

THE STRATIGRAPHY AND INVERTEBRATE
PALEONTOLOGY OF EARLY PALEOZOIC ROCKS, SOMERSET
AND PRINCE OF WALES ISLANDS, N.W.T.

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by
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ABSTRACT

Stratigraphy and Invertebrate Paleontology of early Paleozoic rocks, Somerset and Prince of Wales Islands, N.W.T.

The basal Paleozoic succession on Somerset and Prince of Wales Islands begins with two formations of Middle Cambrian to Middle Silurian age. The lower, newly named Lang River Formation rests unconformably upon Precambrian sedimentary and metamorphic rocks and is characterised by several dolostone types, fissile dolostone and sandstone. The overlying Allen Bay Formation is mostly dolostone and superficially is more uniform in appearance.

Laminated dolostone; stromatolite beds, intraformational breccia and conglomerate, oolite and a few beds with marine invertebrate fossils are present in the two formations and are evidence of fluctuations between the extremes of supratidal and shallow subtidal deposition. Sedimentation had begun by Middle Cambrian times with a marine transgression and this event is marked by beds of sandstone near the base of the Lang River Formation. These early terrestrially-derived sediments were succeeded by marine carbonates which persisted throughout the deposition of the upper Lang River Formation and the Allen Bay Formation. On Prince of Wales Island the lower Lang River Formation contains cyclical units. At one locality these cyclothem consist of alternating sandstone and dolostone; at a second locality they consist of fissile dolostone and stromatolite-rich dolostone beds.

The difference in rock types within and between the two

formations can be related to variations in the supply of terrigenous sediment, to local depositional and topographic factors and to changes in basin stability. The rock types and their inferred depositional environments appear to be typical of early Paleozoic sedimentation throughout much of the Arctic Lowlands.

Four faunal assemblages are present in the two formations. The oldest, from the Lang River Formation at Creswell Bay (central Somerset Island), is Lower Ordovician in age and consists of gastropods and nautiloids. However, Middle Cambrian strata identified by previous workers on the Boothia Peninsula (to the south of Somerset Island) are probably a southerly extension of the Lang River Formation and this is the oldest age that can be suggested for the formation. A rich and diverse Upper Ordovician fauna is present near the top of the Lang River Formation on Somerset Island and a similar fauna occurs in the lower part of the Allen Bay Formation of Prince of Wales Island suggesting that the boundary between the formations is diachronous. Diverse Lower and Middle Silurian fossils are present in the Allen Bay Formation of both islands. The overlying Young Bay Formation (informal name) contains a fish bed which other work has shown to be no older than latest Wenlockian (Middle Silurian) in age.

Detailed systematic studies show the presence of faunal elements corresponding to the Upper Ordovician Stony Mountain Formation of Manitoba. Many new species were encountered

and the Upper Ordovician halysitid corals in particular include morphological types which have not previously been recorded.

