

P.S. 124

Confidential to A. 179

ROBERTSON RESEARCH (NORTH AMERICA) LIMITED

EXPLORATION REPORT NO. 175

O.F. 648

THE MICROPALAEONTOLOGY, PALYNOLOGY AND STRATIGRAPHY OF

THE CHEVRON UPLUK M-38 WELL

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Project No. RRNA/778/424

JUNE, 1977

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C O N T E N T S

		<u>Page No.</u>
I	INTRODUCTION	1
II	SUCCESSION	3
III	MATERIALS AND METHODS	4
IV	QUATERNARY	6
V	TERTIARY	8
VI	STRATIGRAPHICAL REMARKS	14
VII	REFERENCES	17
VIII	APPENDIX	22

ENCLOSURES: Biostratigraphical analysis charts, Nos. 1 and 2.

I

INTRODUCTION

This report comprises a summary of the micropalaeontological, palynological and stratigraphical analyses carried out under Project No. RRNA/778/424, on material from the interval 600' - 12,300' (T.D.) of the Chevron Upluk M-38 well.

The well was drilled on an unnamed island in the Mackenzie Delta region, Northwest Territories between Garry and Kendall Islands, at Latitude $69^{\circ} 27' 56''$ N., and Longitude $135^{\circ} 24' 54''$ W..

The stratigraphical interval covered by this well section commences in strata of Pleistocene - Recent age, which are underlain by Pliocene - Miocene and Oligocene sediments. These, in turn, pass down into strata of Eocene age within which the well terminated.

In view of the complex non-marine to marginal marine depositional history of the Canadian Arctic Coastal Plains, no attempt has been made to adopt a classification of palaeoenvironments in terms of marine bathymetry. An alternative assessment of maximal and minimal marine influences on the transitional environments which prevailed in an essentially deltaic complex has therefore been attempted. Implicit in this is the recognition of transgressive and regressive sedimentary cycles within the sequence. These characteristic lithological sequences, together with their seismic and gamma ray log motifs, are discussed by Young, Myhr and Yorath, (1976) within

the Mackenzie Basin. This evidence coupled with fluctuating abundances of microplankton and foraminifera greatly aided environmental interpretations.

A summary of the sequence penetrated in the well can be seen overleaf in Table I.

II

SUCCESSIONTABLE I

<u>INTERVAL</u>	<u>THICKNESS</u>	<u>SERIES</u>	<u>SYSTEM</u>
600' - 1400'	800'	Pleistocene-Recent)	Quaternary
1400' - 2320'	920'	Miocene-Pliocene)	Neogene
2320' - 7050'	4730'	Oligocene)	
7050' - 10,270'	3220'	Mid-Late Eocene)	Palaeogene
10,270' - 12,300'	2030'	Early Eocene)	

N. B. The above figures are based on results derived mainly from ditch cuttings samples and are therefore approximations only.

III

MATERIALS AND METHODS

Under Project No. RRNA/778/424, prepared and unprepared material from the interval 600' - 12,300' (T.D.) was available for both palynology and micropalaeontology. In the case of micropalaeontological examination, samples between the intervals 600' - 4520', and 10,200' - 11,500' had already been prepared by Chevron Standard, Calgary. The remaining samples, namely 4520' - 10,200' and 11,500' - 12,300', were predominantly unwashed sediments, again the property of Chevron Standard, and were processed in the laboratories of Robertson Research (North America) Limited. Sampling intervals for micropalaeontological analyses were as follows: Interval 600' - 6750', 30' composites; interval 6750' - 10,200', 40' composites; interval 10,200' - 11,500', 20' composites; interval 11,500' - 12,300', 40' composites.

Palynological analyses examined ditch cuttings samples prepared at RR(NA) between 600' - 7190' at 90' composites, together with Chevron spot samples at 100' intervals between 4700' - 5100'. Chevron ditch cuttings samples between 7180' - 12,300' (T.D.) were also examined. These were of 20' and 30' composites. In addition 30 sidewall cores between 1400' - 4650' and a core between 10,341' - 10,405' were examined.

