in many parts of the world, widely distributed in Jurassic, Cretaceous and Tertiary sediments.

Infraturma GRANULONAPITI Cookson

**Genus *Araucariacites* COOKSON ex COUPER**

Type species: *Araucariacites australis* COOKSON.

1947: Cookson, p. 130, Pl. 13, Figs. 1–4.
1953: Cookson, p. 151 (in Couper 1958).

*Araucariacites australis* COOKSON

1947: Cookson, p. 130, Pl. XIII, Figs. 1–4.
1958: Couper, p. 151, Pl. XXVII, Figs. 3–5.

ORIGINAL MATERIAL: slide Kul. 644.22–644.27/2 (99.4/22.7).
STRATIGRAPHICAL AND GEOGRAPHICAL DISTRIBUTION: in Jurassic, Cretaceous and Tertiary sediments of both the northern and southern hemispheres.

**Genus *Campenia* MÄDLER**

Type species: *Campenia gigas* MÄDLER.

1963: Mädler, p. 350.

*Campenia gigas* MÄDLER
(not illustrated)

1963: Mädler, p. 350.
1967: Schulz, p. 600.
1978: Morbey & Dunay, p. 50 (in Thusu 1978).

ORIGINAL MATERIAL: slide Kul. 644.22–644.27/2 (95.0/41.0).
STRATIGRAPHICAL AND GEOGRAPHICAL DISTRIBUTION: in the Upper Liassic (Lias epsilon–Lias zeta 3) of Germany and in the Northwest European Continental Shelf and adjacent areas. Not previously recorded in Sweden.

Turma PLICATES (NAUMOVA 1939) POTONIÉ 1960
Subturma MONOCOLPATES IVERSON et TROELS-SMITH 1950

**Genus *Chasmatosporites* NILSSON**

Type species: *Chasmatosporites major* NILSSON.

1958: Nilsson, p. 51–55.

*Chasmatosporites* cf. *major* NILSSON
(not illustrated)

ORIGINAL MATERIAL: slide Kul. 644.22–644.27/2 (97.6/30.6).
STRATIGRAPHICAL AND GEOGRAPHICAL DISTRIBUTION: at Kullemölla. In Sweden, *Chasmatosporites major* NILSSON is known from the Lower Jurassic of Sandåkra (Nilsson 1958) and Valhall (Guy-Ohlson 1981).

**Genus *Ginkgocycadophytus* Samoilovitch**

Type species: see de Jersey 1962, p. 12.

*Ginkgocycadophytus nitidus* (Balme) de Jersey

1957: Balme, p. 30, Pl. VI, Figs. 78–80 *(Entylissa nitida)*.
1962: de Jersey, p. 12, Pl. V, Figs. 1–3.
1963: de Jersey, p. 8.

Original material: slide Kul. 642.50–644.22/3 (105.6/31.7).
Stratigraphical and geographical distribution: universal distribution occurring throughout the Mesozoic.

**Genus *Eucommiidites* Erdtman emend. Couper**

Type Species: *Eucommiidites troedssonii* Erdtman.

1948: Erdtman, pp. 267–268.
1958: Couper, p. 160.

*Eucommiidites troedssonii* Erdtman
Fig. 34

1958: Couper, pp. 160–161.

Original material: slide Kul. 641.90–642.50/2 (104.0/24.6).
Stratigraphical and geographical distribution: Triassic to Cretaceous. Eurasia and western Canada. In Sweden, at Pålsjö (Nilsson 1958), Eriksdal (Tralau 1968), Vilhelmsfält, (Middle Jurassic sediments, Guy 1971) and at Valhall (Rhaeto-Liassic sediments, Guy-Ohlson 1981).

**Genus *Monosulcites* Couper ex Couper**

Type species: (subsequent designation) *Monosulcites minimus* Cookson.

1947: Cookson, p. 135.

*Monosulcites minimus* Cookson
(not illustrated)

1947: Cookson, p. 135.

Original material: slide Kul. 641.30–641.76/2 (101.9/38.3).
Stratigraphical and geographical distribution: in Aptian-Albian sediments in England. (Kemp 1970, p. 124).

**Genus *Clavatipollenites* Couper**

Type species: *Clavatipollenites hughesii* Couper.

1958: Couper, p. 159, Pl. 31, Figs. 19–22.

*Clavatipollenites hughesii* (Couper) Kemp
Fig. 21

1968: Kemp, p. 426–430.

Original material: slide Kul. 635–636/10 (110.7/41.0).
Stratigraphical and geographical distribution: from Barremian to Upper Albian in England, likewise in U.S.A. and Canada.

*Clavatipollenites* sp.
Figs. 6 & 7

Original material: slide Kul. 635–636/2 (109.3/43.8).
Description: monosulcate pollen grain, with subcircular almost circular outline and extremely fine tectate exine. Sulcus in the described specimen is not conspicuous. The length of the grain is 30.7 μm and the width 31.5 μm.
Stratigraphical and geographical distribution: at Kullemölla, Sweden.
Remarks: the specimen bears resemblance to that of *Clavatipollenites rotundus* Kemp, but is perhaps even more rounded than the mean dimensions given by Kemp (1968, p. 45). Identity of this Kullemölla specimen with *C. rotundus* is not suggested as the sulcus and structure associated with the sulcus cannot be examined readily in this particular case.

**Genus *Perinopollenites* Couper**

Type species: *Perinopollenites elatoides* Couper.

1958: Couper, p. 152.

*Perinopollenites elatoides* Couper

1958: Couper, p. 152, Pl. 27, Figs. 9–11.

Original material: slide Kul. 641.90–642.50/2 (91.8/48.0).
Stratigraphical and geographical distribution: Lower Jurassic – Lower Cretaceous in Europe. Also found in Antarctica, Australia, U.S.A. and Canada (Norris 1967, p. 110).

Turma POROSES (NAUMOVA 1939) POTONIÉ 1960
Subturma MONOPORINES NAUMOVA 1939

**Genus *Classopollis* PFLUG**

Type species: see "remarks" in Kemp 1970, p. 125.

1953: Pflug, p. 91.

*Classopollis classoides* (PFLUG) POCOCK et JANSONIUS
Fig. 28

1961: Pocock and Jansonius, p. 443.

ORIGINAL MATERIAL: slide Kul. 642.50–644.22/3 (101.4/24.3).

STRATIGRAPHICAL AND GEOGRAPHICAL DISTRIBUTION: Jurassic to Lower Cretaceous. Present in both northern and southern hemispheres.

**Genus *Exesipollenites* BALME**

Type Species: *Exesipollenites tumulus* BALME.

1957: Balme, p. 39.

*Exesipollenites tumulus* BALME
(not illustrated)

1957: Balme, p. 39.
1970: Kemp, p. 126.

ORIGINAL MATERIAL: slide Kul. 641.30–641.76/2 (92.6/33.5).

STRATIGRAPHICAL AND GEOGRAPHICAL DISTRIBUTION: in Aptian and Albian sediments of England and Mesozoic sediments of Western Australia.

*Exesipollenites* sp.
Fig. 33

ORIGINAL MATERIAL: slide Kul. 619.06–623.09/2 (103.0/23.8)

DESCRIPTION: pollen grain with sub-circular to almost circular amb, no tetrad scar visible. Exine giving the appearance of being differentially thickened at one pole. Exine giving the impression of being regularly perforated. Diameter: 36.5 μm.

STRATIGRAPHICAL AND GEOGRAPHICAL DISTRIBUTION: at Kullemölla, Sweden.

Subturma TRIPORINES NAUMOVA 1939

**Genus *Trudopollis* PFLUG**

Type species: *Trudopollis pertrudens* (PFLUG in Thomson and Pflug) PFLUG 1953.

1953: Pflug, p. 98.
1976: Jansonius & Hills, Cards 3090 and 3091.

*Trudopollis* sp.
Fig. 45

ORIGINAL MATERIAL: slide Kul. 616.07–619.06/2 (101.1/32.3).

DESCRIPTION: pollen grain with triangular amb and sides straight. The internal cavity is almost circular, the three germinals almost protruding because of exine thickenings. Size: 16.2 μm.

STRATIGRAPHICAL AND GEOGRAPHICAL DISTRIBUTION: at Kullemölla, Sweden.

REMARKS: this is the only example, in the sediments investigated, of a palynomorph genus which is usually considered to commence its stratigraphical range in Upper Cretaceous sediments. As only *one* specimen was found it is assumed its occurrence is from contamination due to its presence in the overlying Upper Cretaceous sediments.

## ORGANIC WALLED MICROPLANKTON

(No attempt has been made to arrange the following microplankton in any systematic order).

### Genus *Palaeoperidinium* Deflandre

Type species: see Stover and Evitt 1978, p. 218.

*Palaeoperidinium caulleri* Deflandre

1934: Deflandre, p. 967, Fig. 7.
1962: Pocock, p. 80.

Original material: slide Kul. 635–636/6 (110.4/24.4).
Stratigraphical and geographical distribution: Upper and Lower Cretaceous of western Canada.

### Genus *Cribroperidinium* (Neale et Sarjeant) Davey

Type species: *Cribroperidinium sepimentum* Neale et Sarjeant.

1962: Neale et Sarjeant, p. 443.
1969: Davey, p. 125.

*Cribroperidinium edwardsii* (Cookson et Eisenack) Davey
Fig. 16

1978: Stover and Evitt, p. 150.

Original material: slide Kul. 635–636/10 (94.4/42.4).
Stratigraphical and geographical distribution: Aptian to Upper Cretaceous in Romania, England and Australia.
Remarks: this species was formerly known as *Gonyaulax edwardsii* Cookson et Eisenack (see Cookson and Eisenack 1958, pp. 32–33).

### Genus *Canningia* Cookson et Eisenack

Type species: *Canningia reticulata* Cookson et Eisenack.

1960: Cookson and Eisenack, pp. 37–39.

*Canningia* sp.
Fig. 32

1978: Stover and Evitt, pp. 24–25.