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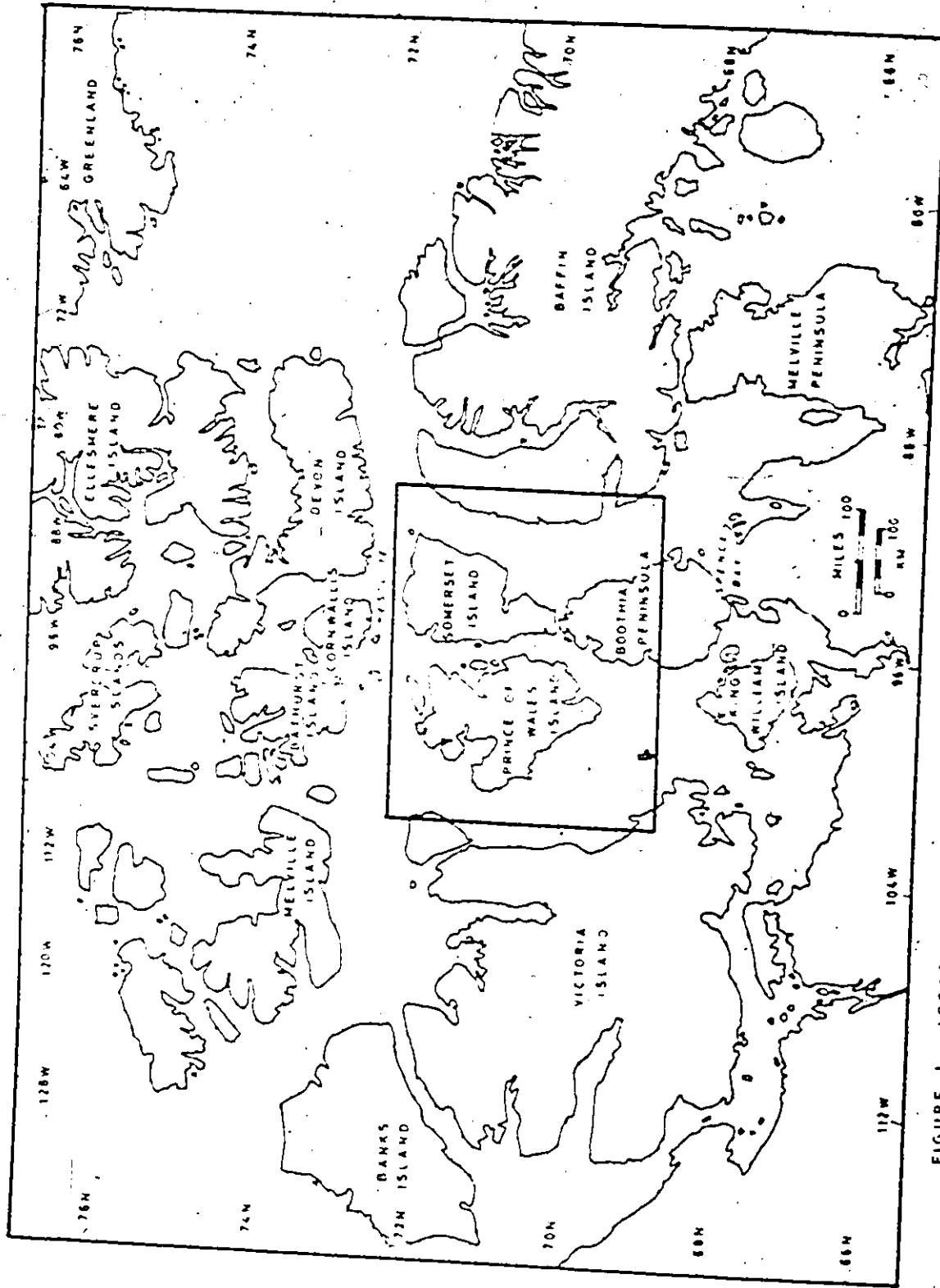


FIGURE 1 LOCATION OF SOMERSET AND PRINCE OF WALES ISLANDS WITHIN THE ARCTIC ISLANDS

I INTRODUCTION

Location and Methods

Prince of Wales and Somerset Islands were the areas in which the geological studies were undertaken. The two islands are located in the southern part of the Canadian Arctic archipelago between latitudes 71° and 74° north and longitudes 90° and 102° west (fig.1). No permanent settlements are established on either of the two islands, although at least one Eskimo family lives intermittently in the vicinity of Stanwell-Fletcher Lake, Somerset Island. It is highly probable that this family may soon be integrated into one of the permanent settlements nearby. The absence of settlements required the use of Resolute, Cornwallis Island, as an operations base.

Camp-sites, previously chosen from the study of aerial photographs, were reached by flying out of Resolute with supplies in either a single- or twin-engined Otter aircraft. The aircraft were chartered from Atlas Aviation Ltd., Bradley Air Services Ltd. (on charter to the Polar Continental Shelf Project) and J.C. Sproule and Associates Ltd.

The camp-sites were set up as near as possible to the chosen river gorges, as these provided maximum continuous exposure. Each work area was intensively studied for two to three weeks. Two sites were visited on Prince of Wales Island in 1969. The first camp was on a raised beach two