The Upluk M-38 well initially penetrated sediments to a depth of 10,560'. However, three subsequent sidetracks terminated at depths of 12,300', 12,060' and 12,350' respectively. The samples examined for

biostratigraphy are predominantly a composite of the initial well and sidetrack No. 2, i.e. to 12,300' (T.D.). The micropalaeontological examination of the intervals 5790' - 10,810' and 10,810' - 11,490' were however from sidetracks No. 2 and No. 3 respectively, whereas palynological examination above and below 10,030' was from the initial well and sidetrack No. 2 respectively, with a degree of overlap between 10,030' - 10,500' for reasons of continuity. This resulted in two sets of slides from the same depths being examined. The microfloras from each were identical.

Although, sampling differences resulted due to the complex nature of this well, nevertheless, similar lithologies and identical ages were determined for corresponding depths. The lithological column plotted for the well is therefore a composite with the respective sidetrack intervals marked. For specific information reference should be made to the biostratigraphical analysis charts, enclosures Nos. 1 and 2.

A tentative interpretation of the environments of deposition is indicated on the biostratigraphical analysis charts and discussed in the stratigraphical conclusions. The interpretation of a probable environment is based on the use of a combination of factors including the faunal and floral diversity and dominance, their stratigraphical distribution, the comparison of assemblages with analogous components in the Recent and fossil record, and the lithological characteristics of the intervals studied.

It should be realised that as the information is mainly derived from cuttings samples, only a generalised interpretation of the environment is feasible throughout the well section.

IV

QUATERNARYINTERVAL 600' - 1400': Pleistocene - RecentGeneral Lithology

The interval 600' - 1040' consists of scattered wood fragments in a clay matrix. The remainder of the interval is made up of interbedded coarse sandstone with minor chert together with clay.

Micropalaeontology

The presence of Pleistocene - Recent ostracods characterise this interval. Between 780' - 1160', both freshwater and marine ostracod species occur sporadically. These include Heterocyprideis sorbyanoides and Canona^d cf. paraohioensis.

Also extremely rare occurrences of Eggerella cf. advena and Astrononion gallowayi were recorded.

Palynology

In situ palynomorphs encountered in this interval include Pinuspollenites spp., Piceapollenites sp., Myrica sp., Stereisporites sp., Gleicheniidites sp., undifferentiated bisaccate pollen and periporate pollen.

The fungal group is not represented and microplankton are rare.

Reworking of older forms occurs to some extent. These include, Densosporites spp., of Palaeozoic age, Costatoperforosporites foveolatus and

Vitreisporites sp. of Mesozoic age. The sporadic occurrences of Sigmopollis sp. and dinoflagellate ovoid cysts may be due to reworking from the underlying interval.

V

TERTIARYINTERVAL 1400' - 2320': Miocene - PlioceneGeneral Lithology

This interval is predominantly clay with minor coarse sands throughout. Toward the base of the interval a thin, fine sandstone bed occurs again underlain by clay containing minor chert.

Micropalaeontology

Foraminiferid species diversity increases over this interval, although of low absolute numbers. Characteristic species encountered include Protoelphidium cf. orbiculare, Elphidium groenlandicum, Cibicides lobatulus and Elphidium clavatum. This assemblage is characteristic of the Pliocene - Pleistocene, although some of the above range from the Miocene.

Minor reworking of possibly Cretaceous species also occurs.

Palynology

Palynomorphs occurring in this interval include forms which are characteristic of the Sigmopollis - Dinoflagellate ovoid cyst Assemblage, a typical palynoflora known to occur in (Neogene) Miocene sequences of the Mackenzie Delta area. Recorded are Sigmopollis sp., Sigmopollis hispidis, an ovoid cyst form of dinoflagellate affinity, Jussiaea sp. and

Chenopodiaceae - Amaranthaceae. In addition to these, Corylus sp., Piceapollenites sp., Cyathidites sp., Sphagnum sp., Alnipollenites sp., Taxodiaceapollenites hiatus and Triporopollenites sp.' (Betula type) were encountered in the interval.