Original material: slide Kul. 642.50–644.22/3 (107.6/20.5).
Stratigraphical and geographical distribution: at Kullemölla. Various species of *Canningia* have been reported from Lower Cretaceous sediments of the northwest European Continental Shelf and adjacent areas. (Duxbery in Thusu 1978).

### Genus *Odontochitina* (Deflandre) Davey

Type species: *Odontochitina operculata* (O. Wetzel) Deflandre et Cookson.

1935: Deflandre, p. 234.
1937: Deflandre, p. 94.
1970: Davey, p. 354.

*Odontochitina operculata* (O. Wetzel) Deflandre et Cookson
Fig. 52

1955: Deflandre and Cookson, pp. 291–292.

Original material: slide Kul. 616.07–619.06/2 (96.2/40.0).
Stratigraphical and geographical distribution: considered as occurring as diagnostic taxon from the Hauterivian, Barremian and Aptian of arctic Norway. (Thusu 1978, Table II), also known from Lower Cretaceous sediments of Australia and New Guinea (Deflandre and Cookson 1958).

### Genus *Evansia* Pocock

Type species: *Evansia granulata* Pocock.

1972: Pocock, p. 95.

*Evansia* sp.
Fig. 60

1978: Stover and Evitt, p. 230.

ORIGINAL MATERIAL: slide Kul. 641.30–641.76/2 (92.2/44.7).

STRATIGRAPHICAL AND GEOGRAPHICAL DISTRIBUTION: at Kullemölla, Sweden.

REMARKS: *Evansia erregulensis* FILATOFF has been recorded from the Jurassic of western Australia and *Evansia granulata* POCOCK from the Jurassic of Canada.

**Genus *Nannoceratopsis* (DEFLANDRE) EVITT**

Type species: *Nannoceratopsis pellucida* DEFLANDRE.

1938: Deflandre, p. 183.
1961: Evitt, p. 306.

Cf. *Nannoceratopsis gracilis* (ALBERTI) EVITT
Figs. 25, 26 & 27

1961: Alberti, p. 30, Pl. 7, Figs. 16–17 *(N. gracilis)*.
1961: Evitt, pp. 308–312, Pl. 1, Figs. 1–14, Pl. 1.2, Figs. 1–29, Text-fig. 5, 9, 17 *(N.deflandrei)*.
1962: Evitt, pp. 1129–1130.
1966: Stover, pp. 41–45, 1 pl.
1978: Sarjeant, p. 7, Fig. 1.

ORIGINAL MATERIAL: slide Kul. 644.22–645.50/5 (105.5/50.5).

STRATIGRAPHICAL AND GEOGRAPHICAL DISTRIBUTION: Lower Jurassic (Liassic) but occasionally found in the Middle Jurassic (Bajocian).

REMARKS: the genus *Nannoceratopsis* can be considered as an index fossil for Jurassic sediments. *Nannoceratopsis gracilis* is essentially a Lower Jurassic form, but may be encountered as far up as in Bajocian sediments (Sarjeant 1978, p. 5). According to Stover (1966, p. 44), Gocht (1964) has pointed out that Dogger specimens of *Nannoceratopsis gracilis,* considered collectively, tend to be slightly more elongate than those from the Liassic. Measurements are given in Fig. 27 (see illustrations).

*Nannoceratopsis* sp. *cf. gracilis* (ALBERTI) EVITT

ORIGINAL MATERIAL: slides Kul.
1. 642.50–644.22/2 (upper) (111.5/48.7).
2. 642.50–644.22/3 (upper) (105.4/24.2).
3. 641.90–642.50/2 (104.6/44.3).

REMARKS: the three above mentioned specimens are slightly "distorted" or partly obscured by other palynomorph material in the slides; thus it is difficult to make a thorough examination of them. Nevertheless such distinctive characters are visible so that they can be referred to the above species.

**Genus *Systematophora* KLEMENT**

Type species: *Systematophora areolata* KLEMENT.

1960: Klement, p. 62.

*Systematophora* sp.
Fig. 55

1978: Stover and Evitt, pp. 84–85.

ORIGINAL MATERIAL: slide Kul. 619.06–623.07/2 (95.8/25.5).

REMARKS: this species of dinoflagellate is confined to the upper sediments of the samples investigated at Kullemölla.

**Genus *Hystrichodinium* (DEFLANDRE) CLARKE et VERDIER**

Type species: *Hystrichodinium pulchrum* DEFLANDRE.

1935: Deflandre, pp. 229–230.
1967: Clarke and Verdier, p. 37.

*Hystrichodinium* sp.
Fig. 53

1978: Stover and Evitt, pp. 161–162.

ORIGINAL MATERIAL: slide Kul. 631.61–635.10/2 (93.2/24.0).

REMARKS: only two specimens of the species have been recorded in one sample at Kullemölla – see Table 2.

**Genus *Spiniferites* (MANTELL) SARJEANT**

Type species: *Spiniferites ramosus* (EHRENBERG) LOEBLICH et LOEBLICH.

1978: Stover and Evitt, pp. 189–191.

*Spiniferites ramosus* (EHRENBERG) MANTELL subsp. *ramosus* DAVEY et WILLIAMS
Fig. 5, 56 & 57

ORIGINAL MATERIAL: slide Kul. 635.10–639.10/2 (98.3/22.5).
STRATIGRAPHICAL AND GEOGRAPHICAL DISTRIBUTION: recorded as ranging from Valanginian to Tertiary in the north-west European Continental Shelf and adjacent areas.

*Spiniferites* sp.
Fig. 15

ORIGINAL MATERIAL: slide Kul. 635–636/9 (108.2/41.3).
REMARKS: the above specimen is similar to that published by Baltes, 1967, Pl. IV, fig. 10, as *Hystrichosphaera furcata* (EHRENBERG) WETZEL and recorded as being present in Hauterivian to Albian sediments in Europe and Upper Cretaceous in Australia. According to Stover and Evitt 1978, p. 293, "*Hystrichosphaera*" is a junior synonym to *Spiniferites* and on p. 190 they agree that *Hystrichosphaera furcata* = *Spiniferites ramosus*.

**Genus *Tasmanites* NEWTON**

Type species: *Tasmanites punctatus* NEWTON.
1875: Newton.

*Tasmanites* sp.
Fig. 31

ORIGINAL MATERIAL: slide Kul. 635–636 (100.1/31.1).
DESCRIPTION: palynomorph almost spherical, but somewhat compressed, with thickish punctate wall. Diameter 48.6 mμ.
STRATIGRAPHICAL AND GEOGRAPHICAL DISTRIBUTION: species of *Tasmanites* have been recorded from Lower Cretaceous sediments of Germany (Filatoff 1975, p. 93). *Tasmanites* cf. *newtoni* WALL has been recorded in Swedish Jurassic sediments at Vilhelmsfält (Guy 1971).
REMARKS: this particular specimen found at Kullemölla is not particularly large but falls e.g. within the diameter size range of 44–110 μm given by Wall (1965).

**Genus *Micrhystridium* DEFLANDRE**

Type species: *Micrhystridium inconspicuum* (DEFLANDRE) DEFLANDRE.

*Micrhystridium* sp. A
Fig. 36

ORIGINAL MATERIAL: slide Kul. 644.22–644.27/2 (97.1/36.8).
REMARKS: only one single specimen (diameter: 11.3 μm, spines: 8.1 μm) has been found in this sample of the Kullemölla material. *Micrhystridium cf lymensis* WALL var. *gliscum* has been recorded from the Middle Jurassic of Vilhelmsfält (Guy 1971).

*Micrhystridium* sp. B
(not illustrated)

ORIGINAL MATERIAL: slide Kul. 641.30–641.76/2 (92.6/24.3).
REMARKS: differs from the above example by its smaller size. (Diameter: 9.7 μm, spines: 6.5 μm).

**Genus *Botryococcus* KUTZING**

Type species: *Botryococcus algarum* KUTZING.
1849: Kutzing, p. 982.

*Botryococcus* sp.
Fig. 18

ORIGINAL MATERIAL: slide Kul. 635–636/10 (96.0/43.8).
REMARKS: these large yellowish-green algal colonies are to be found throughout the interval examined in 11 of the 14 samples investigated (see Table 2). Such fresh water algal colonies are frequently found in Mesozoic sediments and probably in particular cases when found together with other organic walled microplankton (which are associated with a marine facies) *Botryococcus* is indicative of a brackish facies.

## DISCUSSION OF THE PALYNOLOGICAL RESULTS

## AND THEIR BIOSTRATIGRAPHICAL, TECTONIC AND PALAEOENVIRONMENTAL IMPLICATIONS

A word of caution concerning the discussion and subsequent interpretation of the given results is advisable. It should be remembered that Lower Cretaceous palynological assemblages have not been described before from Swedish sediments, so no direct local comparisons may be made. It is perhaps best to consider the discussion and implications of the results from Kullemölla as preliminary, and expect definite confirmation only after detailed comparison of the Kullemölla palynological assemblages with those assemblages which hopefully will be obtained from further investigation of the internationally accepted Lower Cretaceous stratotypes.

### BIOSTRATIGRAPHY

From examination of Table 2 it is possible to observe that the palynomorphs recorded in the sediments at Kullemölla can be grouped, in a general way, according to their known stratigraphical range into

(a) those palynomorphs restricted in range to Jurassic sediments,
(b) those ranging from Jurassic to Lower Cretaceous sediments,
(c) long-ranging palynomorphs from Jurassic to Upper Cretaceous,
(d) those palynomorphs restricted to Lower Cretaceous sediments,
(e) those known to occur in both Lower and Upper Cretaceous sediments, and
(f) a single specimen of a species with its stratigraphical distribution restricted to Upper Cretaceous sediments.

On the basis of the above grouping it is possible to divide biostratigraphically the samples investigated into three, namely:

(I) samples from 642.50–644.50 metres,
(II) samples from 641.00–642.50 metres,
(III) samples from 616.07–639.06 metres.