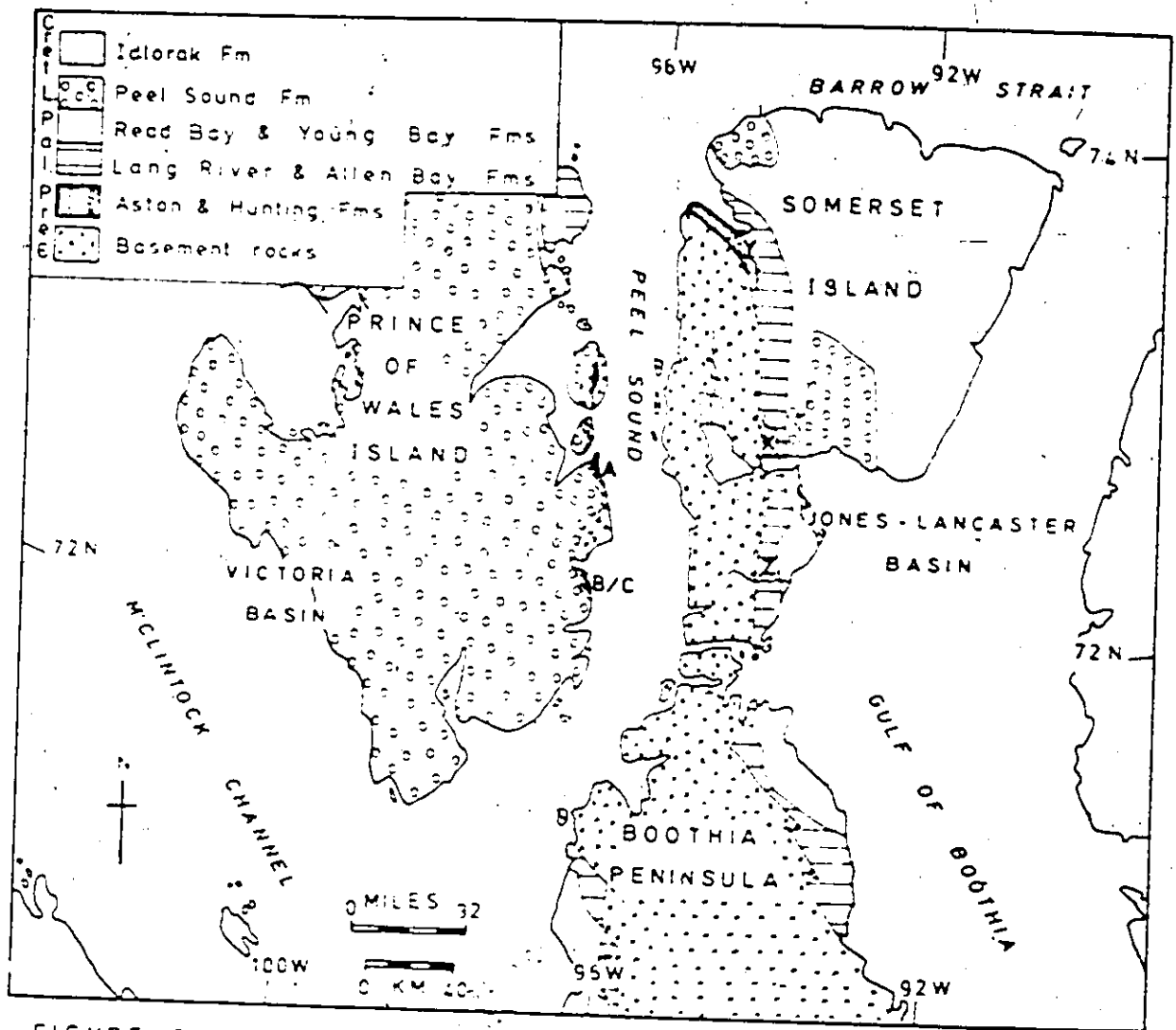


FIGURE 2 REGIONAL GEOLOGY AND LOCATION OF STUDY AREAS

- A Savage Point
- B/C Strzelecki Harbour
- X Creswell Bay
- Y Hunting River
- Z Lang River

to three miles (3.2-4.8Km.) south-west of Savage Point (latitude $75^{\circ} 35'N$, longitude $96^{\circ} 25'W$; figs. 2 and 10; stratigraphic sections and specimens prefixed by the letters A, CB1 and CB2). The second site was 30 miles (48.3Km.) further south, near Strzelecki Harbour (latitude $72^{\circ} 05'N$, longitude $94^{\circ} 00'W$; figs. 2 and 10; stratigraphic sections and specimens prefixed by the letters B and C) where two gorge sections were available for study.

On Somerset Island three sites were visited between mid-June and early August of 1970. The first site was near the northern coastline of western Creswell Bay (latitude $72^{\circ} 45'N$, longitude $94^{\circ} 00'W$; figs. 2 and 6; stratigraphic sections and specimens prefixed by the letter X). Two camp-sites were used at Creswell Bay; the spring thaw forced us to abandon the first camp-site. With the assistance of a helicopter from a nearby geological party another camp was set up in a more central position (fault block B, fig. 6). The Hunting River camp-site was located on a river bar in the lower reaches of the Hunting River valley (latitude $73^{\circ} 33'N$, longitude $94^{\circ} 45'W$; figs. 2 and 8; stratigraphic sections and specimens prefixed by the letter Y). The final camp-site was at Lang River (latitude $72^{\circ} 15'N$, longitude $93^{\circ} 50'W$; figs. 2 and 3; stratigraphic sections and specimens prefixed by the letter Z).

