



PE990021

APPENDIX X a

PALYNOLOGICAL REPORT ON SHELL
PECTEN 1A WELL, 4044 FEET - 9305 FEET

by

Dr. M.E. Dettmann

Text Figures

Table 1 : Preservation and zonal attribution of plant microfossil assemblages in sidewall cores of Shell Pecten 1A well, 4044 feet - 9305 feet.

Table 2 : Vertical ranges of selected spore and pollen species.

Enclosure

1. Distribution of Microflora, Lowermost Tertiary and Cretaceous, Pecten 1A.

PALYNOLOGICAL REPORT ON SHELL PECTEN 1-A WELL,

4044 FEET - 9305 FEET

by

Dr. M.E. Dettmann

The present account includes the documentation and evaluation of microfloral data obtained from sediments in Pecten 1-A well between 4044 feet and 9305 feet. From within this interval 38 sidewall cores were processed and all yielded plant matter that includes spores, pollen grains, wood, and cuticular fragments; microplankton were also extracted from several samples between 4044 feet and 5920 feet.

The microfloral yield of the individual samples is documented in Table 1, which also incorporates preservation details of the various types of plant microfossils constituting the microfloral assemblages. The quality of preservation was determined on residues which had been subjected to treatment with cold hydrofluoric acid followed by mineral separation with zinc bromide. Residues from samples at and below 7204 feet required no further treatment for the specific determination of the spore-pollen types present in the microfloras. However, residues of samples between 4044 feet and 6155 feet were given additional treatment with Schulze solution for $\frac{1}{2}$ -1 hour followed by $\frac{1}{2}\%$ ammonium hydroxide before specific analyses were carried out.

The spore-pollen-microplankton content of all samples is documented below, and the ages of the individual assemblages are discussed. Thus, the present account incorporates data presented in a previous report (Dettmann 1967) on samples between 4044 feet and 4493 feet. As outlined below, the microfloral evidence clearly indicates that the entire section examined is of Cretaceous age, ranging from Aptian or older to Senonian and later. Moreover, several distinct microfloral assemblages are recognizable within the section, thus enabling correlation of the sediments with the spore-pollen and microplankton zones delineated by Dettmann and Playford (1968a) and Evans (1966) respectively in Cretaceous sequences of the Otway Basin and of other basins in eastern Australia.

DISCUSSION AND AGE OF MICROFLORAL ASSEMBLAGES

A. 4044 feet - 5078 feet

4044 feet

The following species of well preserved spores, pollen, and microplankton are represented in the residue:

- Spores: Cyathidites australis Couper
C. minor Couper
Camazonosporites amplus (Stanley)
C. ohaiensis (Couper)
Gleicheniidites circinidites (Cookson)
Kraeuselisporites papplatus Harris
Laevigatosporites ovatus Wilson & Webster
L. major (Cookson)
Lycopodiumsporites sp.
Stereisporites antiquasporites (Wilson & Webster)
S. viriosus Dettmann & Playford
- Pollen: Dacrycarpites australiensis Cookson & Pike
Nothofagidites senectus Dettmann & Playford
Phyllocladidites mawsonii Cookson
Polyporina fragilis Harris
Proteacidites amolosexinus Dettmann & Playford
P. cf. crassus Cookson
P. subscabratus Couper
Tricolpites lillei Couper
T. pachyexinus Couper
T. sabulosus Dettmann & Playford
Triorites edwardsii Cookson & Pike
aff. T. edwardsii Cookson & Pike

Microplankton: Baltisphaeridium sp.
Epicephalopyxis indentata Deflandre & Cookson
Hystrichosphaeridium cf. heteracanthum Deflandre & Cookson
? Trichodinium sp.
Remanié: Nuskoisporites sp. - Permian

4248 feet

Well preserved spores, pollen, and microplankton that constitute the following assemblage were extracted from the sample:

Spores: Cyathidites australis Couper
Camazonosporites amplus (Stanley)
C. ohaiensis (Couper)
Gleicheniidites circinidites (Cookson)
Kraeuselisporites pappilatus Harris
Laevigatosporites major (Cookson)
L. ovatus Wilson & Webster
Lycopodiumsporites sp.
Ornamentifera sentosa Dettmann & Playford
Stereisporites antiquasporites (Wilson & Webster)
Pollen: Dacrydiumites florinii Cookson & Pike
Microcachryidites antarcticus Cookson
Nothofagidites senectus Dettmann & Playford
Podocarpidites ellipticus Cookson
Podosporites microsaccatus Couper
Proteacidites amolesexinus Dettmann & Playford
P. scaboratus Couper
P. subscabratus Couper
Tricolpites pachyexinus Couper
T. sabulosus Dettmann & Playford
T. sp.
Triorites edwardsii Cookson & Pike
aff. T. edwardsii Cookson & Pike
Microplankton: Baltisphaeridium sp.
Deflandrea pellucida Cookson & Eisenack
Epicephalopyxis indentata Deflandre & Cookson
? Odontochitina sp.
Palambages Form A Manum & Cookson

4403 feet

The following forms of well preserved spores, pollen, and microplankton were identified in the residue:

Spores: Cyathidites australis Couper
C. cf. splendens Harris
Camazonosporites ohaiensis (Couper)
Rouseisporites sp.
Stereisporites antiquasporites (Wilson & Webster)
Pollens: Araucariacites australis Cookson
Dacrydiumites florinii Cookson & Pike
Microcachryidites antarcticus Cookson
Nothofagidites senectus Dettmann & Playford
Phyllocladidites mawsonii Cookson
Podocarpidites ellipticus Cookson
Proteacidites amolosexinus Dettmann & Playford
P. scaboratus Couper
Tricolpites pachyexinus Couper
T. sabulosus Dettmann & Playford
Microplankton: Baltisphaeridium sp.
Remanié: Nuskoisporites sp. - Permian

4493 feet

Fair concentrations of well preserved spores, pollen, and microplankton were extracted from the sample. Species identified include:

- Spores: Cyathidites australis Couper
C. minor Couper
Ceratosporites sp.
Camarozonosporites amplus (Stanley)
C. ohaiensis (Couper)
Clavifera triplex (Bolkhovitina)
Densoisporites velatus Weyland & Kreiger
Gleicheniidites circinidites (Cookson)
Lycopodiumsporites sp.
Laevigatosporites major (Cookson)
Stereisporites antiquasporites (Wilson & Webster)
S. viriosus Dettmann & Playford
- Pollen: Dacrydiumites florinii Cookson & Pike
Microcachryidites antarcticus Cookson
Nothofagidites senectus Dettmann & Playford
Phyllocladidites mawsonii Cookson
Podocarpidites ellipticus Cookson
Proteacidites amolosexinus Dettmann & Playford
P. scaboratus Couper
Tricolpites gillii Cookson
T. pachyexinus Couper
T. sabulosus Dettmann & Playford
T. sp.
Triorites edwardsii Cookson & Pike
- Microplankton: Deflandrea pellucida Cookson & Eisenack
D. cf. micracantha Cookson & Eisenack
- Remanié: Nuskoisporites sp. - Permian

4618 feet

The following assemblage of well preserved spores and pollen grains was extracted from the sample:

- Spores: Cyathidites australis Couper
Camarozonosporites amplus (Stanley)
C. ohaiensis (Couper)
Clavifera triplex (Bolkhovitina)
Gleicheniidites circinidites (Cookson)
Kraeuselisporites sp.
Laevigatosporites major (Cookson)
Lycopodiumsporites sp.
Neoraistrickia sp.
Stereisporites antiquasporites (Wilson & Webster)
S. viriosus Dettmann & Playford
- Pollen: Dacrydiumites florinii Cookson & Pike
Nothofagidites senectus Dettmann & Playford
Phyllocladidites mawsonii Cookson
Podocarpidites ellipticus Cookson
Proteacidites amolosexinus Dettmann & Playford
P. scaboratus Couper
P. subscabratus Couper
Tricolpites gillii Cookson
T. pachyexinus Couper
T. sabulosus Dettmann & Playford
Triorites minor Couper
- Remanié: Nuskoisporites sp. - Permian

4685 feet

The following species of well preserved spores, pollen grains, and microplankton were extracted from the sample:

- Spores: Baculatisporites comaumensis (Cookson)
Cyathidites australis Couper
Camazonosporites amplus (Stanley)
Clavifera triplex (Bolkhovitina)
Gleicheniidites circinidites (Cookson)
Laevigatosporites ovatus Wilson & Webster
Stereisporites antiquasporites (Wilson & Webster)
- Pollen: Araucariacites australis Cookson
Classopollis cf. classoides Pflug
Microcachryidites antarcticus Cookson
Nothofagidites senectus Dettmann & Playford
Phyllocladidites mawsonii Cookson
Podocarpidites ellipticus Cookson
Proteacidites amolosexinus Dettmann & Playford
P. scaboratus Couper
P. subscabratus Couper
Tricolpites pachyexinus Couper
T. sabulosus Dettmann & Playford
Triorites minor Couper
- Microplankton: Xenikoon australis Cookson & Eisenack
- Remanie: Nuskoisporites sp. - Permian
Dictyotosporites speciosus Cookson & Dettmann - Lower Cretaceous
Murospora florida (Balme) - Lower Cretaceous

4785 feet

Well preserved spores and pollen grains identified in the sample comprise the following species:

- Spores: Baculatisporites comaumensis (Cookson)
Cyathidites australis Couper
Camazonosporites amplus (Stanley)
Gleicheniidites circinidites (Cookson)
Laevigatosporites ovatus Wilson & Webster
Lycopodiumsporites sp.
Ornamentifera sentosa Dettmann & Playford
- Pollen: Araucariacites australis Cookson
Microcachryidites antarcticus Cookson
Nothofagidites senectus Dettmann & Playford
Phyllocladidites mawsonii Cookson
Podocarpidites ellipticus Cookson
Proteacidites amolosexinus Dettmann & Playford
P. scaboratus Couper
P. subscabratus Couper
Stephanoporopollenites obscurus Harris
Tricolpites gillii Cookson
T. pachyexinus Couper
T. sabulosus Dettmann & Playford
- Remanie: Nuskoisporites sp. - Permian

5030 feet

The following well preserved spores, pollen grains, and microplankton were identified:

- Spores: Cyathidites australis Couper
Camazonosporites amplus (Stanley)
Clavifera triplex (Bolkhovitina)
Gleicheniidites circinidites (Cookson)
Stereisporites viriosus Dettmann & Playford
- Pollen: Araucariacites australis Cookson
Cycadopites nitidus (Balme)
Microcachryidites antarcticus Cookson

Nothofagidites senectus Dettmann & Playford
Phyllocladidites mawsonii Cookson
Podosporites microsaccatus (Couper)
Proteacidites amolosexinus Dettmann & Playford
P. scaboratus Couper
Stephanoporopollenites obscurus Harris
Tricolpites gillii Cookson
T. pannosus Dettmann & Playford
T. pachyexinus Couper
T. sabulosus Dettmann & Playford
Triorites minor Couper
Microplankton: Hystrichosphaeridium heteracanthum Deflandre & Cookson

5078 feet

Well preserved spores, pollen grains, and microplankton were extracted from the sample and constitute the following assemblage:

Spores: Baculatisporites comaumensis (Cookson)
Cyathidites australis Couper
Camarozonosporites ohaiensis (Couper)
Clavifera triplex (Bolkhovitina)
Gleicheniidites circinidites (Cookson)
Laevigatosporites major (Cookson)
L. ovatus Wilson & Webster
Ornamentifera sentosa Dettmann & Playford
Stereisporites antiquasporites (Wilson & Webster)

Pollen: Araucariacites australis Cookson
Cycadopites nitidus (Balme)
Microcachrydites antarcticus Cookson
Phyllocladidites mawsonii Cookson
Podosporites microsaccatus (Couper)
Podocarpidites ellipticus Cookson
Proteacidites amolosexinus Dettmann & Playford
P. scaboratus Couper
P. subscabratus Couper
Tricolpites gillii Cookson
T. pachyexinus Couper
T. sabulosus Dettmann & Playford

Microplankton: Hystrichosphaeridium heteracanthum Deflandre & Cookson

Remanie: Nuskoisporites sp. - Permian
Dictyotosporites speciosus Cookson & Dettmann - Lower Cretaceous
Murospora florida (Balme) - Lower Cretaceous

Spore-pollen assemblages extracted from samples between 4044 feet and 5078 feet in Pecten 1-A well are characterized by Nothofagidites senectus, Proteacidites amolosexinus, Tricolpites pachyexinus, T. gillii, and T. sabulosus and are conformable with the Nothofagidites Microflora of Dettmann & Playford (1968a). As outlined by these authors and in a previous report (Dettmann 1967) faunal and microfloral evidence indicates a Santonian to uppermost Cretaceous age for the Nothofagidites Microflora. Assemblages referable to the Nothofagidites Microflora occur in the nearby Flaxmans No.1 well between 4126 feet and 4714 feet; accordingly this sequence is correlated with Pecten 1-A well between 4044 feet and 5078 feet.