(I) *Samples from 642.50–644.50 metres*
These samples contain palynomorphs found in the first group see (a) mentioned above (i.e. palynomorphs restricted in range to Jurassic sediments). The eight species concerned occur mainly in the first four samples investigated, i.e. the interval between 642.50 and 644.50 metres. Each of the species recorded in this group is representative of so called "typical" Jurassic species because their stratigraphical distribution delimits them to this particular period. This would appear to indicate that the four samples are in fact of Jurassic age. This fact is not contradicted by the presence of the other palynomorphs in these samples which have stratigraphical distributions of Jurassic to Lower Cretaceous and Jurassic to Upper Cretaceous.

To specify a precise age within the Jurassic is more difficult. *Nannoceratopsis gracilis* (Alberti) Evitt and *Campenia gigas* Mädler both indicate Liassic age. The former has been recorded as ranging from Upper Pliensbachian to Bathonian (Stover 1966, p. 44) and the latter as ranging from Lower to Upper Toarcian (Schulz 1967, p. 600). *Nannoceratopsis gracilis* has been used as an index fossil for Jurassic sediments (Sarjeant 1978, p. 7) particularly Lower Jurassic, even though it has been found to extend occasionally into the Middle Jurassic. Those forms found in the Middle Jurassic, however, tend to differ in shape from the Liassic ones by being more elongated, whereas the Liassic forms are of a roundish nature (Gocht 1964, in Stover 1966, p. 44) as in fact is the case with the Kullemölla example.

Though the co-occurrence of *Nannoceratopsis gracilis* and *Campenia gigas* could be taken to indicate an Early Jurassic age, just how much weight should be placed upon this indication is debatable due to the fact that in each case only one specimen of each species was actually recorded in the samples under discussion. Despite this, their presence does suggest a definite Jurassic age, and even perhaps, though, only tentatively, an Early Jurassic age. This would support the suggestion of Lundegren (1934, 1935) based on lithological descriptions, of a Liassic age, at least for the lower part of the section.

(II) *Samples from 641.00–642.50 metres*

The five samples in this interval contain palynomorphs which belong mainly to groups (b), (c), (d), and (e). Approximately half of the species recorded for this interval are long-ranging species (from Jurassic to Lower or Upper Cretaceous). The other half of the species (though substantially less in actual number of individuals per species) is mainly restricted to Lower Cretaceous sediments. The palynomorphs restricted to the Lower Cretaceous include several species of *Cicatricosisporites* and several species of *Trilobosporites*. This diversity of these two genera is typical for the early part of the Lower Cretaceous succession in northwest Europe (especially true in the Wealden of southern England) and North America (Dörhöfer and Norris 1977, p. 79) and particularly where present along with such species as *Pilosisporites trichopapillosus* (THIERGART) DELCOURT et SPRUMONT and *Parvisaccites radiatus* COUPER. A more precise age of this interval is indicated by examining in detail the actual stratigraphical distribution within the Lower Cretaceous. It may be noted that the presence for example of *Cicatricosisporites purbeckensis* NORRIS indicates as wide a range as from Berriasian to Aptian, while species like *Canningia* sp., *Parvisaccites radiatus* COUPER and *Cicatricosisporites brevilaesuratus* (COUPER) KEMP appear to narrow the range from Hauterivian to Albian. The presence, however, of *Trilobosporites* spp. A & B (refer to p. 10) indicate a Berriasian–Valanginian age at least for sample 641.90–642.50 metres. These facts suggest that on the grounds of palynological content a tentative age of Berriasian to Hauterivian should be proposed for the sample interval 641.00–642.50 metres.

(III) *Samples from 616.07–639.06 metres*

This interval contains palynomorphs from a further five different samples. The palynomorphs belong to the (c), (d), (e), and (f) groups mentioned before, having long-ranging stratigraphical distributions from Jurassic to Lower and Upper Cretaceous, just Lower Cretaceous, Lower and Upper Cretaceous and solely Upper Cretaceous, respectively. The last named group is only represented by *one* single specimen of *Trudopollis* sp. and as it occurs in the sample at 616.07 metres (i.e. highest up in the interval investigated just beneath the overlying Upper Cretaceous sediments which have not been examined in *this* investigation of the Kullemölla boring core) it is thus perhaps best considered in this particular interval as contamination from the overlying Upper Cretaceous sediments.

Chatziemmanouil (1979 and 1982 in press) has biostratigraphically investigated the Kullemölla boring-core studying in particular the Foraminifera. He found no Foraminifera present in the total interval, 616.07–644.50 metres, with which the present investigation is concerned.

The only evidence for the age of this sample interval (i.e. 616.07–639.06 metres) is the presence of twenty-one species of palynomorphs restricted, as far as is known, to Lower Cretaceous sediments (see Table 2 for both the names of the species and the numbers of the specimens for each species).

The presence also in the same samples of Jurassic to Lower and Upper Cretaceous long-ranging palynomorphs is only to be expected just as is also the presence of palynomorphs of known Lower to Upper Cretaceous stratigraphical distribution. It is perhaps significant though, that the long-ranging species of older age (Jurassic to Early and Late Cretaceous) dominate over those ranging from Early to Late Cretaceous age (ratio: 18:3). This proportion suggests that the exact Early Cretaceous age of these sediments might be more to the older part of the Early Cretaceous rather than to the younger part of the Early Cretaceous which would have been indicated by the presence of a greater number of species with Lower to Upper Cretaceous stratigraphical distribution.

A more precise age can be obtained by examining the exact stratigraphical distribution of the 21 species restricted to the Lower Cretaceous. Examining this particular group in Table 2 the stratigraphical distribution can be narrowed to that of Valanginian to Albian on the basis of the presence of *Spiniferites ramosus* (EHRENBERG) MANTELL for the entire interval as *Spiniferites ramosus* occurs in each of the samples.

The presence of *Odontochitina operculata* (WETZEL) DEFLANDRE et COOKSON, however, indicates an Hauterivian to Aptian age for the uppermost 2 samples, namely that at 619.06–623.09 metres and that at 616.07–619.06 metres. Taking the whole assemblage of this interval between 616.07 and 639.06 metres into consideration it would appear that on the grounds of *palynological evidence* a Valanginian to Hauterivian age for the interval 631.61–639.06 metres can be suggested tentatively and likewise tentatively a Hauterivian to Aptian age for the strata from 616.07–623.07 metres.

## TECTONIC ACTIVITY

In the light of the foregoing tentative biostratigraphical age determinations it is of interest to recall to mind that the strata of the Kullemölla borehole are recorded (Gavelin 1919, p. 225) as being conformable to a depth of

640 metres but thereafter from 640–645.50 metres the sediments were recorded as being tilted (60°–80°). This discordance must have occurred somewhere between what has been termed the sample interval (II) and the sample interval (III), i.e. between the depth of 639.06 and 641.00 metres. If the biostratigraphical ages based on the palynological evidence are accepted, even tentatively, this would suggest that the tilting of the strata must have occurred towards the end or shortly after what has been determined as the Berriasian–Hauterivian.

## PALAEOENVIRONMENT

In the total interval studied different palaeoenvironments can be observed and accounted for

(I) *Samples from 642.50–644.50 metres*
The presence of the dinoflagellate *Nannoceratopsis gracilis* (Alberti) Evitt in the sample at 644.27–644.50 metres is taken to indicate a marine facies, whereas the occurrence of *Classopollis* sp. and the other palynomorphs in the samples 642.50–644.27 metres are taken as representing a near-shore coastal vegetation (Pocock and Jansonius 1961 and Herngreen, van Hoeken-Klinkenberg and De Boer 1980, p. 361).

(II) *Samples from 641.00–642.50 metres*
Here the increase in the total number of species represented is very apparent compared with the previous interval. Overall, the species present indicate limnic facies, and the high number of *Botryococcus* compared with the number of *Classopollis* sp. in sample 641.00–641.30 metres is consistent with that already found for the Berriasian in Holland (Herngreen *et al.* 1980, p. 36, text-fig. 4). The aquatic palynomorph, *Botryococcus*, is usually indicative of a freshwater environment, but when found with other organic-walled microplankton suggests significant freshwater influence on the depositional environment. The site of deposition may have been near-shore, close to a river mouth.

(III) *Samples from 616.07–639.06 metres*
Here there are present in the samples a number of organic-walled microplankton, mainly dinoflagellate cysts, which indicate a marine facies for the entire interval from 616.07–639.06 metres. The fact that these sediments probably accumulated during a marine transgression is indicated by the reduction in the number of individuals of *Classopollis*, the presence of very few specimens of *Botryococcus* and the increase in the abundance of dinoflagellate species which are present in each of the samples examined. This is in agreement with what has already been shown by Herngreen *et al.* (*loc. cit.* p. 362) for the transgression at the beginning of the Valanginian in the Netherlands. In Scania, Norling (1970, 1977, 1981) recorded the first Early Cretaceous transgression in Valanginian time based on Foraminifera. These palaeoenvironmental implications thus corroborate the tentative biostratigraphical age suggestions of Valanginian to Aptian for these strata. Thus in the total sedimentary interval (616.07–644.50 metres) examined, several changes of depositional environment are indicated from marine to limnic, then brackish and again marine. The palynomorphs vary in *colour* from light yellow to yellow-orange. They would probably obtain a value of 3 on the thermal alteration index scale of Batten (1981) which would indicate that the sediments are immature from the hydrocarbon generation viewpoint.

## COMPARISON OF PALYNOLOGICAL CONTENT

Many studies of Lower Cretaceous palynological assemblages have been published in e.g. U.S.A. (Stover 1964), Canada (Pocock 1962, 1967 & 1976 and Brideaux 1971, 1973 & 1974), England (Hughes 1958, 1973, Hughes and Croxton 1973, Hughes and Moody Stuart 1969, Norris 1969, Kemp 1970, Batten 1968, 1972, 1973), Europe (e.g. Baltes 1967, Dörhöfer and Norris 1977) etc. In fact, the list is so extensive that only work of particular relevance to Kullemölla will be commented upon here.

When reporting on Lower Cretaceous palynomorph assemblages from Arundel, Maryland, U.S.A., Stover (1964) noted that despite their wide geographical separation 23 of the 35 species from the Arundel Formation also occurred in the Lower Cretaceous Wealden sequence of England. Twenty of these twenty-three found common to both localities are also found in the Kullemölla sediments (616.07–639.06 metres) which have been suggested as being of Early Cretaceous age.