Apart from rare occurrences of Leptodinium sp., Lingulodinium sp. and Oligosphaeridium spp., microplankton were absent.

INTERVAL 2320' - 7050': Oligocene

General Lithology

The top of this interval between 2320' - 4200' consists of sandy clay with scattered minor chert. Interbedded with the above are horizons of coarse sandstone and lignite particularly between 3800' - 4200'. The remainder of the interval consists of clay with minor chert and fine sands throughout. Toward the base of the interval two thin shale horizons occur.

Micropalaeontology

The regular occurrence of Turrilina alsatica at the top of this interval is indicative of the Oligocene. However, with the exception of this topmost section, the entire interval contained only extremely rare, long ranging genera, or was barren of foraminifera.

Palynology

The top 1230' section of this interval (from 2320' to 3500') yielded a fairly rich palynomorph assemblage. It is characterised by the presence of porate angiosperm pollen Triporopollenites sp. (Betula type), Triporopollenites spp., Alnipollenites verus, Myrica sp., Jussiaea sp. and Pterocaryapollenites sp., gymnosperm pollen Podocarpidites sp., Taxodiaceapollenites hiatus, undifferentiated baccates and Tsugaepollenites sp., and the spore taxa Laevigatosporites spp., Osmundacidites wellmanii and Lycopodiumsporites spp.. At 2500' S.W.C., the presence of Ilexpollenites sp. indicates that sediments of Oligocene age were penetrated. Other diagnostic forms occurring in this section include Hamulatisporites sp. and Juglanspollenites sp. at 2750' S.W.C. and Parviprojectus PJ-1 (Staplin, 1976) at 3350' S.W.C.

The occurrence of Pediastrum sp. at 2500' - 2490' could possibly indicate a Neogene age at this depth. This does not contradict the age determination based on palynological evidence. The Palaeogene/Neogene boundary at 2320' was determined on micropalaeontological evidence.

The section below 3550' is characterised by a more depauperate assemblage both in the number of taxa and frequency of specimens recorded. However, significant forms occurring within the interval include Tiliaepollenites vescipites, Tiliaepollenites sp., Parviprojectus PJ-1, Bombacacidites sp., Boisduvalia clavatites and Ericipites sp.. This palynomorph assemblage is included in the Tiliaepollenites Assemblage Zone.

There are rare occurrences of microplankton in this interval. In situ forms include ?Cordosphaeridium cantharellum and Hemicystodinium sp..

The microfloral assemblage recovered from this interval indicates an Oligocene age.

INTERVAL 7050' - 10,270': Mid-Late Eocene

General Lithology

The entire interval is composed of fine sand within a clay matrix with minor, scattered chert throughout.

Micropalaeontology

The first occurrence of Cyclamina arctica-borealis is taken as indicative of the Eocene (fide Langhus and Zingula in Staplin (1976)). This species becomes increasingly common to abundant throughout the entire interval. It was found in association with sporadic occurrences of Haplophragmoides sp. 5124 (Shell), also indicative of the Palaeogene. Toward the base of the interval Haplophragmoides sp. 4106 (Shell) was recorded, although rarely. This species is again indicative of the Palaeogene.

The pyritised skeletons of the diatoms Coscinodiscus sp. 1 and sp. 2 were also commonly found at the base of the interval.

Palynology

A minor influx of microplankton characterises this interval. The consistent occurrence of Dinoflagellate J-7 (Staplin, 1976) is recorded throughout the interval up to 7280'. Other distinctive forms include ?Deflandrea dilwynensis, Deflandrea sp. F. and Oligosphaeridium sp..

This interval contains a fairly impoverished terrestrial palynofloral assemblage. Included are the spore types Laevigatosporites spp., Osmundacidites wellmanii, Osmundacidites sp., Lycopodiumsporites sp.,

Cyathidites sp., gymnosperm pollen Taxodiaceapollenites hiatus and Tsugaepollenites sp. and the diagnostic angiosperm taxa Parviprojectus PJ-1, Tiliaepollenites sp., Tiliaepollenites crassipites, Ericipites sp. and Tricolporopollenites kruschii. It is ascribed to the Tiliaepollenites Assemblage Zone.