In both well sequences Triorites edwardsii commences its range in stratigraphically higher deposits than the first appearances of the Nothofagidites Microflora. Thus on the basis of T. edwardsii horizons in Pecten 1-A well between 4044 feet and 4493 feet may be correlated with Flaxmans No.1 well between 4126 feet and 4316 feet. Within the latter well, the first appearance of T. edwardsii is associated with Taylor's (1964) foraminiferal Zonule A, and thus its lower age limit is within the Santonian.

Dettmann and Playford (1968a) have shown that their Nothofagidites Microflora occurs in sediments equivalent to Evans's (1966) Xenikoon australis and "Deflandrea pellucida" Zones (see Table 2). Microplankton associated with the Nothofagidites Microflora in Pecten 1-A well support this view, with Xenikoon australis represented in sediments at 4618 feet and Deflandrea pellucida and its associates occurring in deposits between 4044 feet and 4493 feet.

B. 5182 feet - 5650 feet

5182 feet

Reasonably well preserved spores and pollen grains extracted from the sample occur in minor proportions and include the following types:

- Spores: Cyathidites australis Couper
C. minor Couper
Clavifera triplex (Bolkhovitina)
Gleicheniidites circinidites (Cookson)
Kraeuselisporites sp.
Laevigatosporites ovatus Wilson & Webster
Stereisporites antiquasporites (Wilson & Webster)
- Pollen: Microcachryidites antarcticus Cookson
Phyllocladidites mawsonii Cookson
Podocarpidites ellipticus Cookson
Proteacidites scaboratus Couper
P. subscabratus Couper
Stephanoporopollenites sp.
Tricolpites pachyexinus Couper

5300 feet

Fairly well preserved spores, pollen grains, and microplankton were observed in the residue. The following forms were identified:

- Spores: Balmeisporites glenelgensis Cookson & Dettmann
Baculatisporites comaumensis (Cookson)
Cyathidites minor Couper
Clavifera triplex (Bolkhovitina)
Gleicheniidites circinidites (Cookson)
Lycopodiumsporites austroclavitudites (Cookson)
Stereisporites antiquasporites (Wilson & Webster)
- Pollen: Araucariacites australis Cookson
Microcachryidites antarcticus Cookson
Phyllocladidites mawsonii Cookson
Podocarpidites ellipticus Cookson
Podosporites microsaccatus (Couper)
Proteacidites scaboratus Couper
P. subscabratus Couper
P. sp.
Stephanoporopollenites obscurus Harris
Tricolpites pachyexinus Couper
T. sp.
- Microplankton: Hystrichosphaeridium heteracanthum Deflandre & Cookson

5398 feet

A diverse assemblage of spores, pollen grains, and microplankton was extracted from the sample. Species present comprise:

- Spores: Cyathidites australis Couper
C. minor Couper
Camazonosporites ohaiensis (Couper)
Clavifera triplex (Bolkhovitina)
Cicatricosporites sp.
Gleicheniidites circinidites (Cookson)
Laevigatosporites ovatus Wilson & Webster

Ornamentifera sentosa Dettmann & Playford
Rouseisporites sp.
Stereisporites antiquasporites (Wilson & Webster)
Pollen: Classopollis cf. classoides Pflug -
Microcachryidites antarcticus Cookson
Phyllocladidites mawsonii Cookson
Podocarpidites cf. ellipticus Cookson
Podosporites microsaccatus (Couper)
Proteacidites scaboratus Couper
P. subscabratus Couper
Stephanoporopollenites obscurus Harris
Tricolpites pachyexinus Couper
T. pannosus Dettmann & Playford
Triorites minor Couper
Microplankton: Deflandrea sp.
Hystrichosphaeridium heteracanthum Deflandre & Cookson

5650 feet

A sparse assemblage comprising the following species of spores, pollen grains, and microplankton was extracted from the sample:

Spores: Cyathidites australis Couper
Camarozonosporites amplus (Stanley)
Gleicheniidites circinidites (Cookson)
Kraeuselisporites sp.
Stereisporites antiquasporites (Wilson & Webster)
Pollen: Microcachryidites antarcticus Cookson
Proteacidites scaboratus Couper
Tricolpites pachyexinus Couper
Microplankton: Deflandrea victoriensis Cookson & Manum
Hexagonifera vermiculata Cookson & Eisenack
Hystrichosphaeridium heteracanthum Deflandre & Cookson
Odontochitina sp.

Deposits between 5182 feet and 5650 feet in Pecten 1-A well are assigned to the Tricolpites pachyexinus Zone of Dettmann and Playford (1968a). This zone is characterized at the base by the incoming of Tricolpites pachyexinus, Proteacidites scaboratus, and Camarozonosporites amplus and its upper limit is marked by the introduction of elements diagnostic of the Nothofagidites Microflora. The age of the zone is within the Senonian, since at the type section its base approximates to the base of Taylor's (1964) Zonule A and its upper limit is within the same zonule (Dettmann & Playford 1968a, b). The zone occurs in Flaxmans No.1 well between 4974 feet and 5970 feet and in Port Campbell No.2 well between 5340 feet and 5919 feet. These sequences may thus be correlated with Pecten 1-A well between 5182 feet and 5650 feet.

The Tricolpites pachyexinus Zone includes the Deflandrea cretacea and Nelsoniella aceras microplankton Zones of Evans (1966; - see Table 2 this report). Although the indices of Evan's zones were not recovered from Pecten 1-A well, the occurrence of Hexagonifera vermiculata and Deflandrea victoriensis (at 5650 feet) is significant, since both species are concomitant with the bases of the Tricolpites pachyexinus and Deflandrea cretacea Zones and complete their ranges at the base of the Nelsoniella aceras Zone (Dettmann and Playford 1968a, Evans 1966).

C. 5735 feet - 5827 feet

5735 feet

The following species of imperfectly preserved spores, pollen, and microplankton were extracted from the sample:

- Spores: Arcellites hexapartitus (Dijkstra)
Appendicisporites distocarinatus Dettmann & Playford
Baculatisporites comaumensis (Cookson)
Balmeisporites glenelgensis Cookson & Dettmann
Ceratosporites sp.
Cicatricosisporites sp.
Cyathidites australis Couper
C. minor Couper
Gleicheniidites cf. circinidites (Cookson)
Kraeuselisporites jubatus Dettmann & Playford
Laevigatosporites ovatus Wilson & Webster
Lycopodiumsporites sp.
Stereisporites antiquasporites (Wilson & Webster)
- Pollen: Araucariacites australis Cookson
Microcachryidites antarcticus Cookson
Phyllocladidites mawsonii Cookson
Podocarpidites cf. ellipticus Cookson
Stephanoporopollenites obscurus Harris
Tricolpites pannosus Dettmann & Playford
Triorites minor Couper
- Microplankton: Hystrichosphaeridium complex (White)
H. heteracanthum Deflandre & Cookson

5827 feet

Spores, pollen grains, and microplankton extracted from the sample include the following reasonably preserved forms:

- Spores: Appendicisporites distocarinatus Dettmann & Playford
Baculatisporites comaumensis (Cookson)
Balmeisporites glenelgensis Cookson & Dettmann
Cyathidites australis Couper
C. minor Couper
Gleicheniidites cf. circinidites (Cookson)
Laevigatosporites major (Cookson)
L. ovatus Wilson & Webster
Stereisporites antiquasporites (Wilson & Webster)
- Pollen: Araucariacites australis Cookson
Alisporites grandis (Cookson)
Cycadopites nitidus (Balme)
Microcachryidites antarcticus Cookson
Podocarpidites cf. ellipticus Cookson
Tricolpites pannosus Dettmann & Playford
- Microplankton: Gonyaulax sp.
Hystrichosphaeridium cf. heteracanthum Deflandre & Cookson
Odontochitina operculata Deflandre

The presence of Phyllocladidites mawsonii together with Appendicisporites distocarinatus would suggest assignment of the horizon at 5735 feet in Pecten 1-A well to the basal portion of the Clavifera triplex Zone or possibly to the upper part of the underlying Appendicisporites distocarinatus Zone. As defined by Dettmann and Playford (1968a), the former zone immediately underlies the Tricolpites pachyexinus Zone and is characterized at the base by the incoming of Clavifera triplex and Phyllocladidites mawsonii. The C. triplex Zone has been recognized in Flaxmans No.1 well between 6375 feet and 6636 feet and in Port Campbell No.2 well between 7093 feet and 7904 feet, and these sequences may be in part equivalent to the horizon at 5735 feet in Pecten 1-A well. In the former wells the C. triplex Zone includes horizons of Taylor's (1964) Zonule B and deposits immediately below this zonule. Thus the zone is dated as Turonian with possible extensions into the Cenomanian and Senonian. The C. triplex Zone incorporates upper horizons of Evans's (1966) Ascodinium parvum

Zone and the succeeding "unclassified gap" (see Table 2).

The deposit at 5827 feet in Pecten 1-A well yielded Appendicisporites distocarinatus and apparently lacks diagnostic elements of the Clavifera triplex Zone. Thus, the horizon is assigned to the Appendicisporites distocarinatus Zone, the age of which is considered on microfloral evidence to be Upper Albian - ?Cenomanian/Turonian (Dettmann and Playford 1968a). The zone occurs in Flaxmans No.1 well between 6832 feet and 6902 feet and in Port Campbell No.2 well between 8096 feet and 8418 feet; and is within Evans's (1966) Ascodinium parvum Zone (see Table 2) of which Odontochitina operculata is a component.

D. 5920 feet

Abundant spores and pollen grains and rare microplankton occur in the sample from 5920 feet. Species present include:

Spores: Aequitriradites spinulosus (Cookson & Dettmann)
Appendicisporites distocarinatus Dettmann & Playford
Cyathidites australis Couper
C. minor Couper
Cicatricosporites australiensis (Cookson)
C. cuneiformis Pocock
Crybelosporites striatus (Cookson & Dettmann)
Coptospora paradoxa (Cookson & Dettmann)
Foraminisporis asymmetricus (Cookson & Dettmann)
F. dailyi (Cookson & Dettmann)
Gleicheniidites cf. circinidites (Cookson)
Kraeuselisporites jubatus Dettmann & Playford
Leptolepidites verrucatus Couper -
Lycopodiumsporites circolumenus Cookson & Dettmann
L. sp.
Rouseisporites reticulatus Pocock
Stereisporites antiquasporites (Wilson & Webster)

Pollen: Alisporites grandis (Cookson)
Araucariacites australis Cookson
Cycadopites nitidus (Balme)
Classopollis cf. classoides Pflug
Podosporites microsaccatus (Couper)
Tricolpites pannosus Dettmann & Playford

Microplankton: Ascodinium parvum (Cookson & Eisenack)

The association of Coptospora paradoxa and Tricolpites pannosus clearly demonstrates that the sediment at 5920 feet in Pecten 1-A well belongs to the Tricolpites pannosus Zone which Dettmann and Playford have shown to be of Upper Albian - ?Cenomanian age. The zone has been recognized in Port Campbell No.2 well between 8556 feet and 8624 feet but has not been certainly identified in Flaxmans No.1 well. It is however, widely distributed in the Otway Basin, being present for example in Eumeralla No.1 well at 3311-21 feet and Timboon No.5 bore at 3500-04 feet. (see Dettmann 1963a, 1964a).