Dispersed microspore assemblages isolated from the uppermost Jurassic and lowermost Cretaceous strata of the Western Canada plains were described by Pocock (1962). The similarity of the actual content of the assemblages from the Canadian Neocomian sediments with that of Kullemölla is not marked at the species level, but more so at the generic level (*loc. cit. ad.* p. 28). The Canadian sediments also demonstrate that the first appearance of e.g. *Cicatricosisporites* is a reliable indicator of basal Cretaceous age (Pocock 1967, p. 29) as is also the case at Kullemölla. Part of these Canadian assemblages were compared by Kemp (1970, p. 133) with Aptian and Albian miospores from southern England. Likewise, Kemp made further comparisons with American and Australian microfloras of similar age.

Hughes (1973) pointed out and discussed the theoretical difficulties involved in palynological time correlations of the English non-marine Wealden succession with the traditional and international stratigraphical scale of the marine Cretaceous of Europe. He favoured the use of biorecords expressing little faith in, for example, the comparison of explicit palynological content on the grounds that certain taxa used for such purposes are unreliable and tend to have such long stratigraphical ranges that they give no indication of age better than merely Early Cretaceous.

Despite this, there are present at Kullemölla so many species which have been recorded already for Jurassic–Lower Cretaceous palynological investigations in other countries that some qualitative comparison may, in fact, be of interest, especially as the presence of certain organic-walled microplankton with restricted stratigraphical range enable more precise tentative age suggestions (Thusu 1978).

It may be noted, e.g. in Hughes' (1973, p. 188) time correlation statement under "119" that *Clavatipollenites hughesii* (Couper) Kemp makes its appearance for the first time at what could be interpreted as the "Hauterivian – Barremian boundary". This would be similar to the appearance of *Clavatipollenites hughesii* (Table 2) in the Kullemölla sample 635–636 (suggested as being Valanginian–Hauterivian in age) and also the existence of the same species in the sample 619.06–623.09 metres (suggested as being Hauterivian–Aptian/Albian in age).

By comparison with the work of Dörhöfer and Norris (1977) it would seem that part of the palynological content of the Kullemölla material has more in common with the German (Bückeberg Formation–Lower Saxony Basin) 'palynofloral succession' than with that of e.g. Britain described under the headings of Suite A (Tithonian), Suite B (Lower Berriasian = Upper Volgian), and Suite C (Upper Berriasian–Lower Valanginian), *loc. cit.* 83–85 (Norris 1969). Similarity can be noted e.g. between the palynological interval of the samples constituting the interval between 641.00–642.50 metres at Kullemölla and the Hils-1 palynological suite of Dörhöfer by the presence in both of several species of *Trilobosporites, Cerebropollenites mesozoicus* (Couper) Nilsson, *Pilosisporites trichopapillosus* Delcourt et Sprumont, *Cicatricosisporites purbeckensis* Norris along with several other species of *Cicatricosisporites*. The Hils-1 suite is of Late Berriasian age which would tie in well with the probable Berriasian age suggested for the Kullemölla sample interval of 641.00–642.50 metres. Less obvious are the similarities of the Hils suites (2–4) with the remaining sample interval of the Kullemölla material.

Though only minor qualitative comparisons may be made on the grounds of palynological content over vast geographical distances it is, nevertheless, of interest to observe the general similarities or differences which characterise the various Lower Cretaceous assemblages.

## CONCLUSION

On the basis of the palynological content of the samples examined from the interval 616.07 to 644.50 metres of the Kullemölla boring core it has been possible to *tentatively* suggest:

(a) an Early Jurassic age for the interval between 642.50–644.50 metres,
(b) a Berriasian-Hauterivian age for the interval between 641.00–642.50 metres,
(c) a Valanginian to Hauterivian age for the interval between 631.61–639.06 metres, and
(d) a Hauterivian to Aptian-Albian age for the interval 616.07–623.09 metres.

(The presence in the Kullemölla boring core of selected palynomorphs of stratigraphical importance is summarized in Table 1.)

If these ages are accepted, even tentatively, then the tectonic activity which accounts for the unconformity between 639.06 and 641.00 metres must have occurred towards the end of the Berriasian–Hauterivian.

Palaeoenvironmental changes from marine to limnic, through brackish and back to marine are suggested by the composition of the palynomorph assemblages.

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## ALPHABETICAL LIST OF PALYNOMORPHS

Alisporites thomasi (COUPER) NILSSON
Alisporites bilateralis ROUSE
Alisporites grandis (COOKSON) DETTMANN
Araucariacites australis COOKSON
Baculatisporites comaumensis (COOKSON) POTONIÉ
Botryococcus sp.
Calamaspora mesozoica COUPER
Callialasporites sp.
Callialasporites dampieri (BALME) SUKH DEV
Campenia gigas MÄDLER
Canningia sp.
Chasmatosporites cf. major NILSSON
Cicatricosisporites purbeckensis NORRIS
Cicatricosisporites sp. A
Cicatricosisporites sp. B
Cicatricosisporites sp. C
Cicatricosisporites brevilaesuratus (COUPER) KEMP
Cicatricosisporites ludbrooki DETTMANN
"Classopollis classoides" (PFLUG) POCOCK et JANSONIUS
Clavatipollenites sp.
Clavatipollenites hughesii (COUPER) KEMP
Cedripites cretaceus POCOCK
Cedripites canadensis POCOCK
Cerebropollenites mesozoicus NILSSON
Ceratosporites sp.
Coronatospora valdensis (COUPER) DETTMANN
Concavissimisporites informis DÖRING
Concavissimisporites variverrucatus (COUPER) BRENNER
Contignisporites sp.
Cribroperidinium edwardsi (COOKSON et EISENACK) DAVEY
Cyathidites australis COUPER
Cyathidites minor COUPER
Densoisporites velatus WEYLAND et KRIEGER
"Evansia" sp.
Eucommiidites troedsonii ERDTMAN
Exesipollenites sp.
Exesipollenites tumulus BALME
Gleicheniidites senonicus (ROSS) SKARBY
Ginkgocycadophytus nitidus (BALME) de JERSEY
"Hystrichosphaera" sp.
Hystrichodinium sp.
Inaperturopollenites dubius (POTONIÉ et VENITZ) THOMSON et PFLUG
Klukisporites (Ischyosporites) sp.
Laevigatosporites cf. ovatus WILSON et WEBSTER
Lycopodiumsporites clavatoides (COUPER) TRALAU
Marattisporites scabratus COUPER
Matonisporites sp.
Micrhystridium sp. A
Micrhystridium sp. B
Monosulcites minimus COOKSON
Nannoceratopsis gracilis (ALBERTI) EVITT
"Nannoceratopsis" sp.
Odontochitina operculata (WETZEL) DEFLANDRE et COOKSON
"Palaeoperidinium caulleri" DEFLANDRE
Parvisaccites radiatus COUPER
Perinopollenites elatoides COUPER
Pilosisporites trichopapillosus (THIERGART) DELCOURT et SPRUMONT
Podocarpidites sp.
Patellasporites sp.
Rugubivesiculites rugosus PIERCE
Schizosporis sp.
Sp. indet.
Spiniferites ramosus (EHRENBERG) MANTELL
Stereisporites sp.
"Systematophora" sp.
Tasmanites sp.
Todisporites cf. minor COUPER
Trilobosporites sp. A
Trilobosporites sp. B
Trilobosporites sp. C
Trudopollis sp.
Uvaesporites sp.
Vitreisporites pallidus (REISSINGER) NILSSON

## PLATES I–VIII

Illustrations of the palynomorphs which were suitable for photography. All photographs were taken at a magnification of ×1000 (unless otherwise stated) under oil immersion on the Leitz Wetzlar microscope No. 940229 at the Swedish Museum of Natural History. Yvonne Arremo, the photographer at the Section of Palaeobotany, has developed and printed all the photographs and has also taken the two photographs of the dinoflagellate in Figs. 25 and 26. The remaining photos were taken using the automatic photographic equipment on the above-mentioned microscope No. 940229. The figures in brackets after the slide numbers are the reference co-ordinate numbers on the above-mentioned microscope.

The slide material is the property of the Department of Geological History and Palaeontology of the University of Lund, but the slides are deposited at the Section of Palaeobotany, Swedish Museum of Natural History, Stockholm.

## PLATE I

Fig. 1: *Parvisaccites radiatus* Couper
K. 635–636/2 (103.8/38.4)

Fig. 2: Sp. indet.
K. 635–636/2 (103.5/38.4)

Fig. 3: Sp. indet.
K. 635–636/2 (104.6/22.0)