The occurrence of the above mentioned forms in the assemblage indicate a Middle to Late Eocene age for this interval.

INTERVAL 10,270' - 12,300': Early Eocene

General Lithology

The top of the interval is composed of dark shale and scattered cherts. This is underlain by interbedded coarse sandstones and shales. The remainder of the interval comprises dark shale with fine sands, together with minor coal stringers throughout.

Micropalaeontology

The extremely rare occurrences of foraminifera encountered over this interval are of low biostratigraphical value and did not contribute to the dating of this interval. The majority of the samples examined were barren of foraminifera.

Palynology

A spectrum of palynomorph assemblages of Eocene age were recovered from this interval.

The interval is characterised by an influx of members of the fungal group which constitute a distinctive assemblage here designated the 'Pesavis Assemblage.' It consists of such regular elements as Pesavis tagluensis, Pesavis sp., Striadiporites sanctaebarae, Diporicellaesporites sp., Brachysporisporites cotalis, Dyadosporonites sp., undifferentiated fungal hyphae and spores and Pluricellaesporites hillsi. Terrestrial palynofloral elements ascribable to the Tiliaepollenites Assemblage were recorded. These include porate pollen such as Alnipollenites verus, Tiliaepollenites vespites, T. sp., Triporopollenites spp., Pterocaryapollenites sp. and Tricolporopollenites kruschii. Other terrestrial forms which occur in abundance in this interval include Taxodiaceapollenites hiatus, Tricolporopollenites sp. (Castanea type), Azolla sp. and Tsugaepollenites sp.

The marine microplankton assemblages recorded from this interval are common and diverse. They are ascribable to the Wetzeliella Assemblage which includes several Wetzeliella species such as Wetzeliella sp. cf. hampdenensis, W. articulata, W. sp. cf. symmetrica, Wetzeliella sp. A (Williams and Brideaux, 1975) as well as Dinoflagellate J-7 (Staplin, 1976), Pseudodeflandrea sp. cf. sagittula, Oligosphaeridium complex, Ceratiopsis sp. and Hystriosphraeridium recurvatum. Other distinctive forms encountered include Thallasiphora pelagica (abundant), cf. Oligosphaeridium pulcherrimum, Deflandrea sp. cf. hialina (common), Cordosphaeridium exilimurum, Adnatosphaeridium sp. (common), Cyclonephelium type (abundant), and ?Areoligera sp. (common). These dinoflagellate species appear to be of local occurrence, however, some of them have been encountered in previous well analyses and may prove to be useful in the zonation of this part of the Mackenzie Delta region.

The palynomorph assemblages recovered from this interval indicate an Early Eocene age.

VI

STRATIGRAPHICAL REMARKS

The lithofacies of the molassic sequences in nearby wells within the Mackenzie Delta have been well documented and illustrated by Young, Myhr and Yorath (1976). The Upluk M-38 well penetrated a series of sediments in accordance with ages and structures compiled by the above authors. Similarly, these authors' Palaeogene palaeogeographical reconstruction indicates that the position of this well straddles a boundary between the paludal/delta front and delta front/prodelta environments within the Richards Island Basin. Biostratigraphical analyses are in agreement with this interpretation. The palaeoenvironmental history of the Upluk M-38 well within the Palaeogene is one of regression with progressive shallowing accompanying delta infill. This is illustrated by the decreasing abundance of microplankton from the base of the well upward. Minor reworking of microplankton and foraminifera is found within the Palaeogene. The Neogene sediments show a return to shallow marine conditions with the occurrence of a diverse foraminiferid assemblage. It is possible that an unconformity separates the Neogene and upper Palaeogene sediments, as also suggested on micropalaeontological evidence by Staplin (1976) within the alluvial delta facies to the south. These sediments are succeeded by non-marine to brackish water Pleistocene to Recent deposits. Individual stratigraphical units are briefly described below. They are related, where possible, to the diachronous lithological sequences.