The Tricolpites pannosus Zone includes (see Table 2) upper horizons of the Odontochitina operculata Zone and the lowest portion of the Ascodinium parvum Zone (Evans 1966). It is noteworthy, therefore, that Pecten 1-A well at 5920 feet yielded Ascodinium parvum, the index of the latter microplankton zone.

E. 5977 feet - 7920 feet

5977 feet

The following imperfectly preserved spores and pollen grains were extracted from the sample:

- Spores: Aequitriradites spinulosus (Cookson & Dettmann)
Baculatisporites comaumensis (Cookson)
Cyathidites australis Couper
C. minor Couper
Coptospora paradoxa (Cookson & Dettmann)
Crybelosporites striatus (Cookson & Dettmann)
Laevigatosporites ovatus Wilson & Webster
Rouseisporites reticulatus Pocock
Stereisporites antiquasporites (Wilson & Webster)
Trilites cf. tuberculiformis Cookson
- Pollen: Alisporites grandis (Cookson)
Araucariacites australis Cookson
Classopollis cf. classoides Pflug
Cycadopites nitidus (Balme)
Microcachryidites antarcticus Cookson
Podocarpidites cf. ellipticus Cookson

6013 feet

Abundant, fair-poorly preserved spores and pollen grains were recovered from the sample. Species identified comprise:

- Spores: Appendicisporites distocarinatus Dettmann & Playford
Baculatisporites comaumensis (Cookson)
Cyathidites australis Couper
C. minor Couper
C. punctatus (Delcourt & Sprumont)
Cicatricosporites hughesi Dettmann
Contignisporites glebulentus Dettmann
Crybelosporites striatus (Cookson & Dettmann)
Gleicheniidites cf. circinidites (Cookson)
Krauselisporites jubatus Dettmann & Playford
Kuylisporites sp.
Lycopodiumsporites austroclavatidites (Cookson)
L. eminulus Dettmann
Stereisporites antiquasporites (Wilson & Webster)
Trilites cf. tuberculiformis Cookson
- Pollen: Alisporites grandis (Cookson)
Araucariacites australis Cookson
Classopollis cf. classoides Pflug
Microcachryidites antarcticus Cookson
Podosporites microsaccatus (Couper)
Velosporites triquetrus (Lantz)

6155 feet

The sample yielded a sparse assemblage of imperfectly preserved spores and pollen grains. Species identified include:

- Spores: Aequitriradites spinulosus (Cookson & Dettmann)
Baculatisporites comaumensis (Cookson)
Ceratosporites equalis Cookson & Dettmann
Cyathidites australis Couper
C. minor Couper
Coptospora paradoxa (Cookson & Dettmann)
Gleicheniidites cf. circinidites (Cookson)
Stereisporites antiquasporites (Wilson & Webster)
- Pollen: Alisporites grandis (Cookson)
Araucariacites australis Cookson
Classopollis cf. classoides Pflug
Cycadopites nitidus (Balme)
Microcachryidites antarcticus Cookson

Remanie: Nuskoisporites sp. - Permian

7204 feet

The sparse assemblage identified in the residue is composed of the following forms:

Spores: Cyathidites australis Couper
Cicatricosisporites australiensis (Cookson)
C. hughesi Dettmann
Crybelosporites striatus (Cookson & Dettmann)
Leptolepidites verrucatus Couper
Stereisporites antiquasporites (Wilson & Webster)

Pollen: Alisporites grandis (Cookson)
Araucariacites australis Cookson

7276 feet

The following assemblage of poorly-fairly preserved spores and pollen grains was extracted from the sample:

Spores: Aequitriradites spinulosus (Cookson & Dettmann)
Baculatisporites comaumensis (Cookson)
Cyathidites australis Couper
C. minor Couper
Cicatricosisporites australiensis (Cookson)
C. hughesi Dettmann
Coptospora paradoxa (Cookson & Dettmann)
Gleicheniidites cf. circinidites (Cookson)
Klukisporites scaberis (Cookson & Dettmann)
Lycopodiumsporites austroclavatidites (Cookson)

Pollen: Alisporites grandis (Cookson)
Araucariacites australis Cookson
Classopollis cf. classoides Pflug
Microcachryidites antarcticus Cookson
Podocarpidites cf. ellipticus Cookson

7399 feet

The microflora of the sample includes the following poorly preserved forms:

Spores: Aequitriradites spinulosus (Cookson & Dettmann)
Cyathidites australis Couper
C. minor Couper
Cicatricosisporites australiensis (Cookson)
C. hughesi Dettmann
Coptospora paradoxa (Cookson & Dettmann)
Crybelosporites striatus (Cookson & Dettmann)
Foraminisporis asymmetricus (Cookson & Dettmann)
Krauselisporites majus (Cookson & Dettmann)
Laevigatosporites ovatus Wilson & Webster
Lycopodiumsporites austroclavatidites (Cookson)
Rouseisporites reticulatus Pocock

Pollen: Araucariacites australis Cookson
Microcachryidites antarcticus Cookson

7490 feet

A sparse assemblage of poorly preserved spores and pollen grains was recovered from the sample. Species identified include:

- Spores: Baculatisporites comaumensis (Cookson)
Cyathidites australis Couper
C. punctatus (Delcourt & Sprumont)
Cicatricosisporites australiensis (Cookson)
Contignisporites sp.
Crybelosporites striatus (Cookson & Dettmann)
Klukisporites scaberis (Cookson & Dettmann)
Leptolepidites major Couper
Lycopodiumsporites sp.
Rouseisporites sp.
Stereisporites antiquasporites (Wilson & Webster)
- Pollen: Alisporites grandis (Cookson)
Araucariacites australis Cookson
Classopollis cf. classoides Pflug
Microcachryidites antarcticus Cookson

7552 feet

The following sparse assemblage of poorly preserved spores and pollen grains was obtained from the sample:

- Spores: Baculatisporites comaumensis (Cookson)
Cyathidites australis Couper
C. minor Couper
Ceratosporites equalis Cookson & Dettmann
Cicatricosisporites australiensis (Cookson)
Klukisporites scaberis (Cookson & Dettmann)
- Pollen: Alisporites grandis (Cookson)
Araucariacites australis Cookson
Microcachryidites antarcticus Cookson

7715 feet

Poorly preserved spores and pollen grains comprising the following assemblage were extracted from the sample:

- Spores: Aequitriradites spinulosus (Cookson & Dettmann)
Baculatisporites comaumensis (Cookson)
Cyathidites australis Couper
C. minor Couper
Cicatricosisporites australiensis (Cookson)
Klukisporites scaberis (Cookson & Dettmann)
Stereisporites antiquasporites (Wilson & Webster)
- Pollen: Alisporites similis (Balme)
Araucariacites australis Cookson
Classopollis cf. classoides Pflug
Podocarpidites cf. ellipticus Cookson

7920 feet

A diverse assemblage of poorly preserved spores and pollen grains occurs in the sediment. Forms identified comprise:

- Spores: Aequitriradites spinulosus (Cookson & Dettmann)
Balmesporites holodictyus Cookson & Dettmann
Baculatisporites comaumensis (Cookson)
Cyathidites australis Couper
C. punctatus (Delcourt & Sprumont)
Cicatricosisporites australiensis (Cookson)
C. hughesi Dettmann
Coptospora paradoxa (Cookson & Dettmann)
Crybelosporites striatus (Cookson & Dettmann)
Foraminisporis asymmetricus (Cookson & Dettmann)
F. dailyi (Cookson & Dettmann)
Lycopodiumsporites sp.

Neoraistrickia truncata (Cookson)
Pilosisporites grandis Dettmann
Rouseisporites reticulatus Pocock
R. sp.
Stereisporites antiquasporites (Wilson & Webster)
Trilobosporites trioreticulosus Cookson & Dettmann
Pollen: Araucariacites australis Cookson
Microcachryidites antarcticus Cookson
Podocarpidites cf. ellipticus Cookson

Samples between 5977 feet and 7920 feet in Pecten 1-A well yielded assemblages containing Coptospora paradoxa in association with Trilobosporites trioreticulosus, Pilosisporites grandis, Kraeuselisporites majus, and Cicatricosisporites hughesi; tricolpate and triporate angiospermous grains are entirely lacking. Thus the sediments may be equated to the Upper Aptian - Upper Albian Coptospora paradoxa Zone of Dettmann and Playford (1968a). This zone has wide distribution in the Otway Basin and has been recognized in for example, Flaxmans No.1 well between 7200 feet and 9135 feet (cf. Dettmann 1964b) and in Penola No.1 well between 1200 and 2798 feet (Dettmann 1963b).

F. 8120 feet - 9132 feet

8120 feet

A sparse microflora composed of the following poorly preserved spores and pollen grains was extracted from the sample:

Spores: Baculatisporites comaumensis (Cookson)
Cyathidites australis Couper
Cicatricosisporites australiensis (Cookson)
Crybelosporites striatus (Cookson & Dettmann)
Lycopodiumsporites sp.
Rouseisporites sp.
Stereisporites antiquasporites (Wilson & Webster)
Pollen: Alisporites grandis (Cookson)
Classopollis cf. classoides Pflug
Microcachryidites antarcticus Cookson
Podocarpidites cf. ellipticus Cookson

8206 feet

The following poorly preserved species of spores and pollen grains were observed in the sample:

Spores: Baculatisporites comaumensis (Cookson)
Cyathidites australis Couper
C. minor Couper
Cicatricosisporites australiensis (Cookson)
Crybelosporites striatus (Cookson & Dettmann)
Lycopodiumsporites austroclavatidites (Cookson)
L. sp.
Pollen: Alisporites grandis (Cookson)
Araucariacites australis Cookson
Classopollis cf. classoides Pflug
Microcachryidites antarcticus Cookson

8333 feet

The sample yielded a poorly preserved microflora. Species identified include:

Spores: Aequitriradites spinulosus (Cookson & Dettmann)
Baculatisporites comaumensis (Cookson)
Cyathidites australis Couper
C. minor Couper
C. punctatus (Delcourt & Sprumont)
Cicatricosisporites australiensis (Cookson)

C. ludbrooki Dettmann
Crybelosporites striatus (Cookson & Dettmann)
Foraminisporis asymmetricus (Cookson & Dettmann)
Lycopodiumsporites austroclavatidites (Cookson)
Pollen: Rouseisporites reticulatus Pocock
Microcachryidites antarcticus Cookson
Podosporites microsaccatus (Couper)
Podocarpidites cf. ellipticus Cookson

8546 feet

Poorly preserved spores and pollen grains observed in the residue include the following forms:

Spores: Aequitriradites spinulosus (Cookson & Dettmann)
Baculatisporites comaumensis (Cookson)
Cyathidites australis Couper
C. minor Couper
C. punctatus (Delcourt & Sprumont)
Crybelosporites striatus (Cookson & Dettmann)
Lycopodiumsporites austroclavatidites (Cookson)
Osmundacidites wellmanii Couper
Pilososporites notensis Cookson & Dettmann
Pollen: Stereisporites antiquasporites (Wilson & Webster)
Microcachryidites antarcticus Cookson
Podocarpidites cf. ellipticus Cookson