The method of study was to take detailed measurements and observations of sections and collect representative

samples of the rock types and fossils. The area of study rarely exceeded a 5 mile (8.0Km.) distance away from the river gorges due mostly to the lack of exposure.

Previous Research

Many of the nineteenth century explorers sighted or landed on the two islands and for a review of these expeditions I refer the reader to Blackadar (in Fortier et al. 1963, pp.105-107) and Blackadar and Christie (1963).

The early geological reports referring to the two islands and the Boothia Peninsula were mostly fossil identifications (Ross 1835; Haughton 1860; Etheridge 1878; Foerste 1921; 1929; Teichert 1937). Initial fossil reports were of a Silurian fauna and Ordovician fossils were recognised later.

Thorsteinsson and Tozer (1960) wrote a summary account of the structural history of the Arctic region which included the structural elements of Prince of Wales and Somerset Islands. Gregory, Bower and Morley (1960) traversed the southern part of the Arctic islands in an aeromagnetic survey giving information on the basement and sedimentary basins of Prince of Wales and Somerset Islands

The first major stratigraphic and structural mapping of the two islands took place during Operation Franklin, a large geological survey undertaken in 1953 by the federal government. The resulting publication (Fortier et al. 1963)

describes the geology of the two islands in chapter III, section A and also includes a simple geological map.

The regional survey was followed by detailed mapping, lithological descriptions and subdivisions by Blackadar and Christie (1963). Kerr and Christie (1965) wrote a detailed account of the structural elements and tectonic history relating to the study area. Measured sections were compiled by Christie (1967). Brown, Dalziel and Rust (1969) reviewed the geological development of the Boothia Arch. Berkhout (1970) did a gravity survey of the two islands and northwest Baffin Island and Thorsteinsson (in Douglas 1970, p.549) briefly mentioned the area. Christie et al. (1971) compiled a map of western Prince of Wales Island and presented a brief report. Dineley (1971) mentioned the two islands in an account of the paleogeographic synthesis of the Arctic Lowlands.

Since 1964 members of the University of Ottawa Geology Department have studied various aspects of the geology of the two islands (Dineley 1965a,b; 1966a,b; Tuke, Dineley and Rust 1968; Dineley and Rust 1968; Rust and Coakley 1966; Miall 1970) but did not study in detail the rocks underlying the Peel Sound Formation. Examination of these early Paleozoic rocks began in 1968 by S.R. Williams studying the Read Bay Formation and in 1969 the present author began work on the underlying rocks. In 1972 B. Jones, also of the University of Ottawa, began a further examination of the Read Bay Formation on the northern coastline of Somerset Island.

Research Objectives

Prior to 1964 the Lower Paleozoic geology of Prince of Wales and Somerset Islands was only superficially documented during reconnaissance investigations of the Geological Survey of Canada (Fortier et al. 1963; Blackadar and Christie 1963; Christie 1967). Since 1964 the University of Ottawa has sent several expeditions to study aspects of the regional geology in more detail. The present project involved a biostratigraphic investigation of the Cambrian to Silurian strata of these two islands.

Of primary concern in this study was the stratigraphy, in particular the clarification of nomenclature, documentation of the succession of rock types, dating of the formations and regional correlation. Although fossils were used mostly for age dating, systematic investigations of many of the fossils were also conducted. Detailed fossil descriptions are included in the thesis, firstly to record the fossils from an area in which the fossil faunas are largely undescribed, and secondly to review the taxonomy of the more abundant fossils.

Published sedimentological interpretations of the early Paleozoic rocks of the two islands are few in number and usually of a very general nature. The present study expands upon this work by recording details of the sedimentary succession, interpreting the regional sedimentary environments and reviewing the sedimentary history of the area.

The wide scope of this research project has inherent

limitations. Stratigraphic and paleontologic work were given greater priority in terms of time spent in research and less time was devoted to sedimentological work. Consequently the treatment of certain areas of research is more detailed than of others.

The transport requirements in the Arctic also imposed limitations on the methods of study. This study deals with the best-exposed sections which are 30-50 miles (48-80Km) apart. With only a minimum of aircraft support and no other means of transport the intervening areas could not be readily investigated. Correlation between these sections proved difficult particularly because of the scarcity of fossil horizons or distinct lithological marker beds. The regional sedimentological interpretation, therefore, can only be general as it is based mainly on the succession of major depositional environments recognised in the various sections.

At the localities studied, observation of lateral variation of the rock types was often hindered by exposures being restricted to valley sections. Difficulties were also encountered in attempting to recognise different dolostone types in the field. The apparent monotony of substantial parts of these very thick dolostone sequences presented considerable problems for field recognition and adequate sampling. Dolomitisation has affected most of the succession and primary sedimentary structures are commonly destroyed or so altered that it is difficult or impossible to ascertain the original rock type.