The Upluk M-38 well reached T.D. from sidetrack No. 2 at 12,300' within a series of interbedded fine sandy shales, and coarse sandstones with coal stringers. These sediments have been determined as Early Eocene in age based on palynology. The interval extends from the base of the well to 10,270'. The fine sands within the carbonaceous shale are overlain by sandstones forming part of a coarsening upward cycle typical of the delta front/prodelta environment. These sediments have been assigned to the ?Unnamed Eocene Shale Unit Equivalent and constitute both the Pesavis and Wetzeliella palynological Assemblages Zones.

Overlying these deposits, is the Mid-Late Eocene and Oligocene paludal/delta front facies which consists primarily of fine sandy clay/mudstone often being carbonaceous. It extends from 10,270' - 2320' and has been assigned to the ?Upper Palaeogene Clastic Wedge Equivalent. The decreasing abundance of microplankton and the low foraminiferid species diversity is in agreement with this interpretation and elucidates the change from the marine influence within the delta front/prodelta to that of a swampy, brackish water environment. On micropalaeontological evidence the top of the Eocene has been placed at 7050'. This is supported by the occurrence of Eocene microfloras at 7280'. Similarly the top of the Oligocene has been determined on micropalaeontological evidence at 2320' again corroborated by Oligocene microflora at 2550'. The entire interval falls within the palynological Tiliaepollenites Assemblage Zone.

The interval 2320' - 1400' of Miocene - Pliocene age has been assigned to the Sigmopollis - Dinoflagellate ovoid cyst Assemblage zone, and is equated with the ?Neogene Clastic Wedge. The absence of microplankton

together with a relatively diverse foraminiferid assemblage suggests a very shallow marine environment. The sediments are again of paludal facies.

The Neogene sediments, are in turn succeeded between 1400' - 600' by Quaternary clays with coarse sands and wood fragments. They contain freshwater and shallow marine ostracods indicative of a paludal, marginal marine environment.

VII

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APPENDIX

CLASSIFICATION OF PALYNOLOGICAL ASSEMBLAGE ZONES

Signopollis - Dinoflagellate ovoid cyst Zone

Diagnostic forms: Signapollis sp., an ovoid cyst of dinoflagellate affinity and Pediastrum sp.

Other forms also observed in the assemblage: pollen grains of Chenopodiaceae - Amaranthaceae, Compositae (Ambrosia), Gramineae, Caryophyllous pollen species, Taxodiaceapollenites sp. and Sphagnum sp.

Tiliaepollenites Assemblage

Tiliaepollenites is the significant form in this assemblage. It is associated with occurrences of the following species which are characteristic of, although not necessarily restricted to, the zone.

Tripoporollenites maximus

Ericipites sp.

Tripoporollenites spp.

Ulmipollenites sp.

Tripoporollenites (Betula type)

Bombacacidites sp.

Pterocaryapollenites sp.

Caryapollenites sp.

Alnipollenites verus

Taxodiaceapollenites hiatus

Tricolporopollenites spp.

Bisaccate pollen

Juglanspollenites sp.

Pesavis Assemblage

Pesavis tagluensis is the significant form in this assemblage and is associated with the following species which are characteristic of, although not necessarily restricted to, this zone.

Pesavis sp.

Striadiporites sanctaebarae

Dyadosporonites sp.

Brachysporisporites cotalis

Diporicellaesporites sp.

Pluricellaesporites hillsi

Undifferentiated fungal hyphae and spores

Wetzeliella Assemblage

This zone contains many microplankton of the Wetzeliella dinoflagellate species complex in association with other species which may be characteristic of, although not necessarily restricted to, the zone.

Wetzeliella hamptenensis

Wetzeliella arcticulata

Wetzeliella spp.

Wetzeliella symmetrica

Dinoflagellate J7

Pseudodeflandrea sp. cf. sagittula

Ceratiopsis sp.

Cyclonephelium type

Thallasiphora pelagica

Deflandrea sp. cf. hialina

Deflandrea spp.

Adnatosphaeridium sp.

?Areoligera sp.

Hystrichosphaeridium spp.

Oligosphaeridium spp.