8630 feet

The sample yielded good concentrations of poorly preserved spores and pollen grains. Forms identified comprise:

Spores: Balmeisporites holodictyus Cookson & Dettmann
Baculatisporites comaumensis (Cookson)
Cyathidites australis Couper
C. punctatus (Delcourt & Sprumont)
Cicatricosisporites australiensis (Cookson)
Crybelosporites striatus (Cookson & Dettmann)
Foraminisporis asymmetricus (Cookson & Dettmann)
F. wonthaggiensis (Cookson & Dettmann)
Lycopodiumsporites austroclavatidites (Cookson)
L. eminulus Dettmann
Rouseisporites sp.
Pollen: Stereisporites antiquasporites (Wilson & Webster)
Alisporites grandis (Cookson)
Araucariacites australis Cookson
Microcachryidites antarcticus Cookson
Velosporites triquetrus (Lantz)

8670 feet

Poorly preserved spores and pollen grains extracted from the sample constitute the following microflora:

Spores: Aequitriradites spinulosus (Cookson & Dettmann)
A. verrucosus (Cookson & Dettmann)
Baculatisporites comaumensis (Cookson)
Balmeisporites holodictyus Cookson & Dettmann
Cyathidites australis Couper
C. punctatus (Delcourt & Sprumont)
Foraminisporis wonthaggiensis (Cookson & Dettmann)
Rouseisporites reticulatus Pocock
R. sp.
Pollen: Stereisporites antiquasporites (Wilson & Webster)
Araucariacites australis Cookson
Remanie: Nuskoisporites sp. - Permian

8743 feet

An extremely sparse assemblage of spores and pollen grains was obtained from the sample. The following forms were identified:

Spores: Cyathidites minor Couper
Stereisporites antiquasporites (Wilson & Webster)
Pollen: Podocarpidites cf. ellipticus Cookson

8873 feet

This sample yielded only a few fragmented and badly preserved spores and pollen grains. Forms identified include:

Spores: Cyathidites australis Couper
Lycopodiumsporites sp.
Stereisporites antiquasporites (Wilson & Webster)
Pollen: Podocarpidites cf. ellipticus Cookson

8962 feet

Fragmented spores and pollen grains identified in the residue include the following forms:

Spores: Baculatisporites comaumensis (Cookson)
Balmeisporites sp.
Cyathidites australis Couper
C. minor Couper
Leptolepidites major Couper
Lycopodiumsporites sp.
Pollen: Podocarpidites cf. ellipticus Cookson

9132 feet

The sample provided a high yield of plant material that includes minor proportions of identifiable spore and pollen remnants. The following forms were identified:

Spores: Aequitriradites spinulosus (Cookson & Dettmann)
Baculatisporites comaumensis (Cookson)
Cyathidites australis Couper
Crybelosporites striatus (Cookson & Dettmann)
?Dictyosporites speciosus Cookson & Dettmann
Foraminisporis asymmetricus (Cookson & Dettmann)
Kraeuselisporites sp.
Stereisporites antiquasporites (Wilson & Webster)
Pollen: Microcachryidites antarcticus Cookson
Podocarpidites cf. ellipticus Cookson

Samples between 8120 feet and 9132 feet yielded poorly or badly preserved microfloral assemblages in which only a minor proportion of forms are identifiable at specific or generic level. Forms identified include Crybelosporites striatus and Pilosisporites notensis thus demonstrating the presence of the Coptospora paradoxa Zone or the Crybelosporites striatus Subzone of the Dictyosporites speciosus Zone. Assignment to either of these zones is precluded by the apparent absence of identifiable Coptospora paradoxa and Dictyosporites speciosus, although a single fragmentary specimen was doubtfully assigned to D. speciosus in the sample at 9132 feet. Nevertheless, the presence of Crybelosporites striatus in Pecten 1-A well between 8120 feet and 9132 feet indicates that the sediments are no older than the Upper Aptian (Dettmann and Playford 1968a) and suggest correlation with at least part of the section between 7200 feet and 11517 feet in Flaxmans No.1 well (see Dettmann 1964b).

G. 9210 feet - 9305 feet

9210 feet

Badly preserved fragments of spores and pollen grains were extracted from the sample. The following forms were identified:

Spores: Aequitriradites spinulosus (Cookson & Dettmann)
Baculatisporites comaumensis (Cookson)
Cicatricosisporites australiensis (Cookson)
Klukisporites scaberis (Cookson & Dettmann)
Leptolepidites verrucatus Couper
Lycopodiumsporites austroclavatidites (Cookson)
L. sp.
Stereisporites antiquasporites (Wilson & Webster)
Pollen: Podocarpidites cf. ellipticus Cookson

9305 feet

Rare, badly preserved fragmentary remnants of the following spore and pollen forms were observed:

Spores: Cyathidites australis Couper
Cicatricosisporites australiensis (Cookson)
Lycopodiumsporites sp.

Sediments at 9210 feet and 9305 feet in Pecten 1-A well yielded badly preserved spore-pollen remnants, few of which are specifically or generically identifiable. Stratigraphically significant species include Aequitriradites spinulosus and Cicatricosisporites australiensis which demonstrate a Lower Cretaceous or, at the oldest an uppermost Jurassic age.

CONCLUSIONS

Sediments between 4044 feet and 7920 feet in Pecten 1-A well range in age from Lower Cretaceous (Upper Aptian - Albian) to uppermost Cretaceous (Senonian and later) on the basis of spore-pollen assemblages diagnostic of the following biostratigraphic units delineated by Dettmann and Playford (1968a):- the Nothofagidites Microflora; the Tricolpites pachyexinus Zone; the Clavifera triplex Zone; the Appendicisporites distocarınatus Zone; the Tricolpites pannosus Zone; and the Coptospora paradoxa Zone. Sediments at and below 8120 feet are of Lower Cretaceous age (Upper Aptian or older) but contain insufficient representation of identifiable species for their assignment to the spore-pollen zones of Dettmann and Playford (1968a).

Microplankton were obtained from the majority of samples investigated between 4044 feet and 5920 feet, and their presence indicates marine influences during late Albian and Upper Cretaceous times. The stratigraphical distribution of the suites identified within the section supports the age determinations based upon spore-pollen criteria and conforms with the microplankton zonal scheme delineated by Evans (1966).

Remanié spores and pollen of Permian age occur spasmodically throughout the entire section investigated; those of Lower Cretaceous age were observed in late Cretaceous sediments between 4685 feet and 5078 feet.

Exceptionally well preserved plant material was extracted from the youngest Upper Cretaceous horizons investigated, and the remainder of the Upper Cretaceous sequence yielded reasonably preserved microfloral assemblages. The Lower Cretaceous section, however, provided plant material which is less well preserved, ranging from fair to poor in the upper part of the section to extremely bad and fragmented in the lowest intervals.

REFERENCES

- Dettmann, M.E. 1963a. Palynological report on non-marine Lower Cretaceous sediments intersected in F.B.H. Eumeralla No.1 and F.B.H. Pretty Hill No.1 wells. Unpubl. report submitted to Frome-Broken Hill Co. Pty. Ltd. 14/11/63.
- Dettmann, M.E. 1963b. Upper Mesozoic microfloras from south-eastern Australia. Proc. Roy. Soc. Vict., 77, 1-148.
- Dettmann, M.E. 1964a. Palynological report on core samples from Timboon No.5 bore. Unpubl. report submitted to Frome-Broken Hill Co. Pty. Ltd. 24/4/64.
- Dettmann, M.E. 1964b. Palynological report on Cretaceous core samples from F.B.H. Flaxmans No.1 well. Unpubl. report submitted to Frome-Broken Hill Co. Pty. Ltd., 7/4/64.
- Dettmann, M.E. 1967. Preliminary palynological report on Shell Pecten 1-A well. Unpubl. report submitted to Shell Development (Australia) Pty. Ltd., 27/6/67.
- Dettmann, M.E. and Playford, G. 1968a. Palynology of the Australian Cretaceous - a review. A.N.U. Press, Canberra (in press).
- Dettmann, M.E. and Playford, G. 1968b. Taxonomy of some Cretaceous spores and pollen grains from eastern Australia. Proc. Roy. Soc. Vict. (in press).
- Evans, P.R. 1966. Mesozoic stratigraphic palynology of the Otway Basin. Rec. Bur. Min. Resour. Geol. Geophys. Aust. 1966/69 (unpubl.)
- Taylor, D.J. 1964. Foraminifera and the stratigraphy of the western Victorian Cretaceous sediments. Proc. Roy. Soc. Vict. 77, 535-603.

30th August, 1967.

Mary E. Dettmann,
Department of Geology,
University of Queensland,
St. Lucia, Queensland.

EXPLANATION OF TABLE 1

Preservation and zonal attribution of plant microfossil assemblages in sidewall cores of Shell Pecten 1-A well, 4044 feet - 9305 feet.

Abbreviations:

Yield expresses frequency of spores, pollen, and microplankton in the palynological residues as follows:-

- A = abundant
- C = common
- S = sparse
- B = barren

Colour and Preservation. Spores, pollen, microplankton, wood, and cuticle present in the residues are denoted by their colour (col) and quality of preservation (pres) thus:-

- Y = yellow
- Br = brown
- Bl = black
- Exc. = morphological details perfectly preserved
- Good = morphological details well preserved
- Fair = morphological details imperfectly preserved
- Poor = morphological features poorly preserved
- Bad = morphological features rarely determinable
- Frag = microfossils fragmentary

Spore - Pollen Zones are those defined by Dettmann and Playford (1968a). Diagnostic features of the zones are given in the text and on Table 2.

EXPLANATION OF TABLE 2

Vertical ranges of selected spore and pollen species within the zonal scheme defined by Dettmann and Playford (1968a) and with reference to the microplankton zones defined by Evans (1966). (Table taken from Dettmann and Playford 1968a).

Depth (feet)	Yield	Spore-Pollen		Microplankton		Wood		Cuticle		Spore-Pollen Zone
		Col.	Pres.	Col.	Pres.	Col.	Pres.	Col.	Pres.	
3618	A	Y	Exc - good	Y	Exc good	Br	fair	Y	good	<i>Tricolpites edwardsii</i> Lowermost Tertiary - Uppermost Cretaceous
3695	S	"	"	"	"	"	"	"	"	"
3735	C	"	"	"	"	"	"	"	"	"
3797	A	"	"	"	"	"	"	"	"	"
3833	A	"	"	"	"	"	"	"	"	"
3908	A	"	"	"	"	"	"	"	"	<i>Nothofagidites</i>
4044	C	"	"	"	"	"	"	"	"	"
4248	"	"	"	"	"	"	"	Y-Br	fair	"
4403	"	"	good - fair	"	"	Br - Bl	"	"	"	"
4493	"	"	"	"	"	"	"	"	"	"
4618	"	"	"	-	-	"	"	"	"	"
4685	"	"	"	Y	good - fair	"	"	"	"	"
4785	"	Y- Br	fair	-	-	"	fair - poor	Br	fair - poor	"
5030	"	"	"	Y	fair	"	"	Y- Br	"	"
5078	"	"	"	"	"	"	"	"	"	"
5182	S	"	"	-	-	"	"	"	"	<i>Tricolpites pachyexinus</i>
5300	"	"	"	Y	fair	"	"	"	"	"
5398	C	"	"	"	"	"	"	"	"	"
5650	S	"	"	"	"	"	"	"	"	"
5735	"	"	fair - poor	"	"	"	"	"	"	<i>Clavifera triplex</i>
5827	"	"	fair	"	"	"	"	"	"	<i>Appendicisporites distocannatus</i>
5920	C	"	fair - poor	"	"	"	"	"	"	<i>Tricolpites pannosus</i>
5977	"	"	"	-	-	"	"	"	poor	<i>Coptospora paradoxa</i>
6013	A	"	"	-	-	"	"	"	"	"
6155	S	"	"	-	-	"	poor	"	"	"
7204	"	"	"	-	-	"	"	"	fair - poor	"
7276	C	"	"	-	-	"	"	"	"	"
7399	"	"	poor	-	-	"	"	"	poor	"
7490	S	Br	"	-	-	"	"	"	"	"
7552	"	"	"	-	-	"	"	"	"	"
7715	"	"	fair - poor	-	-	"	"	Br	"	"
7920	A	"	poor	-	-	"	"	"	"	"
8120	S	"	"	-	-	"	"	"	"	<i>Coptospora paradoxa</i> or <i>Crybelasporites striatus</i>
8206	C	"	"	-	-	"	"	"	"	"
8333	"	"	"	-	-	"	"	"	"	"
8546	"	"	"	-	-	Bl	"	"	"	"
8630	A	"	"	-	-	"	"	"	bad	"
8670	C	"	"	-	-	"	"	"	"	"
8743	S	"	bad	-	-	"	bad	"	"	"
8873	"	"	bad - frag	-	-	"	"	"	"	"
8962	"	"	"	-	-	"	"	"	"	"
9132	C	"	"	-	-	"	"	"	"	"
9210	"	"	"	-	-	"	"	"	"	Lower Cretaceous, indet.
9305	S	"	"	-	-	"	"	"	"	"