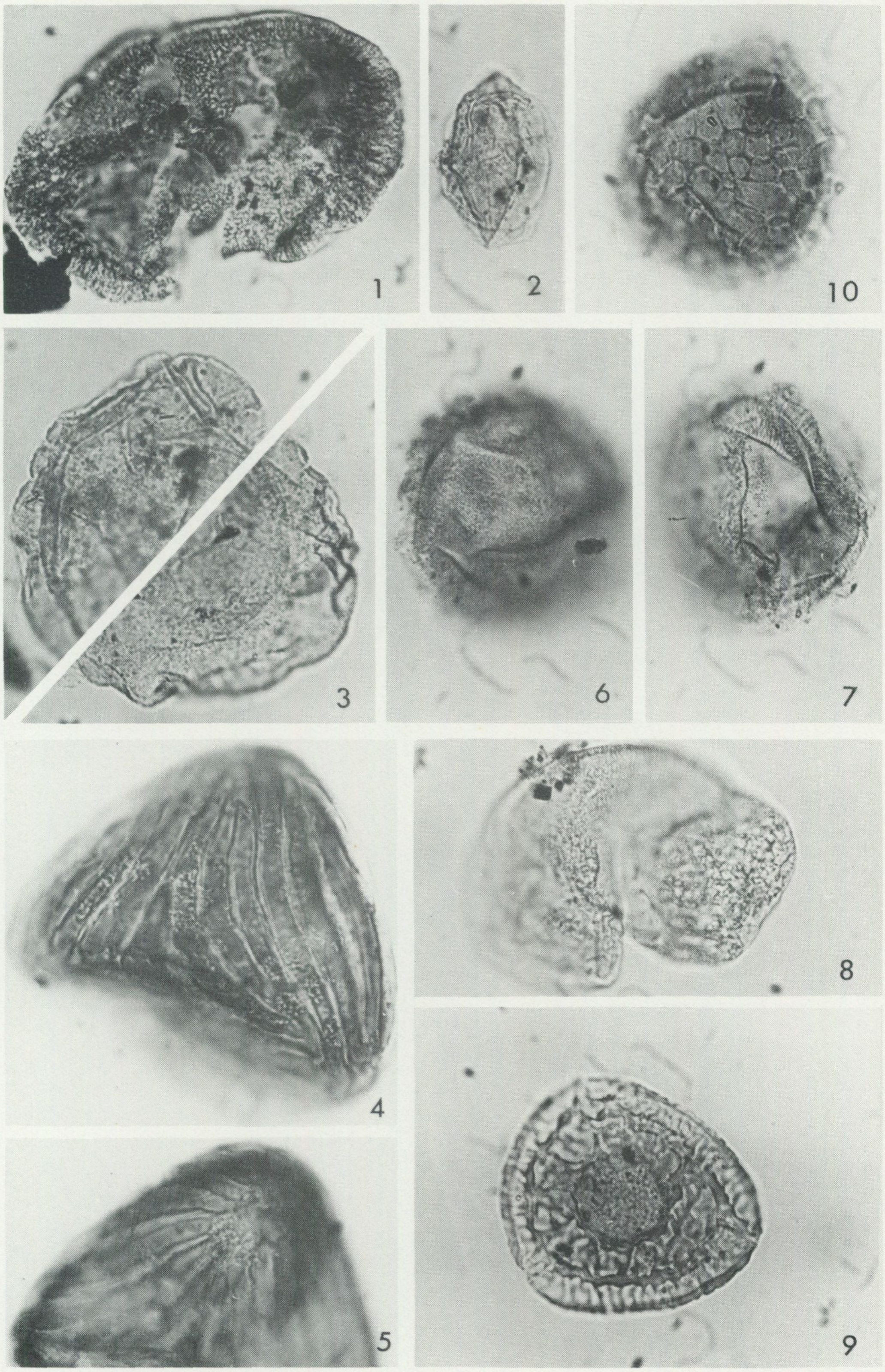
Figs. 4 & 5: *Cicatricosisporites brevilaesuratus* (Couper) Kemp
K. 635–636/2 (108.0/44.4)

Figs. 6 & 7: *Clavatipollenites* sp.?
K. 635–636/2 (109.3/43.8)

Fig. 8: Sp. indet.
K. 635–636/4 (113.5/21.8)

Fig. 9: *Coronatospora valdensis* Couper
K. 635–636/8 (100.7/29.2)

Fig. 10: *Lycopodiumsporites clavatoides* (Couper) Tralau
K. 635–636/9 (92.7/46.8)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## PLATE II

Fig. 11: *Inaperturopollenites dubius* (Potonié et Venitz) Thomson et Pflug.
K. 635–636/9 (99.7/23.5)

Fig. 12: *Cf. Alisporites thomasi* (Couper) Nilsson
K. 635–636/7 (111.0/33.3)

Fig. 13: *Cedripites canadensis* Pocock
K. 635–636/10 (104.4/39.4)

Fig. 14: *Cedripites cretaceus* Pocock
K. 635–636/10 (97.4/29.8)

Fig. 17: *Densoisporites velatus* Weyland et Krieger
K. 635–636/10 (94.0/47.8)

Fig. 18: *Botryococcus* sp.
K. 635–636/10 (96.0/43.8)

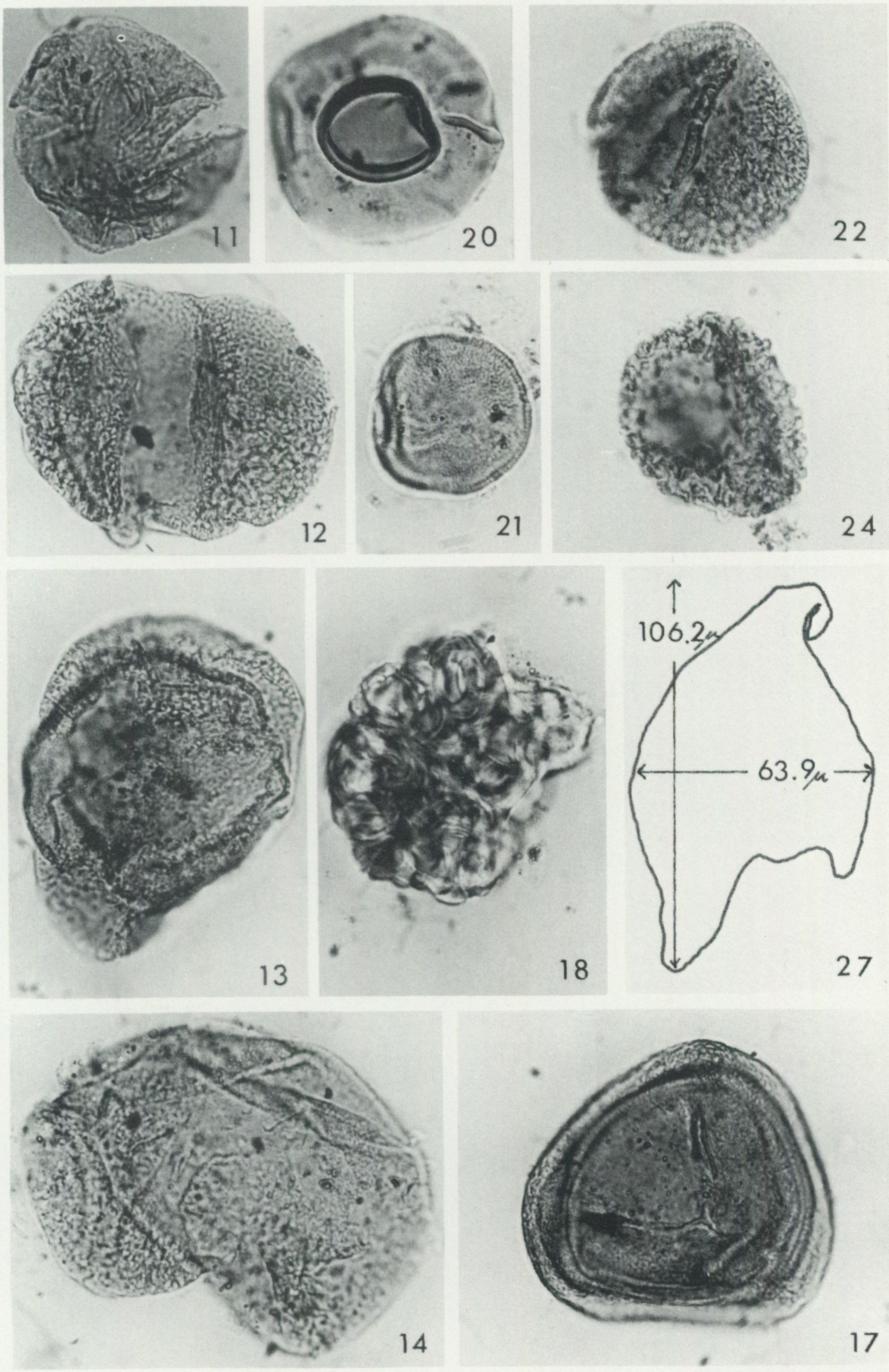
Fig. 20: Sp. indet.
K. 635–636/9 (104.0/38.1)

Fig. 21: *Clavatipollenites hughesii* Couper
K. 635–636/10 (110.7/41.0)

Fig. 22: Sp. indet.
K. 635–636/10 (99.4/23.9)

Fig. 24: *Cerebropollenites mesozoicus* (Couper) Nilsson
K. 635–636/6 (94.8/47.3)

Fig. 27: Approximate dimensions of the dinoflagellate in Fig. 25.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106.2μ
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## PLATE III

Fig. 15: *Spiniferites* sp.
K. 635–636/9 (108.2/41.3)