In addition to the main study other geological features were recorded in the field. Because the Arctic islands are not readily accessible to most geologists any geological information is worthy of mention and the appendices include some of these additional observations.

Geological Setting

Somerset and Prince of Wales Islands lie within the Arctic Lowlands, which from Proterozoic to Devonian times was an area of shallow water, epicontinental sedimentation. This area was marginal to a low-lying land mass to the south which was formed by the metamorphic rocks of the Canadian Shield. The Lowlands are presently divided into several basins by tectonic arches, one of which (the Boothia Arc) extends in a north-south direction through Somerset and Prince of Wales Islands (Kerr and Christie 1965).

The Lowlands are flanked to the north by the Paleozoic Franklinian Geosyncline. The hinge line between the epicontinental areas and the Franklinian miogeosyncline is best known on Cornwallis Island (Thorsteinsson 1958) where a major facies change from dominantly carbonate rocks to shale marks the position of the hinge. Several tectonic events affected the geosyncline during the Paleozoic (Thorsteinsson in Douglas 1970) but usually these events did not affect sedimentation on the epicontinental areas. Sedimentation on the epicontinental areas was generally continuous from Cambrian to Devonian times, although local unconformities are present, especially nearer the geosyncline.

Paleomagnetic data for the Ordovician and Silurian periods (Hood et al. 1968) suggests that the Ordovician-Silurian paleoequators passed through Hudson Bay in a north-easterly direction. This would have placed much of the Arctic region in paleolatitudes with tropical to subtropical climates, a significant factor in the deposition of sediments in the shallow epicontinental seas of the region.

The structural and sedimentary history of Somerset and Prince of Wales Islands has been dominated by the Boothia Arch (Fortier, McNair and Thorsteinsson 1954, p.2079; Kerr and Christie 1965). The rocks of the Arch are principally schists and gneisses attaining amphibolite-granulite metamorphic facies (Brown, Dalziel and Rust 1969, p.526). This tectonic feature is a northerly extension of the Churchill (structural) Province of the Canadian Shield. On the basis of a gravity survey of the area Berkhout (1970) suggested the existence of other north-south basement structures underlying the Paleozoic sedimentary rock cover on Prince of Wales Island but postulated that these have been inactive throughout the Phanerozoic. The Boothia Arch divides the region into two basins, the Jones-Lancaster to the east and the Victoria to the west (fig. 2; Fortier, McNair and Thorsteinsson 1954, pp.2081-2086).

Sedimentation upon the basement began in Proterozoic times with the deposition of clastic sediments in a shallow marine shelf environment (Tuke, Dineley and Rust 1966, p.707). These rocks of the Aston Formation were succeeded by the dominantly carbonate succession of the Hunting Formation

(see appendix 1 for a discussion of the Hunting Formation). Rocks of these two formations are exposed at Aston Bay (Tuke et al. 1966) and in isolated exposures in fault blocks on eastern Prince of Wales Island (Dixon, Williams and Dixon 1971).

Resting unconformably on the Hunting Formation and the basement rocks is a sequence of Paleozoic carbonate and detrital rocks which Blackadar and Christie (1963) divided into four stratigraphic units as follows:

- 1) an unnamed Cambrian formation of sandstone and dolostone (map unit 8),
- 2) a sequence of dolostones thought to correlate with the Cornwallis Group and Allen Bay Formation of Cornwallis Island (map unit 9),
- 3) the Read Bay Formation, a fossiliferous limestone succession of Silurian age (map unit 11),
- 4) the Peel Sound Formation, containing conglomerate, sandstone, siltstone, dolostone and limestone (map unit 12). An early Devonian age was suggested for this formation (Brown et al. 1969, p.536).

Map unit 8 was recognised on the Boothia Peninsula and was extended on to southern Somerset Island but was not recognised on Prince of Wales Island. The Cambrian age was based on the presence of Middle Cambrian fossils in lithologically equivalent strata north of Spence Bay on the Boothia Peninsula. Map units 8 and 9 were undifferentiated on

northern Somerset Island and were mapped as one unit (map unit 10).

The Cambrian formation is the early phase of a later transgression on to the Boothia Arch and the sediments were probably deposited in a shallow marine shelf environment. Succeeding the Cambrian formation are dolostones which were deposited mainly on a tidal flat complex.