NEOCOMIAN		APTIAN		ALBIAN		CENOMANIAN		TURONIAN		CONIACIAN		SANTONIAN		CAMPANIAN		UPPERMOST CRETACEOUS		AGE	
																		<i>Aequitriletes hispidus</i> <i>Crybelosporites stylosus</i> <i>Murospora florida</i> <i>Contignisporites cooksonii</i> <i>Cyclosporites hughesi</i> <i>Kraeuselisporites linearis</i> <i>Biretisporites spectabilis</i> <i>Cicatricosisporites australensis</i> <i>Cicatricosisporites ludbrookii</i> <i>Dictyosporites speciosus</i> <i>Cooksonites variabilis</i> <i>Pilosisporites nolensis</i> <i>Foraminisporis asymmetricus</i> <i>Dictyosporites filus</i> <i>Crybelosporites striatus</i> <i>Arcellites reticulatus</i> <i>Balmeisporites holodictyus</i> <i>Trilobosporites trioreticulosus</i> <i>Coptospora paradoxa</i> <i>Pilosisporites grandis</i> <i>Contignisporites glebulentus</i> <i>Kraeuselisporites majus</i> <i>Cicatricosisporites pseudotripartitus</i> <i>Cicatricosisporites cuneiformis</i> <i>Appendicisporites distocarlinatus</i> <i>Laevigatosporites major</i> <i>Kraeuselisporites jubatus</i> <i>Tricolpites pannosus</i> <i>Balmeisporites gleniegensis</i> <i>Stephanopropollenites obscurus</i> <i>Triorites minor</i> <i>Phyllocladites mawsonii</i> <i>Clavifera triplex</i> <i>Proteacidites scoboratus</i> <i>Tricolpites pachyexinus</i> <i>Stereisporites viriosus</i> <i>Camarozonosporites amplus</i> <i>Camarozonosporites ahariensis</i> <i>Ornamentifera sentosa</i> <i>Tricolpites gillii</i> <i>Tricolpites sabulosus</i> <i>Proteacidites amolosexinus</i> <i>Nothofagidites senectus</i> <i>Triorites edwardsii (pars)</i> <i>Camarozonosporites bullatus</i> <i>aff Triorites edwardsii</i> <i>Dacrydiumites florinii</i>	
		<i>Dictyosporites speciosus</i> Zone		<i>Cyclosporites hughesi</i> Subzone		<i>Coptospora paradoxa</i> Zone		<i>Tricolpites pannosus</i> Zone		<i>Appendicisporites distocarlinatus</i> Zone		<i>Clavifera triplex</i> Zone		<i>Tricolpites pachyexinus</i> Zone		<i>Nothofagidites</i>		Microflora	
		<i>Dingodinium cerviculum</i> Zone		<i>Odontochitina operculata</i> Zone		<i>Ascadinium parvum</i> Zone		Unclassified		<i>Deflandrea cretacea</i> Zone		<i>Nelsoniella aceras</i> Zone		<i>Xenikoan australis</i> Zone		<i>Deflandrea pellicida</i> Zone		Microplankton	
																		Zones	
																		of	
																		<i>Evans (1966 b,d)</i>	

cf

cf

cf

cf

cf

x

x

x

x

x

x

x

x

x

Coptospora paradoxa Zone or Gr.
(of

LOWER
CRETACEOUS
indeterminable

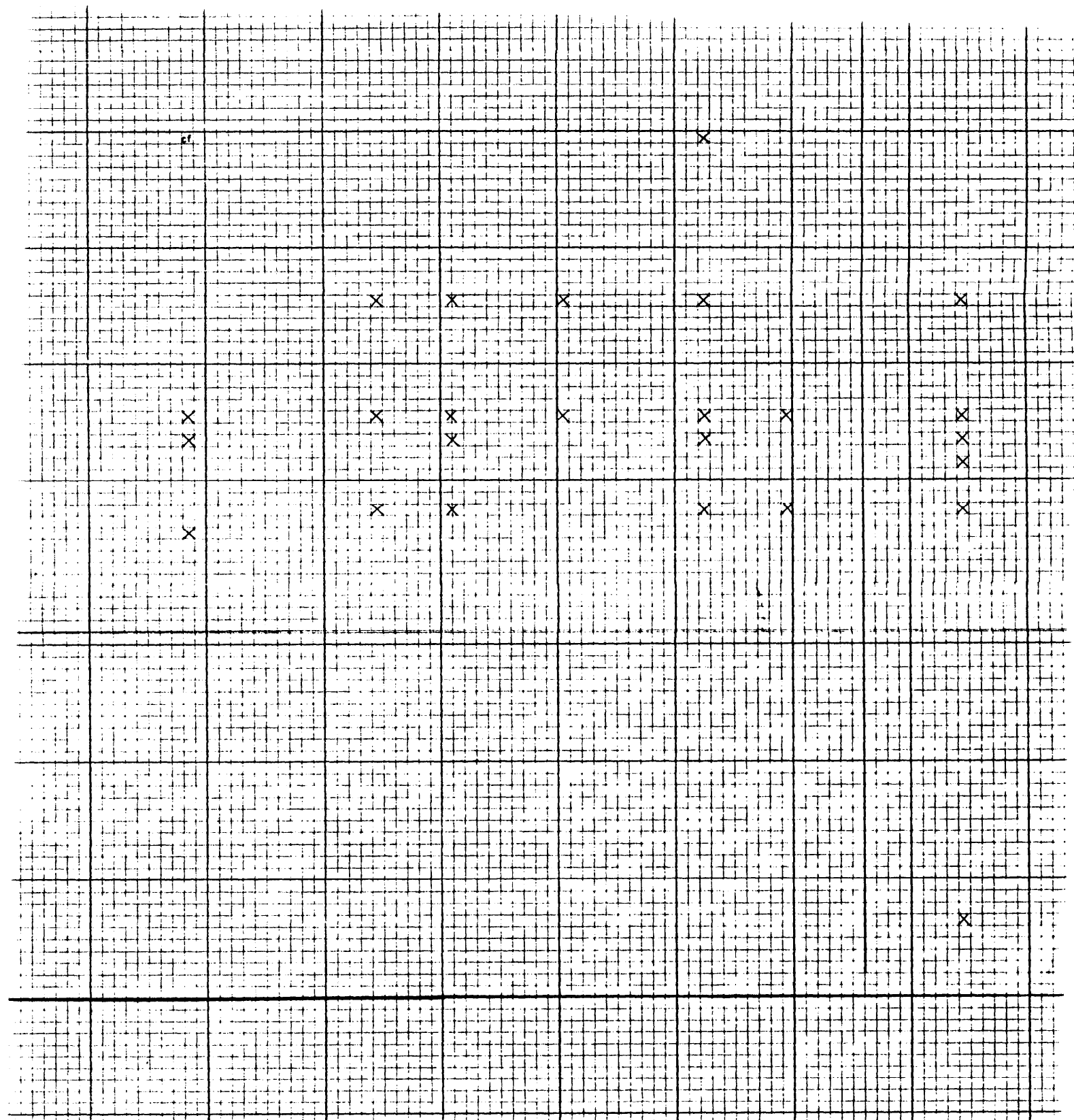
UPPER APT

	ff	e	d	c	b	a	
	x x	x	x	x			x
		x x	x	x		x x	x
		x	x			x	x

striatus Subzone
orites speciosus Zone)