Cordosphaeridium exilimurum

UPLUK M-38

(All magnifications X 500 except where stated)

PLATES 1 - 3

PLATE I



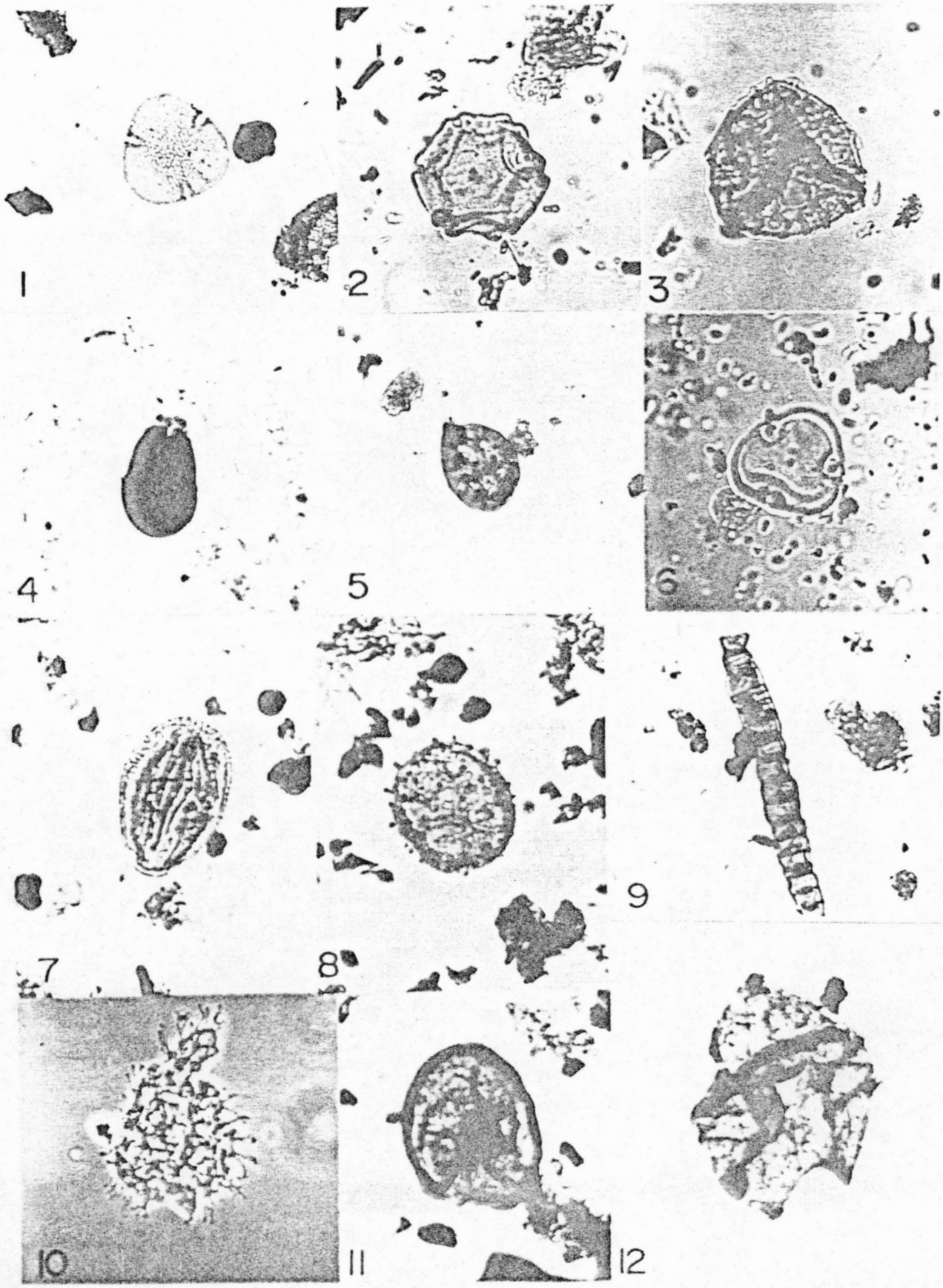


PLATE 3