A gradational contact between the Allen Bay and Read Bay Formations represents a gradual transition from a restricted marine environment to a more open marine shelf environment. Overlying the Read Bay Formation conformably, but locally unconformably (Miall 1970, p.126), are the terrestrial deposits of the Peel Sound Formation. Uplift of the Boothia Arch in early Devonian times provided the conditions necessary for the deposition of this formation (Miall 1970).

Cretaceous-Tertiary rocks are exposed in a block-faulted basin at Stanwell-Fletcher Lake, Somerset Island (the Idlorak Formation of Dineley and Rust 1968) and near Cunningham Inlet, northern Somerset Island (Hopkins 1971). The rocks at Stanwell-Fletcher Lake consist of shale, siltstone and sandstone thought to have been deposited on a prograding coastal delta. Brown et al. (1969, p.542) attributed the deposition of the Idlorak Formation to local vertical movements of the Boothia Arch in late Cretaceous or early Tertiary times.

The two islands are mostly very simple structurally, as shown by the extensive flat-lying to gently folded Paleozoic strata. However, folding and faulting are more intense in

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a narrow zone parallel to the flanks of the Boothia Arch. This zone of greater structural deformation is called the Cornwallis Fold Belt (Thorsteinsson 1958, p.116; Kerr and Christie 1965).

An asymmetry exists in the Cornwallis Fold Belt. The strata on the western side of the Boothia Arch are faulted against the basement rocks and also folded into a homocline. To the east, on Somerset Island, the Paleozoic strata rest unconformably on the basement and are folded into open anticlines and synclines.

Faulting occurred in early Devonian and Cretaceous times. The early Devonian faulting produced the horst-like structure of the Boothia Arch. However, the Arch is only horst-like in the north; in the south it is arched (Kerr and Christie 1965). Walcott (1970) suggested that the Arch was an isostatic phenomenon caused by the accumulation of a sedimentary pile on the flanks of a topographic high. The stress field created may have exceeded the elastic limit of the basement rocks resulting in faulting. Other authors have implied that the Arch is a tectonic feature. From a survey of the Creswell Bay and Hunting River areas it is evident that block faulting is much more extensive than previously recognised.

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II LITHOSTRATIGRAPHY

Introduction

Blackadar and Christie (1963) divided the Paleozoic rocks of the Boothia Arch area into four formations (table 1). All four formations occur on both Prince of Wales and Somerset Islands, although the basal Middle Cambrian formation was only recently recognised on Prince of Wales Island.

After detailed study of the successions at five areas adjacent to the Arch it has become apparent that a partial revision and clarification of the lithostratigraphy is necessary. This revision was initiated by S.R. Williams (pers. comm. 1972) who suggested that the transitional sequence between the Read Bay Formation and the underlying strata merits formational status. The present author is in agreement with this view and the type section of the new formation, called the Young Bay Formation, is near Savage Point, Prince of Wales Island (locality A, figs. 2 and 10). The rocks of the Young Bay Formation consist of mediumly bedded dolostone, calcareous dolostone and dolomitic limestone. (Ingram's classification of stratigraphic units, 1954). These rocks weather recessively and form a distinct topographic depression easily traced on aerial photographs.

The rocks underlying the Young Bay Formation are essentially the same as the two basal formations of Black-

AGE	Thorsteinsson & Kerr 1967		Blackadar & Christie 63		Revised stratigraphy (this report)	
	Cornwallis Is.		Somerset Is.		Somerset Is. Prince of Wales Is.	
SILURIAN	CAPE PHILLIPS FM. (northern facies)	SNOWBLIND BAY FM. (incomplete)	PEEL SOUND FM. (incomplete)	PEEL SOUND FM. (incomplete)		
		READ BAY FM.	READ BAY FM.	READ BAY FM.		
		ALLEN BAY FM.		YOUNG BAY FM.		
ORDOVICIAN			map unit 9	ALLEN BAY FM.		
	CORNWALLIS GROUP			LANG RIVER FM.		
	ELEANOR RIVER FM.		map unit 8			
	BAUMANN FIORD FM.					
CAMB.	?					
PRECAMB.	?					
				unconformity		
				HUNTING FM.		
				ASTON FM.		
				unconformity		
				ASTON FM.		
				fault contact		
				BASEMENT ROCKS		

TABLE 1 TABLE OF FORMATIONS FOR CORNWALLIS, SOMERSET AND PRINCE OF WALES ISLANDS.

adar and Christie (1963). It is proposed that the unnamed Middle Cambrian formation be part of the new Lang River Formation with its type section at Lang River, Somerset Island. The overlying formation corresponds lithologically to the Allen Bay Formation of Cornwallis Island (Thorsteinsson 1958; Thorsteinsson and Kerr 1967).