Captospora

UPPER APTIAN



Coptospora paradoxa Zone

UPPER

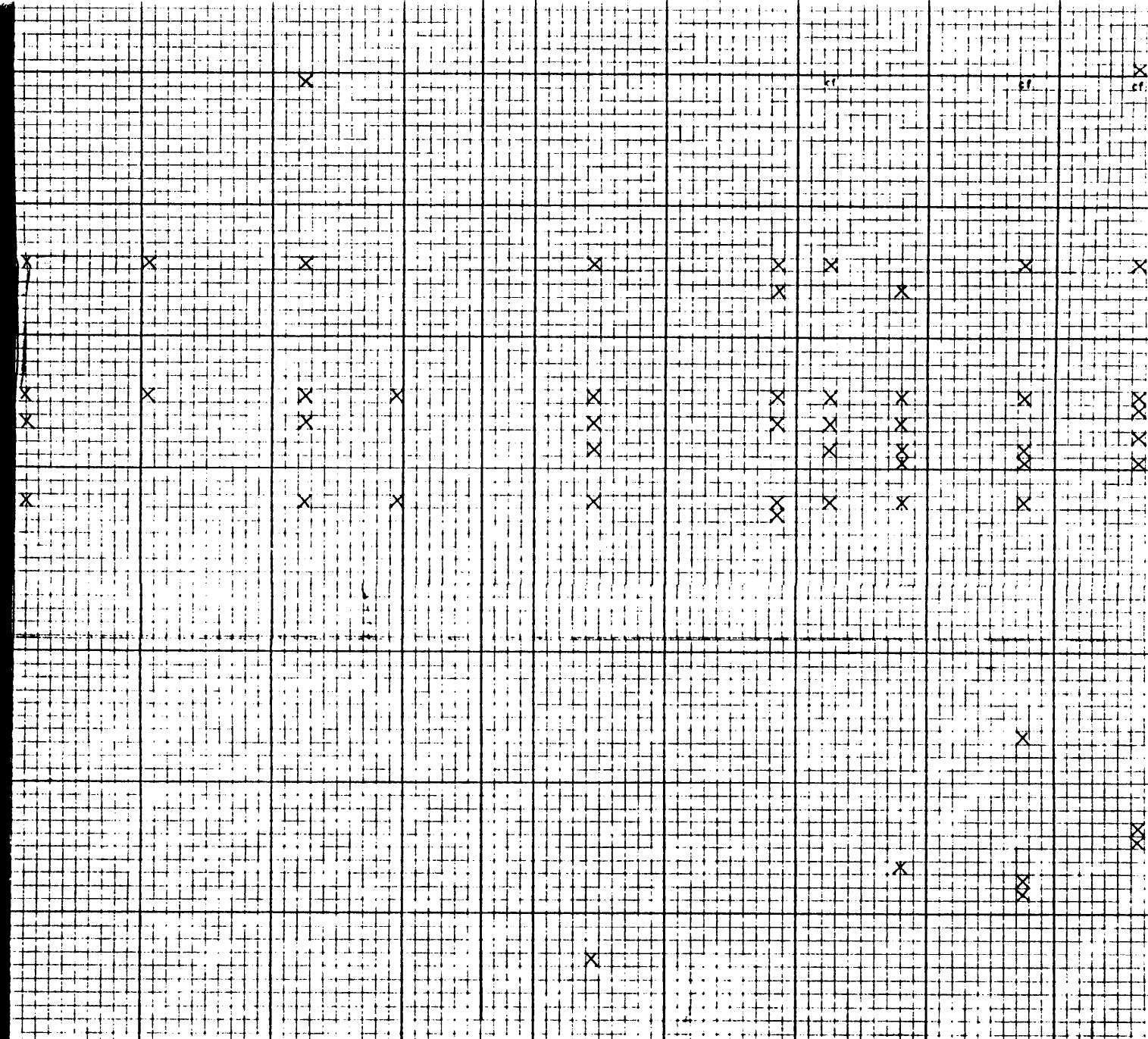
APTIAN

—

UPPER

ALBIAN

Distribution of microflore
and Cretac
Pecten -



paradoxa

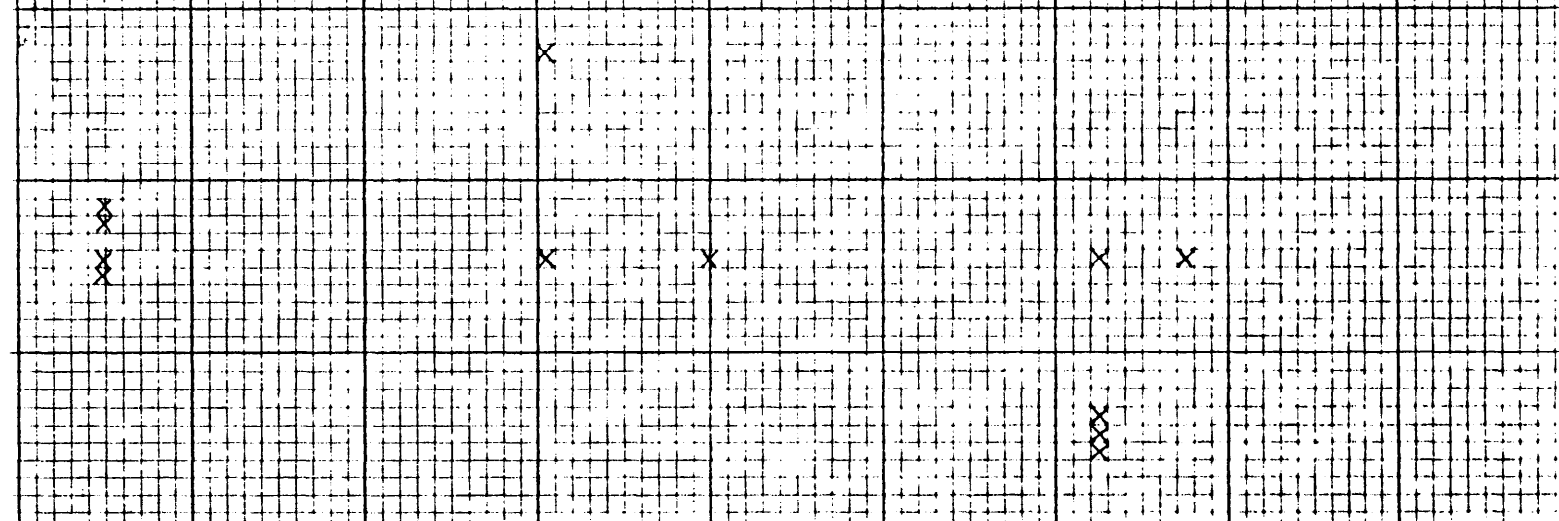
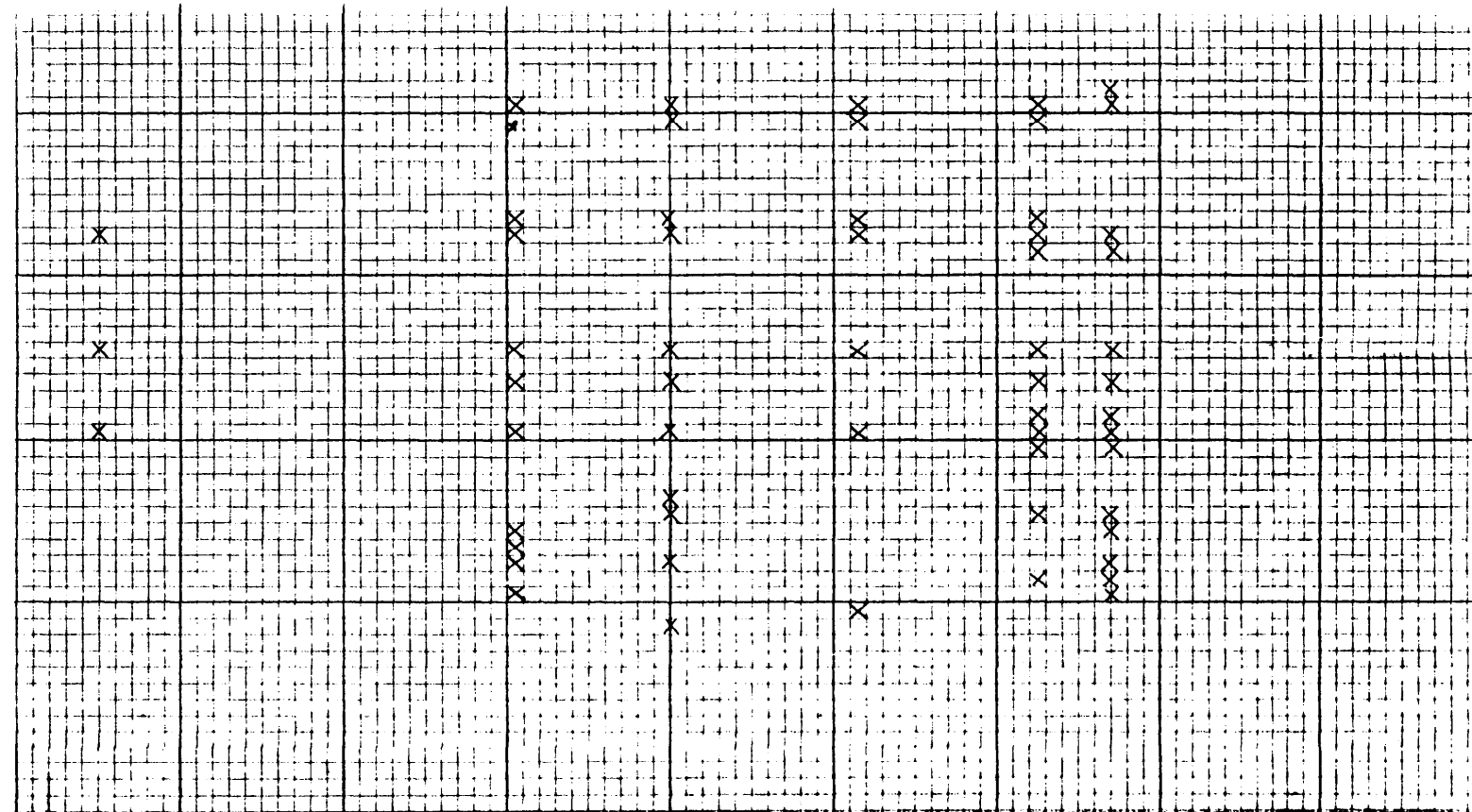
Zone

<i>Trochilites</i> <i>pinnosus</i> Zone	<i>Zonitrochilites</i> <i>diatropoides</i> Zone	<i>Clavites</i> <i>Trilob</i> Zb
---	---	--

UPPER ALBIAN

UPPER ALBIAN CENOMANIAN	UPPER ALBIAN CENOMANIAN TURONIAN	TURC
-------------------------------	---	------

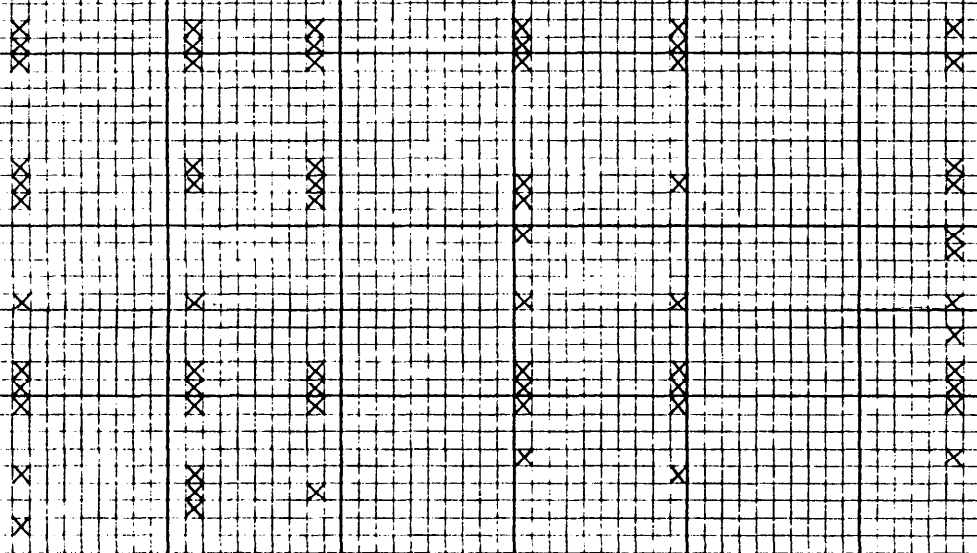
Distribution of microfossils, lowermost Tertiary and Cretaceous Pecten - IA