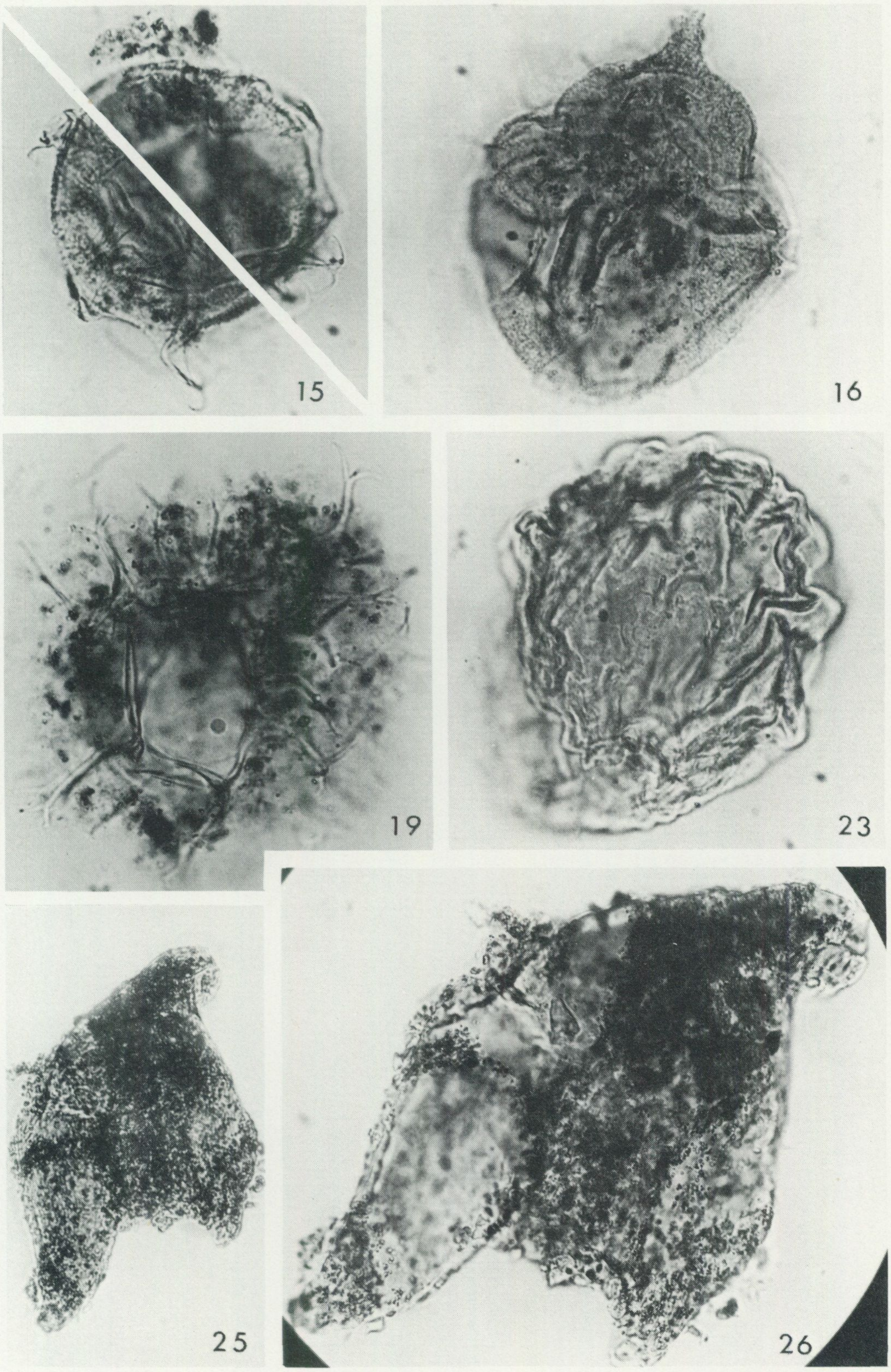
Fig. 16: *Cribroperidinium edwardsii* (COOKSON et EISENACK) DAVEY
K. 635–636/10 (94.4/42.4)

Fig. 19: Sp. indet.
K. 635–636/10 (96.5/43.3)

Fig. 23: *Rugubivesiculites rugosus* PIERCE
K. 635–636/10 (102.0/45.9)

Fig. 25: *Nannoceratopsis gracilis* (ALBERTI) EVITT
K. 644.50/5 (105.5/50.5)
(×400) and correctly orientated.

Fig. 26: as above, but (×800) and incorrectly orientated.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## PLATE IV

Fig. 28: *Classopollis classoides* (PFLUG) POCOCK et JANSONIUS
K. 642.50–644.22/2 (101.4/24.3)

Fig. 29: *Podocarpidites* sp.
K. 644.22–644.27/2 (107.8/59.0)

Fig. 30: *Alisporites bilateralis* ROUSE
K. 644.22–644.27/2 (109.4/24.2)

Fig. 31: *Tasmanites* sp.
K. 635–636/9 (100.1/31.1)

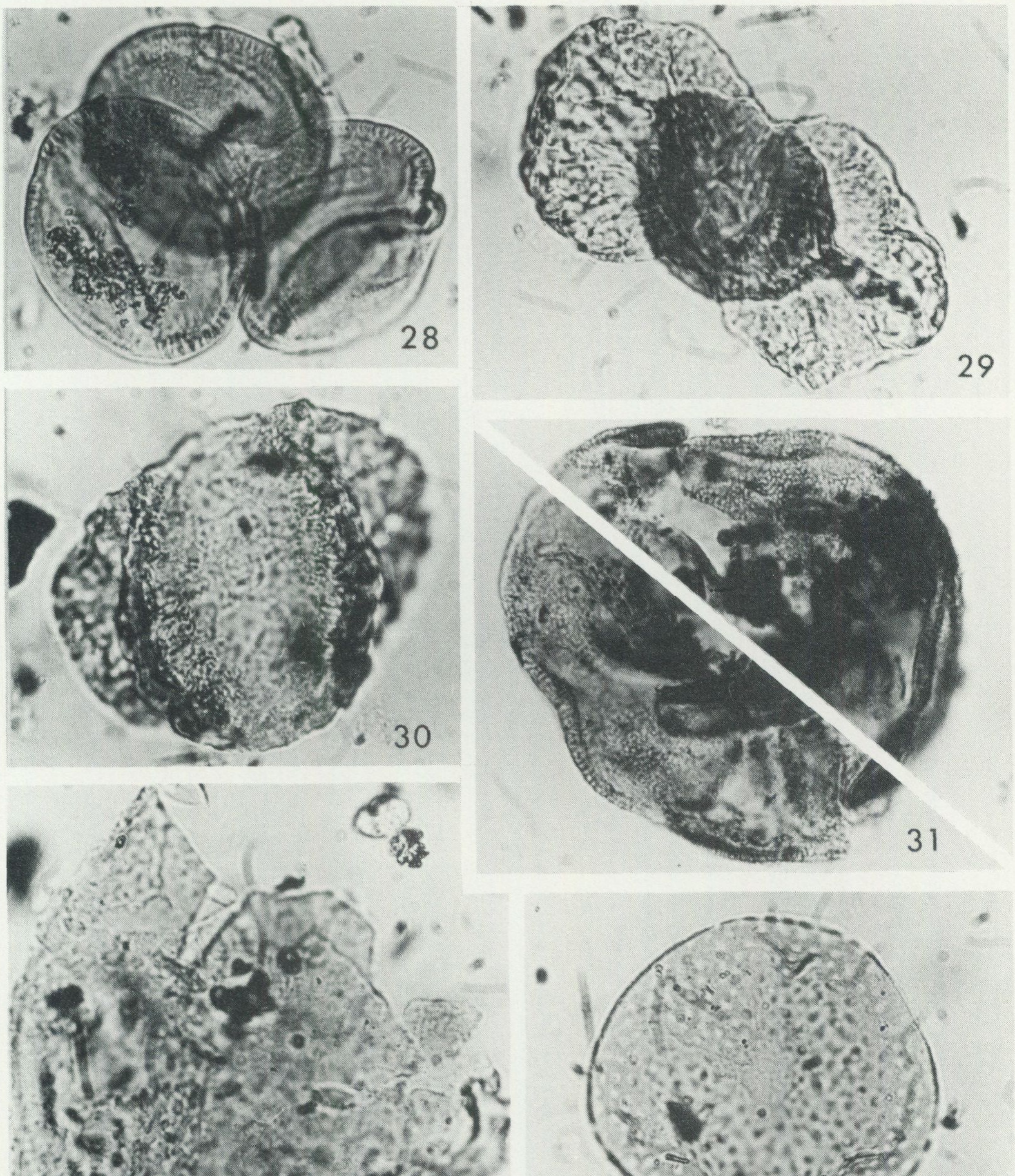
Fig. 32: *Canningia* sp.
K. 642.50–644.22/3 (107.6/20.5)

Fig. 33: *Exesipollenites* sp.
K. 619.06–623.09/2 (103.0/23.8)

Fig. 34: *Eucommiidites troedssonii* ERDTMAN
K. 641.90–642.50/2 (101.0/47.0)

Fig. 35: *Ceratosporites* sp.
K. 641.90–642.50/3 (105.2/29.3)

Fig. 36: *Micrhystridium* sp.
K. 644.22–644.27/2 (97.1/36.8)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## PLATE V

Fig. 37: *Trilobosporites* sp. A.
K. 641.90–642.50/2 (92.3/34.6)

Fig. 38: *Trilobosporites* sp. B.
K. 641.90–642.50/2 (101.0/47.0)

Figs. 39 & 40: *Trilobosporites* sp. C.
K. 619.06–623.09/2 (112.4/23.5)

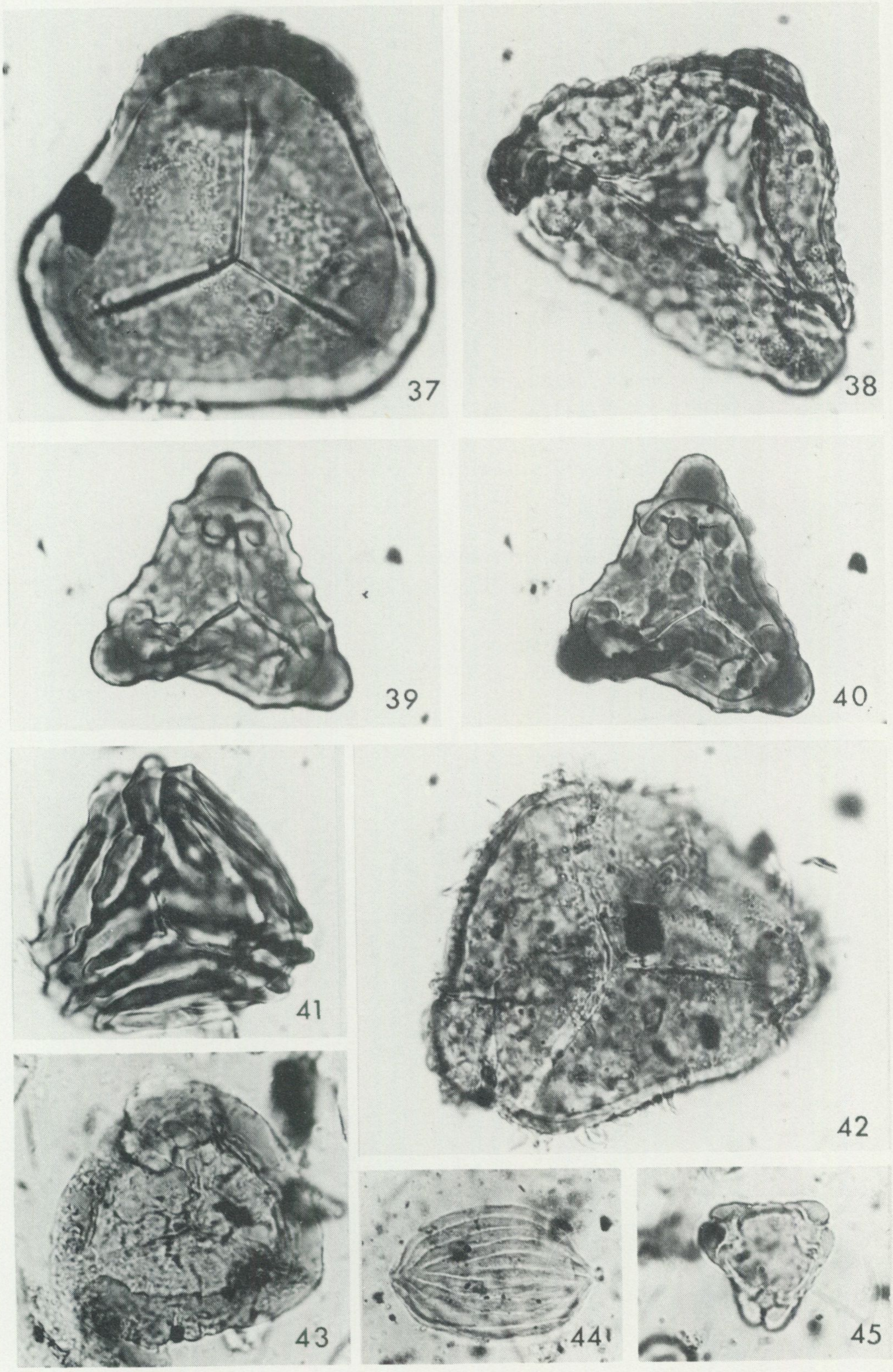
Fig. 41: *Cicatricosisporites purbeckensis* NORRIS
K. 641.90–642.50/3 (98.6/38.2)