The Lang River Formation, as well as including the unnamed Middle Cambrian formation, includes the lower part of unit 9 as mapped by Blackadar and Christie (1963). Rocks of the Lang River Formation are readily recognised on Somerset Island and in addition are now recognised on Prince of Wales Island. Miall (1968, unpublished Ph.D. thesis, University of Ottawa, p.260) reported exposures of the Aston and Hunting Formations 8 miles (12.9 Km.) northwest of Cape Brodie, Prince of Wales Island. The two formations are separated by a fault. However, the rocks Miall (op. cit.) referred to the Hunting Formation are typical of the Lang River Formation elsewhere on Prince of Wales Island. Ten miles (16.1 Km.) to the north of Miall's (op. cit.) reported occurrence Dixon et al. (1971) reported rocks of the Aston Formation near Savage Point faulted against the Lang River Formation (near locality A, fig. 10). At Savage Point the rocks of the Lang River Formation are comparable to those Miall (op. cit.) ascribed to the Hunting Formation. It is considered that Miall mistakenly identified the Lang River Formation as Hunting

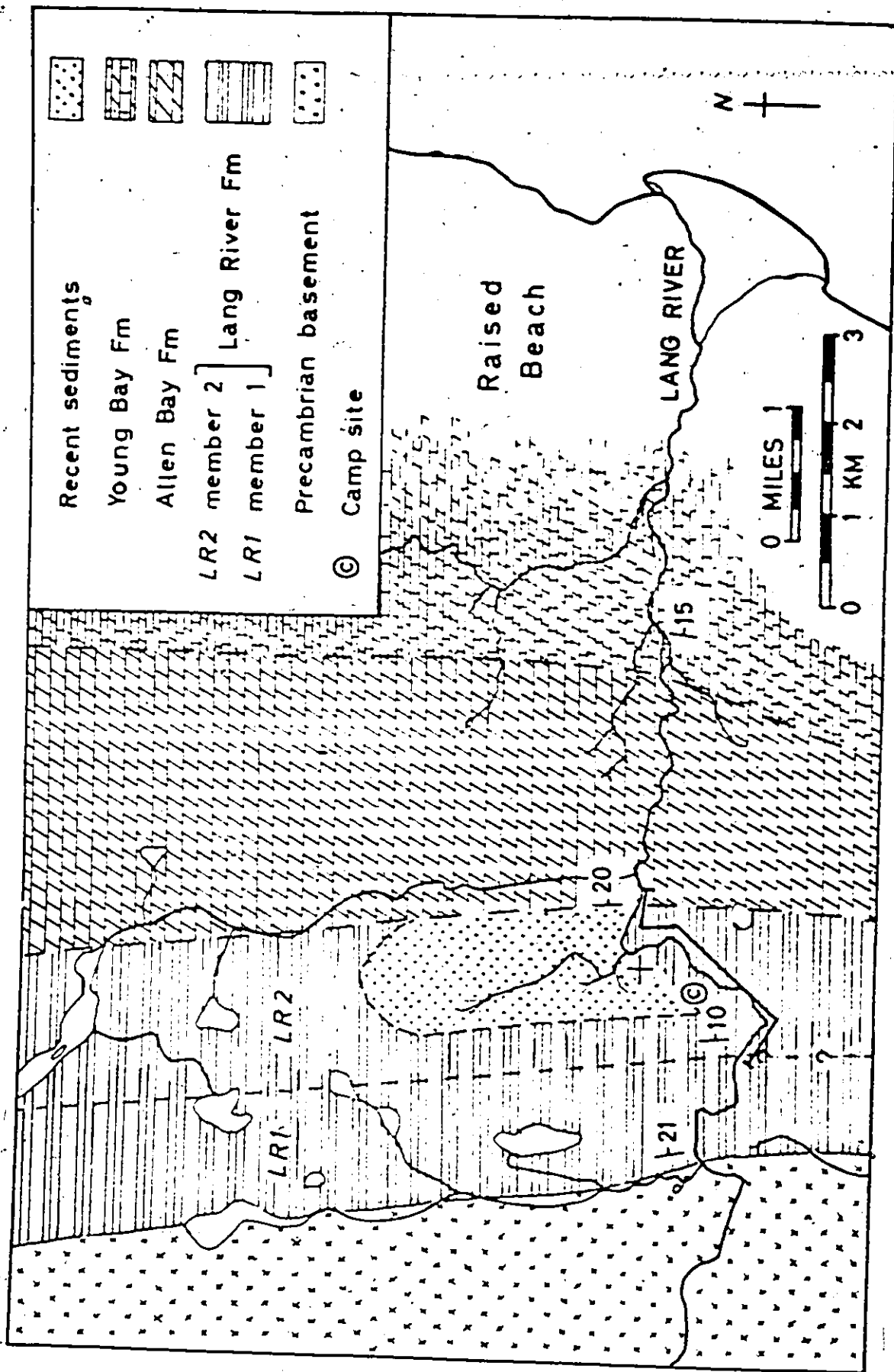


FIGURE 3 Geological sketch map, Lang River, Somerset Island (locality Z)
 Line of section (fig. 5)

Formation.