Tricolpites pachyexinus Zone

SENONIAN

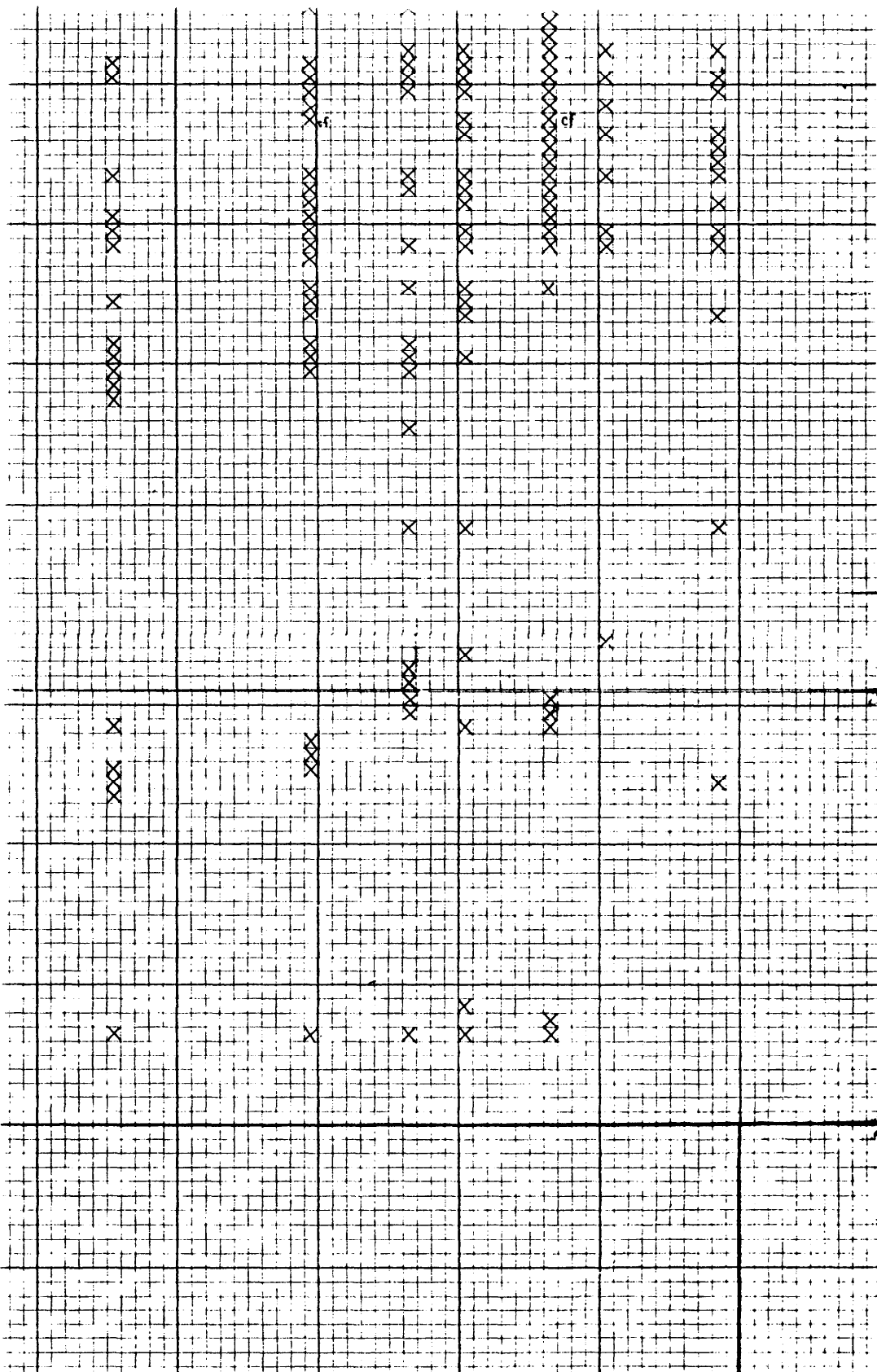
SAN



Nothofagidites

Microflora

SANTONIAN TO UPPERMOST CRETACEOUS



- Dalmanites tuberculatus*
- Livacioides* sp
- Nothofagidites emarcidus*
- Nothofagidites senetus*
- Phyllocladites mawsonii*
- Podocarpidites ellipticus*
- Podocarpidites exiguus*
- Proteacidites adenanthoides*
- Proteacidites parvus*
- Proteacidites cf. rectimarginus*
- Proteacidites reticulosabratus*
- Proteacidites subscabratus*
- Proteacidites scabroratus*
- Tricolpites gillii*
- Tricolpites l'Her.*
- Tricolpites edwardsii*
- aff. T. edwardsii*
- Cycadopites* sp

- Microcachrydites antarcticus*
- Polyporina fragilis*
- Paedospirites microsaccatus*

- Proteacidites amoloxinus*
- Tricolpites pachyaxinus*
- Tricolpites sabulosus*
- Dactyloporites australiensis*
- Proteacidites cf. crassus*
- Tricolpites* spp
- Araucariacites australis*
- Tricolpites minor*
- Cuspidites cf. classoides*
- Stephanopollenites obscurus*
- Cycadopites nitidus*
- Tricolpites pannosus*
- Stephanopollenites* sp
- Proteacidites* sp
- Alisporites grandis*
- Vesporites triquetrus*
- Alisporites similis*

MICROPLANKTON

- Cyclonellum retinatum*
- Epicephalopyxis indentata*
- Deflandrea delectata*
- Sarbadrella australina*
- Deflandrea baheri*
- Deflandrea pellucida*
- Epicephalopyxis indentata*
- Deflandrea* sp
- Ekenackia* sp
- Trichodinium* sp
- Bairdsphaeridium* sp
- Hystriosphæridium cf. heteracanthum*
- P. dentochitina* sp.
- P. ambages*
- Deflandrea cf. micracantha*
- Xenacanth australis*
- Deflandrea victoriensis*
- Hexagonifera vermiculata*
- Hystriosphæridium complex*
- Hystriosphæridium heteracanthum*
- Odontochitina* sp
- Ascodinium parvum*
- Bonyaulax* sp
- Odontochitina operculata*

REMANIE

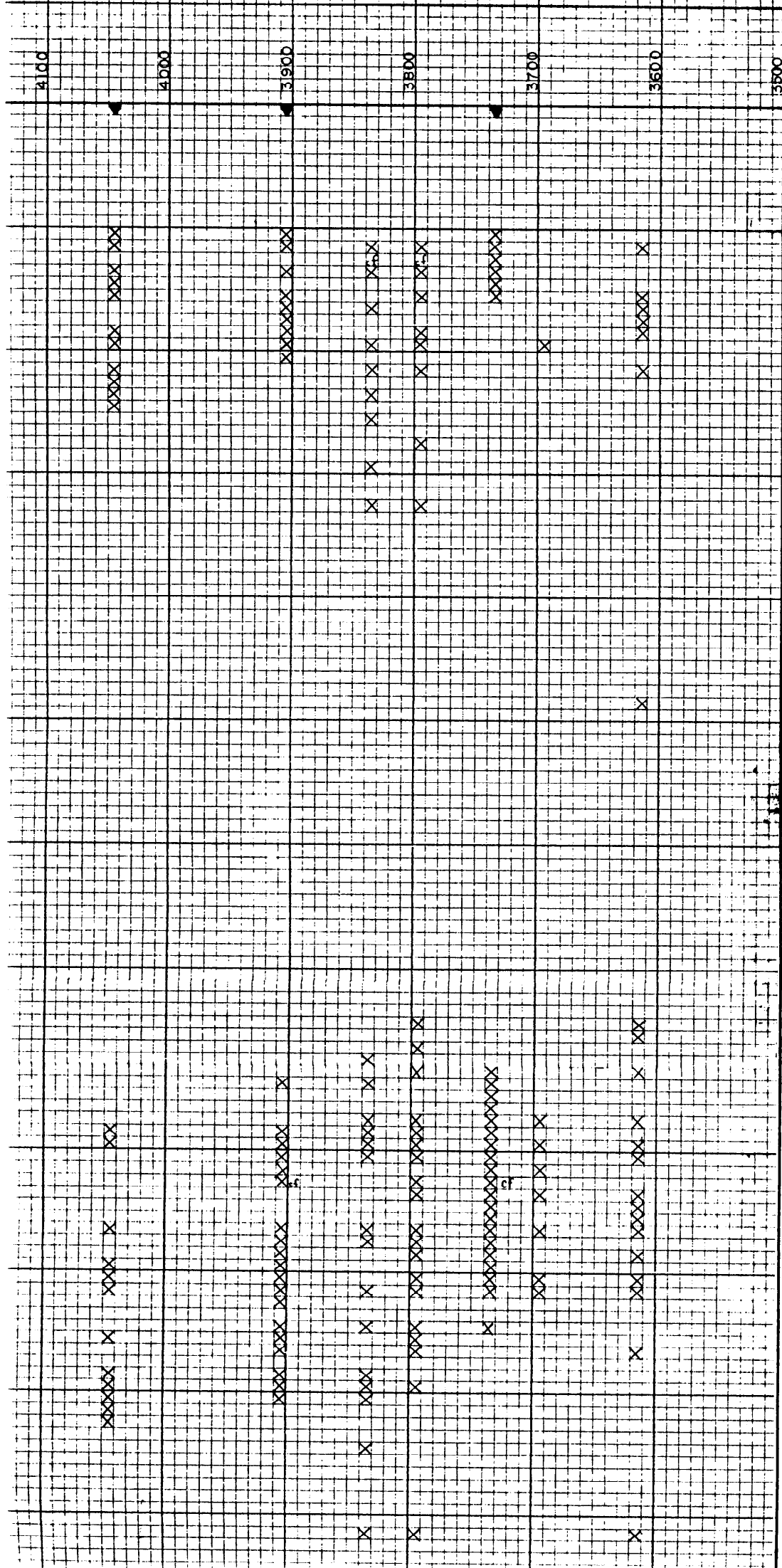
- Spiralites* sp
- Aequitriradites spinulosus*
- Nubiosporites* sp
- Dicelatosporites speciosus*
- Murosora florida*