Fig. 42: *Pilosisporites trichopapillosus* (THIERGART) DELCOURT et SPRUMONT
K. 641.90–642.50/3 (91.5/30.4)

Fig. 43: *Patellasporites* sp.
K. 641.90–642.50/3 (104.0/33.2)

Fig. 44: Sp. indet.
K. 616.07–619.06/2 (109.8/31.0)

Fig. 45: *Trudopollis* sp.
K. 616.07–619.06/2 (101.1/32.3)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# PLATE VI

Fig. 46: *Concavissimisporites variverrucatus* (COUPER) BRENNER
K. 644.22–644.27/2 (101.2/27.2)

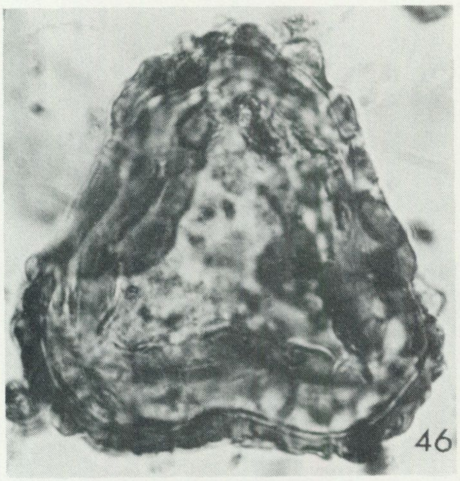
Fig. 47: *Callialasporites dampieri* (BALME) SUKH DEV
K. 641.30–641.76/2 (92.7/36.8)

Fig. 48: *Concavissimisporites informis* DÖRING
K. 641.76–641.90/2 (108.6/21.7)

Fig. 49: *Cicatricosisporites* sp. C
K. 616.07–619.06/2 (105.3/35.1)

Fig. 50: *Cicatricosisporites* sp. A
K. 641.90–642.50/3 (109.4/23.0)

Fig. 51: *Cicatricosisporites* sp. B
K. 631.61–635.10/2 (101.0/45.0)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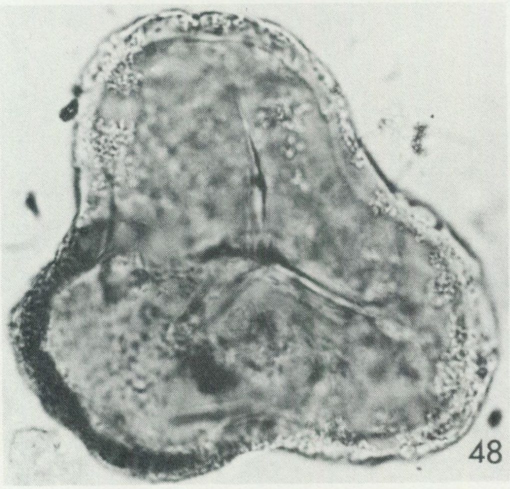
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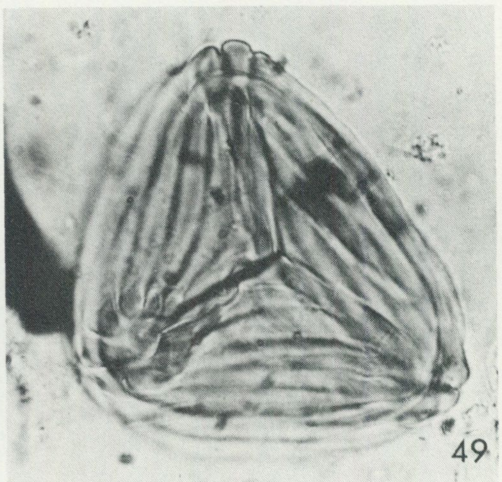
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## PLATE VII

Fig. 52: *Odontochitina operculata* (WETZEL) DEFLANDRE et COOKSON
K. 616.07–619.06/2 (96.2/40.0)

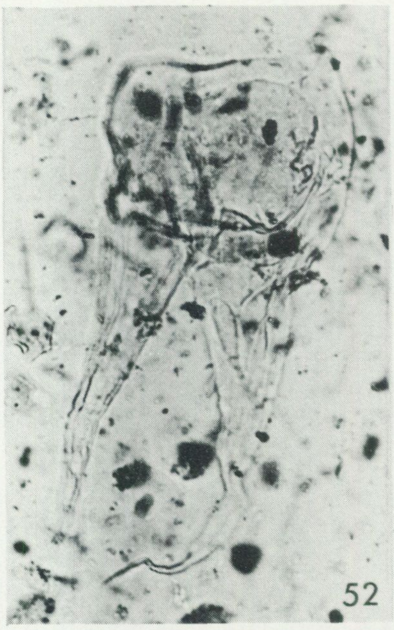
Fig. 53. *Hystrichodinium* sp.
K. 631.61–635.10/2 (93.2/24.0)

Fig. 54: *Canningia* sp.?
K. 616.07–619.06/2 (97.5/51.0)

Fig. 55: *Systematophora* sp.
K. 616.07–619.06/2 (91.4/26.8)

Fig. 56: *Spiniferites ramosus* (EHRENBERG) MANTELL subsp. *ramosus* DAVEY et WILLIAMS
K. 631.61–635.10/2 (93.6/39.1)

Fig. 57: *Spiniferites ramosus* (EHRENBERG) MANTELL subsp. *ramosus* DAVEY et WILLIAMS
K. 619.06–623.09/2 (113.4/41.6) (×400)



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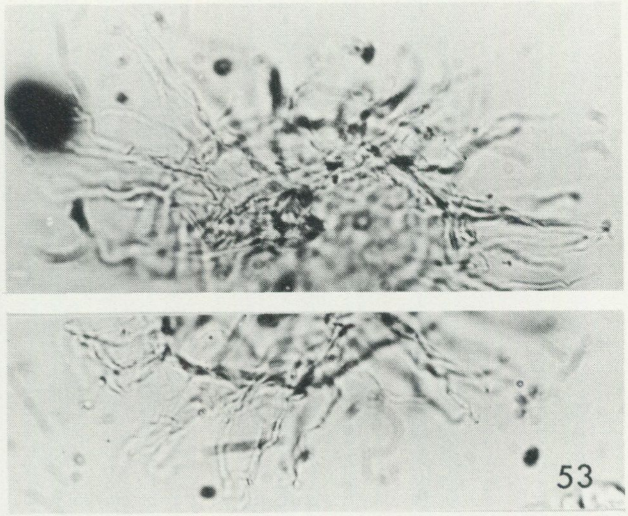

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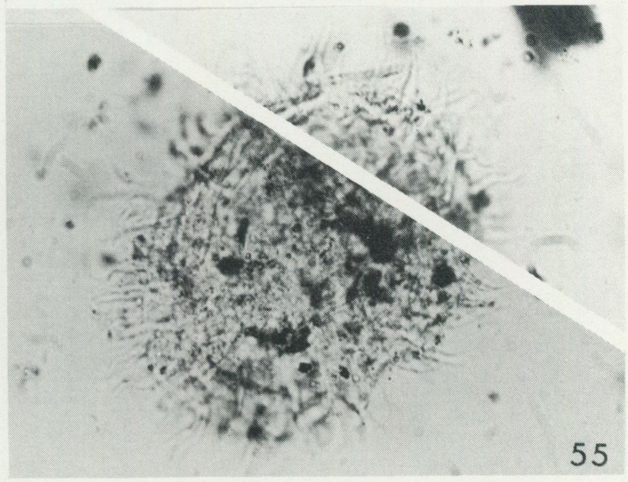

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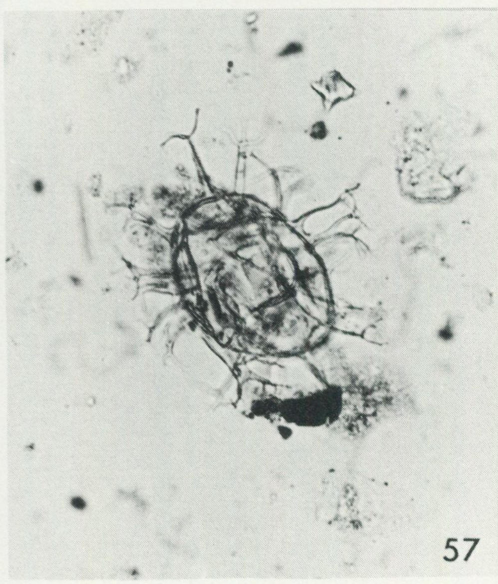

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# PLATE VIII

Fig. 58: *Ischyosporites* sp.
K. 641.90–642.50/3 (104.0/35.0)

Fig. 59: *Callialasporites* sp.
K. 619.06–623.09/2 (113.1/34.3)

Figs. 60 & 61: *Evansia* sp.?
K. 641.30–641.76/2 (92.2/44.7)

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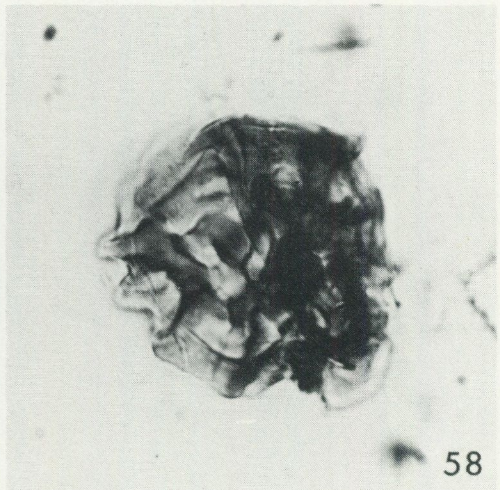

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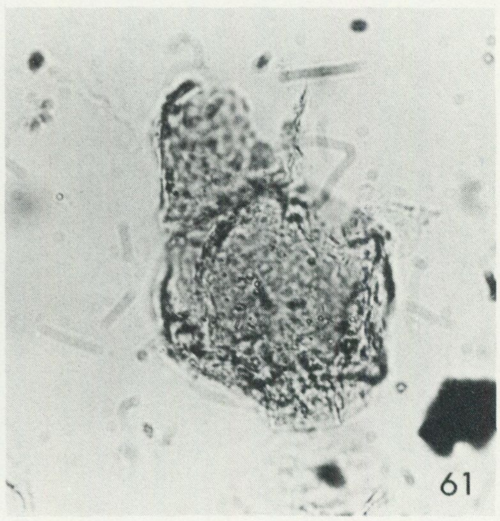

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## KULLEMÖLLA BORE NO.1, SCANIA

Stratigraphical distribution of palynomorphs: JURASSIC; CRETACEOUS — LOWER: BERRIASIAN, VALANGINIAN, HAUTERIVIAN, BARREMIAN, APTIAN, ALBIAN; UPPER: CENOMANIAN, TURONIAN, SENONIAN.

No. of palynomorphs present in samples examined.

| LIST OF PALYNOMORPHS PRESENT | 644.27-644.50 m x | 644.22-644.27 m | 642.50-644.22 m (1) | 642.50-644.22 m (2) | 641.90-642.50 m | 641.76-644.27 m x | 641.76-641.90 m | 641.30-641.76 m | 641.00-641.30 m | 635.10-639.06 m | 635 - 636 m x | 631.61-635.10 m | 619.06-623.09 m | 616.07-619.06 m |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nannoceratopsis gracilis | 1 | | | | | | | | | | | | | |
| Campenia gigas | | 1 | | | | | | | | | | | | |
| Micrhystridium sp. A | | 1 | | | | | | | | | | | | |
| "Nannoceratopsis" sp. | | | | 3 | 1 | | | | | | | | | |
| Todisporites sp. | | 1 | | | 1 | | | | | | | | | |
| Micrhystridium sp. B | | | | | | | | 1 | | | | | | |
| Chasmatosporites sp. | | 1 | | | | | | | | | | | | |
| "Evansia" sp. | | | | | | | | 1 | | | | | | |
| Marattisporites scabratus | | | | | 1 | | | | | | | | | |
| Klukisporites (Ischyosporites) sp. | | 1 | | | 1 | | | | | | | | | |
| Callialasporites dampieri | | | | | 2 | | | 1 | | | | | | |
| Callialasporites sp. | | | | | | | | | | | | | 2 | |
| Vitreisporites pallidus | | 1 | | 1 | 13 | | | 1 | | | | | 1 | |
| "Classopollis classoides" | | 9 | 20 | | 32 | | 1 | 14 | 3 | | | | 1 | |
| Alisporites thomasi | | | | | 2 | | 1 | | 5 | | 1 | 2 | 3 | |
| Cerebropollenites mesozoicus | | 6 | 1 | 1 | 9 | | 1 | 3 | 5 | | 2 | 1 | 5 | 1 |
| Cyathidites australis | | 2 | | | 24 | | 1 | 2 | 1 | | 2 | | 3 | 9 |
| Perinopollenites elatoides | | | 1 | 1 | 16 | | | 9 | | 1 | 1 | | | 1 |
| Cyathidites minor | | 21 | 12 | 5 | 20 | | | 2 | 2 | 1 | 3 | 1 | | 2 |
| Lycopodiumsporites clavatoides | | | | | | | | | | | 1 | | | |
| Ceratosporites sp. | | | | | 2 | | | | | | 1 | | | |
| Densoisporites velatus | | 1 | | | | | | | | | 1 | | | |
| Araucariacites australis | | 3 | 10 | 5 | 21 | | | 18 | 6 | | 2 | 9 | 7 | 49 |
| "Palaeoperidinium caulleri"? | | | | | | | | | | | 1 | | | |
| Monosulcites minimus | | | | | | | | 2 | 1 | | | | | |
| Baculatisporites comaumensis | | 2 | 3 | | | | | | 4 | | | | 1 | 3 |
| Gleicheniidites senonicus | | 1 | | 1 | 1 | | 1 | 17 | 1 | | | 1 | 2 | 5 |
| Eucommiidites troedsonii | | | | | 1 | | | 4 | | | | | | |
| Inaperturopollenites dubius | | | | | | | | 13 | | | 5 | | | |
| Botryococcus sp. | | 4 | 12 | 6 | 8 | | 1 | 3 | 82 | 1 | | 3 | 4 | 8 |
| Ginkgocycadophytus nitidus | | | 2 | | | | | | | | 1 | | | |
| Concavissimisporites variverrucatus | | 1 | | | | | | | | | | | | |
| Exesipollenites tumulus | | | | | | | | 1 | 1 | | | 1 | | |
| Calamaspora mesozoica | | 1 | | | | | | 1 | | | | | | |
| Laevigatosporites cf. ovatus | | | | | 1 | | | | | | | | | |
| Alisporites bilateralis | | 2 | | | 1 | | | | | | | | | |
| Concavissimisporites informis | | | | | | | 1 | | | | | | | |
| Podocarpidites sp. | | 1 | | | | | | | 1 | | 2 | | | |
| Exesipollenites sp. | | | | | | | | | | | | | 2 | |
| Trilobosporites sp. A | | | | | 1 | | | | | | | | | |
| Trilobosporites sp. B | | | | | 1 | | | | | | | | | |
| Cicatricosisporites sp. A | | | | | 1 | | | | | | | | | |
| Cicatricosisporites sp. B | | | | | | | | | | | | 3 | | 2 |
| Cicatricosisporites sp. C | | | | | | | | | | | | | | 3 |
| Cicatricosisporites purbeckensis | | | | | 4 | | | | | | | | | |
| Coronatospora valdensis | | 2 | | | | | | | | | | 1 | | |
| Spiniferites ramosus | | | | | | | | | | 1 | 6 | 3 | 9 | 11 |
| Trilobosporites sp. C | | | | | | | | | | | | | 1 | |
| Cicatricosisporites ludbrooki | | | | | | | | | | | 1 | 1 | | |
| Canningia sp. | | | | 2 | | | | 74 | 3 | | | | | 4 |
| "Systematophora" sp. | | | | | | | | | | | 2 | 2 | 2 | 34 |
| Odontochitina operculata | | | | | | | | | | | | | 1 | 3 |
| Uvaesporites sp. | | | | | | | | | | | 1 | | | |
| Hystrichodinium sp. | | | | | | | | | | | | 2 | | |
| Parvisaccites radiatus | | | | 2 | 4 | | | 6 | 9 | | 4 | 11 | 7 | |
| Clavatipollenites hughesii | | | | | | | | | | | 12 | | 4 | |
| Clavatipollenites sp. | | 3 | | | | | | | | 1 | | 2 | | |
| Cedripites canadensis | | | | | | | | | | | 1 | | | |
| Cicatricosisporites brevilaesuratus | | | | | 5 | | | | | | 1 | | | |
| Pilosisporites trichopapillosus | | | | | 3 | | | | | | | | | |
| Alisporites grandis | | | | | | | | | | | | | | 9 |
| Sp. indet. | | | | | | | | | | | 1 | | | |
| Cribroperidinium edwardsii | | | | | | | | | | | 4 | | | |
| Cedripites cretaceus | | | | | | | | | | | 2 | | | |
| Rugubivesiculites rugosus | | | | | | | | | | | 1 | | | |
| Trudopollis sp. | | | | | | | | | | | | | | 1 |
| "Hystrichosphaera" sp. | | | | | | | | | | | 1 | | | |
| Schizosporis sp. | | | | | 1 | | | | | | | | | |
| Contignisporites sp. | | 1 | | | | | | | | | | | | |
| Matonisporites sp. | | | 1 | | | | | | | | | | | |
| Stereisporites sp. | | | | | 1 | | | | | | | | | |
| Patellasporites sp. | | | | | 1 | | | | | | | | | |
| Tasmanites sp. | | | | | | | | | | | 1 | | | |
| | | | | | | | | | | | | | | |
| Sp. indet. | 0 | 2 | 2 | 6 | 9 | 1 | 1 | 6 | 5 | 2 | 11 | 7 | 2 | 10 |
| Total No. of palynomorphs found for each sample: | 1 | 68 | 64 | 33 | 188 | 1 | 8 | 179 | 129 | 7 | 71 | 50 | 57 | 155 |

TABLE 2. Table showing the stratigraphical distributions of the palynomorphs found at Kullemölla and the numbers found present of each species in the different samples examined. (x denotes the three samples from the first preliminary investigation.)

PRISKLASS F
Distribution
Liber Kartor
162 89 STOCKHOLM

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