ZONE

? TERTIARY

TERTIARY

AGE



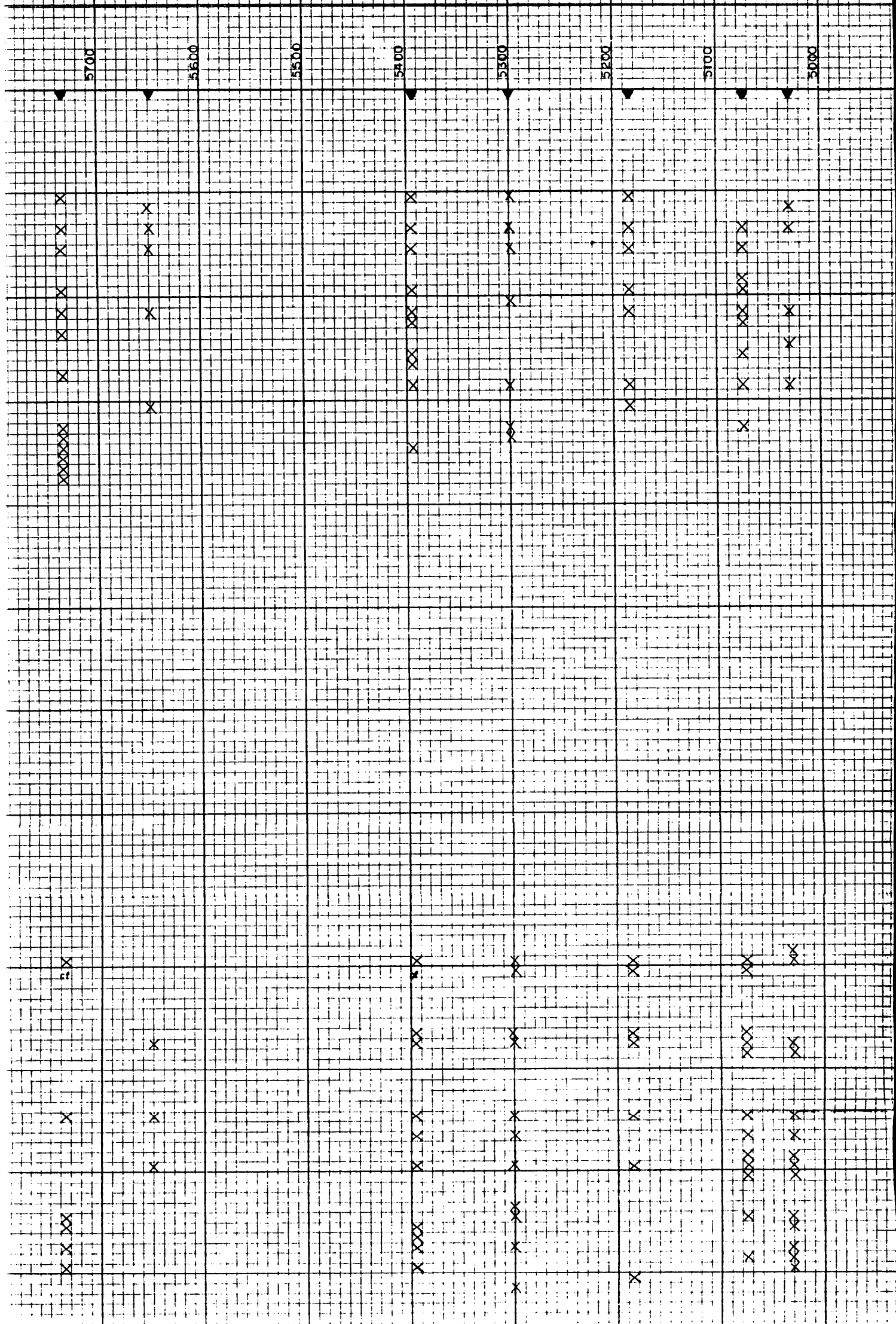
Sidewall sample

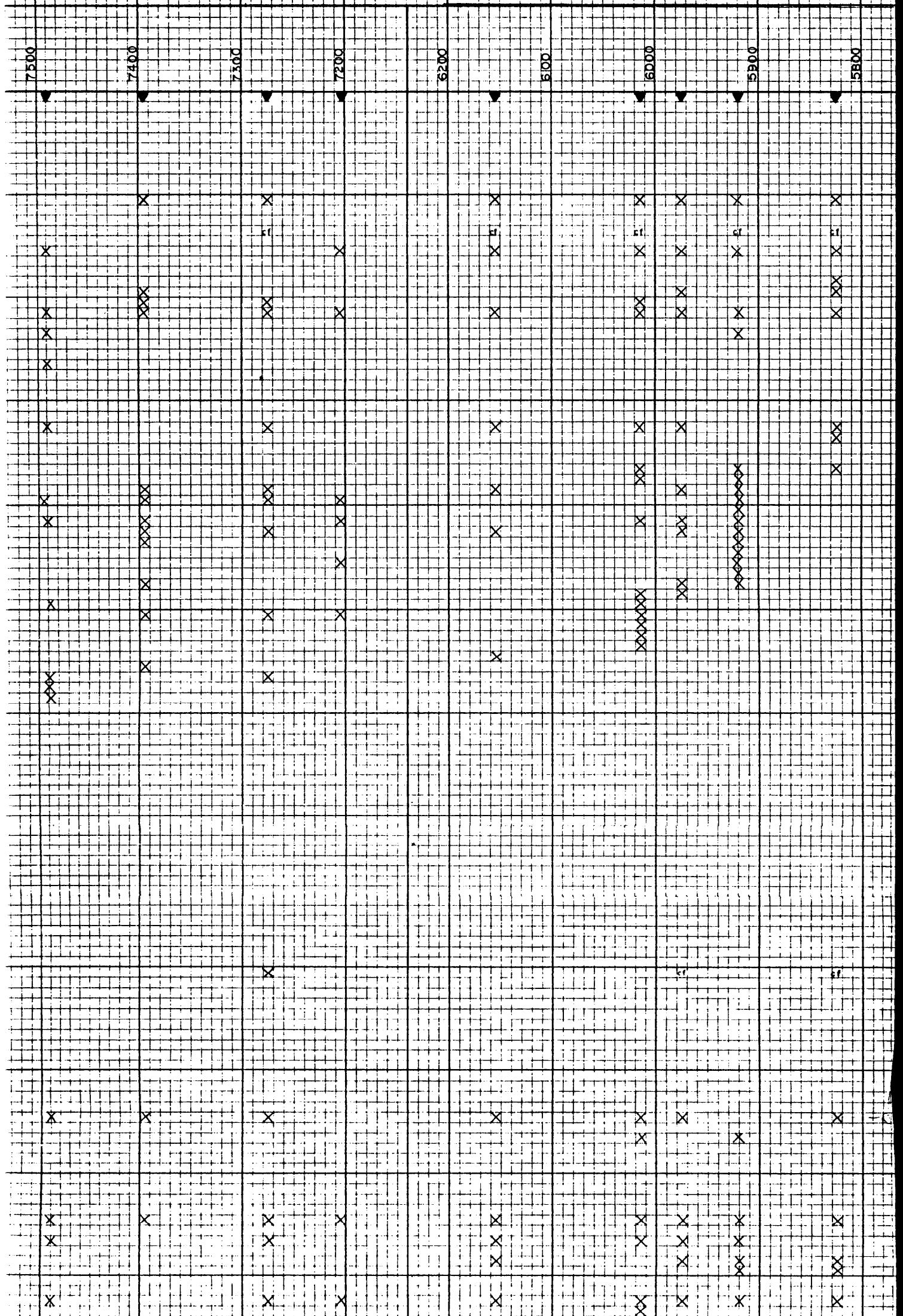
SPORES

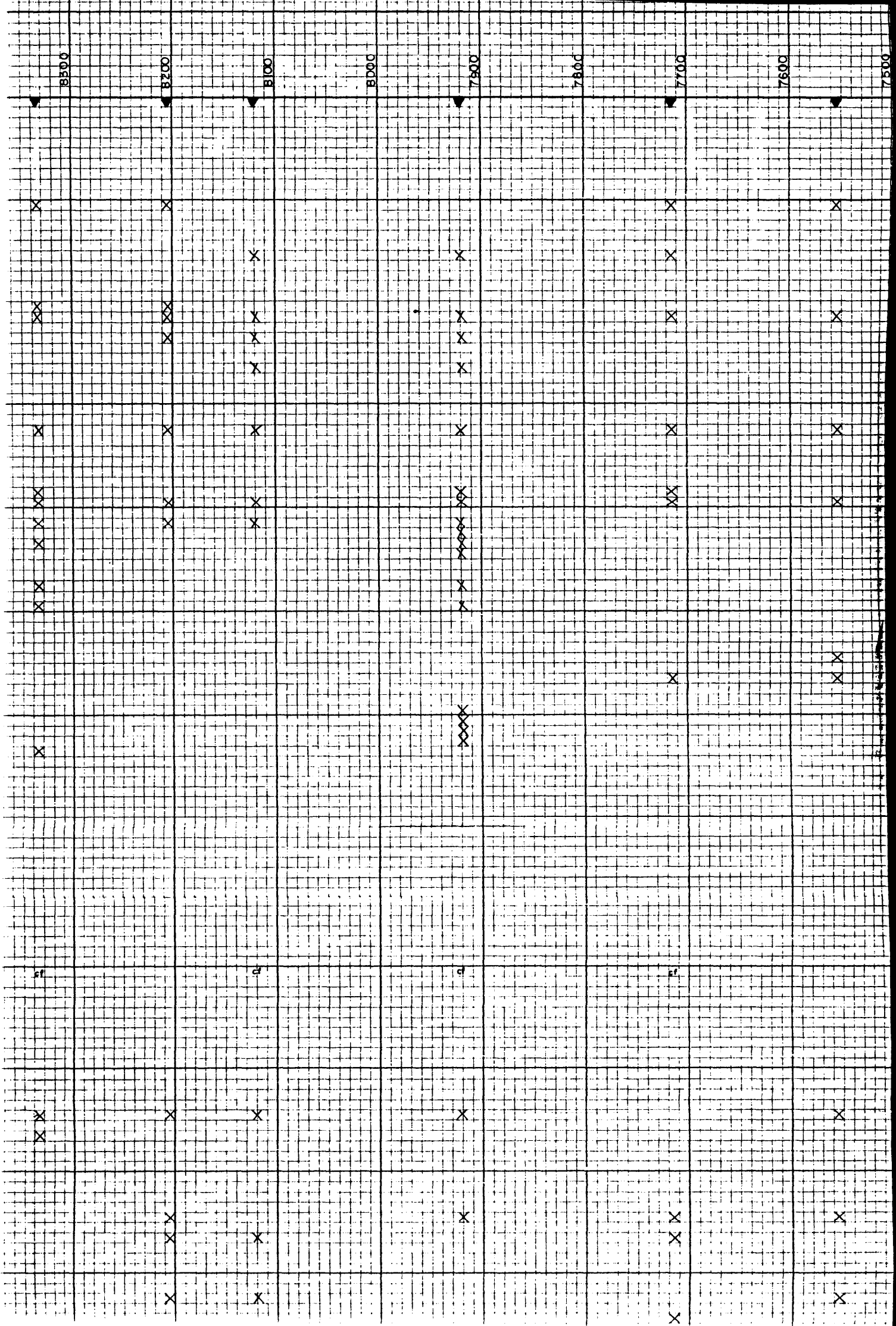
- Cyathidites minor*
- Camarozonosporites amplius*
- Camarozonosporites* sp
- Gleicheniidites arcinidites*
- Kraeuselisporites papillatus*
- Stereisporites antiquasporites*
- Cyathidites splendens*
- Camarozonosporites bullatus*
- Laevigatosporites major*
- Laevigatosporites ovatus*
- Lycopodiumsporites australclavatioides*
- Cyathidites australis*
- Camarozonosporites ohioensis*
- Lycopodiumsporites* spp
- Stereisporites viriosus*
- Ornamenhfera sentosa*
- Rouseisporites* spp
- Ceratopores* sp.
- Clavifera triplex*
- Densosporites velatus*
- Kraeuselisporites* sp
- Neorastrickia* sp
- Baculatisporites comauensis*
- Baimesporites glenelgensis*
- Cicatricosisporites* sp
- Arcalites hexapartitus*
- Appendicisporites distocariniatus*
- Kraeuselisporites jubatus*
- Aequitriradites spinulosus*
- Cicatricosisporites australiensis*
- Cicatricosisporites cuneiformis*
- Crybelosporites striatus*
- Caplospora paradoxa*
- Coraminisporis asymmetricus*
- Praminisporis dailii*
- Lepidolepidites verrucatus*
- Lycopodiumsporites circolumenus*
- Rouseisporites reticulatus*
- Triletes cf. tuberculiformis*
- Cyathidites punctatus*
- Cicatricosisporites hughesi*
- Contignisporites glebulentus*
- Mylisporites* sp
- Lycopodiumsporites emulus*
- Ceratopores* equalis
- Kraeuselisporites major*
- Klukisporites scaberis*
- Contignisporites* sp
- Lepidolepidites major*
- Baimesporites holodictyus*
- Neorastrickia truncata*
- Pilososporites grandis*
- Triletesporites trioreticulosus*
- Cicatricosisporites ludbrookii*
- Osmundacidites wellmanni*
- Pilososporites notensis*
- Praminisporis wanthaggiensis*
- Aequitriradites verrucosus*
- Baimesporites* sp
- Diclytosporites speciosus*

POLLEN

- Dacrydiumites ellipticus*
- Triletes harnsi*
- Triletes cf. fissilis*
- Nothofagidites cf. brachyspinosus*
- Dacrydiumites baimeii*
- Dacrydiumites florinii*
- Dilwynites tuberculatus*
- Lyliacidites* sp
- Nothofagidites emarcidus*
- Nothofagidites senetus*
- Phyllocladites mawsonii*
- Podocarpidites ellipticus*
- Podocarpidites exiguus*
- Proteacidites aenanthoides*
- Proteacidites parvus*
- Proteacidites cf. rectomarginus*
- Proteacidites reticuloscabratus*
- Proteacidites subscabratus*
- Proteacidites scaberratus*
- Tricolpites gillii*
- Tricolpites l. l.*
- Triletes edwardsii*
- aff. T. edwardsii*
- Cycadopites* sp
- Microcachrydites antarcticus*
- Polyparina fragilis*
- Podosporites microsuccatus*
- Proteacidites amolaseinus*
- Tricolpites pachyaxinus*
- Tricolpites sabulosus*
- Dacrydites australiensis*
- Proteacidites cf. crassus*
- Tricolpites* spp
- Tricolpites australis*
- Triletes minor*
- Cuspidites cf. classoides*
- Stephanopropollenites obscurus*
- Cycadopites nitidus*
- Tricolpites pannosus*
- Stephanopropollenites* sp
- Proteacidites* sp
- Alisporites grandis*
- Veisporites triquetrus*







9300

9200

9100

9000

8900

8800

8700

8600

8500

X

X

X

X

X

X

X

X

X

X

X

X

X

X

X

X

X

X

X

X

X

X

X

X

X

X

X

X

X

X

X

X

X

X

X

X

X

X

X

X

X

X

X

X

X

X

X

X

X

X

X

X

X

X

X

X

X

cf

sf

tf

sf

cf

sf

X

X

X

X

X

X