Where exposure is adequate, the Lang River and Allen Bay Formations are readily distinguished but there are many parts of the islands where exposure is very poor. In these areas it is not always possible to differentiate between the two formations on aerial photographs.

Lang River, Somerset Island (locality 2)

The Lang River valley offers an almost continuously exposed section from the basal unconformity to above the Young Bay Formation. For this reason the area was chosen as a reference section as well as the type section of the Lang River Formation. Although there is about 90% exposure, the cliffs limit access to parts of the Allen Bay and Young Bay Formations, but most of the Lang River Formation is accessible.

The gently dipping basal beds of the Lang River Formation form a low escarpment. Near the base of the escarpment there are sandstone beds lithologically comparable to the basal sandstone at Hunting River (p. 29). Although the contact with the Precambrian metamorphic rocks is covered by talus the foregoing features suggest the presence of an unconformity. Furthermore, there were no indications to suggest a fault contact. The basal beds of the Lang River Formation dip 20-25° east but approximately 1 mile (1.6km.) eastwards from the trace of the unconformity the dips flatten to 10° or less (fig. 3). Further east the dips increase again to 20-25° and















towards the Lang River delta decrease to 15-20°.

The section contains about 2,800ft. (854m.) of Lang River and Allen Bay Formation strata and is divisible into three units. In descending order these are as follows:

	Minimum thickness
3) massive, buff-weathering dolostone,	1,490ft. (454m.)
2) fossiliferous dolomitic limestone, calcitic dolostone and dolostone,	410ft. (125m.)
1) alternating sandstone and dolostone,	907ft. (277m.)
Total minimum thickness	2,807ft. (856m.)

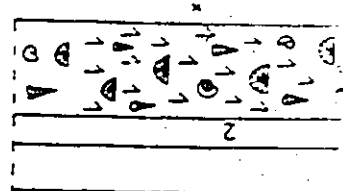
It is proposed that units 1 and 2 become informal members of the Lang River Formation and that unit 3 be equated with the Allen Bay Formation. The latter formation corresponds lithologically to the type section of the Allen Bay Formation on Cornwallis Island (table 1; Thorsteinsson and Kerr 1967). The boundaries between the formations and informal members are gradational and the Lang River-Allen Bay Formations boundary is further complicated by down-dip and vertical facies changes in member 2 of the Lang River Formation (fig. 5).

Member 1 of the Lang River Formation contains a wide variety of dolostone types and the general sequence is shown in figure 4. Resting unconformably on the Precambrian basement is a grey-to-white quartz sandstone with trough and festoon cross-bedding. Overlying the basal sandstone the rocks are mostly dolostone, although up to 658ft. (201m.) above the unconformity there is still a substantial portion of sandy material. Above 658ft. (201m.) there is no

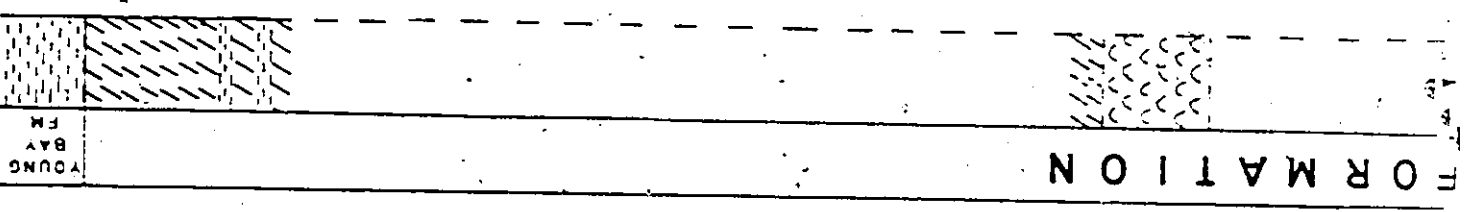
-  DOLOSTONE
-  STROMATOLITIC DOLOSTONE
-  INTRAFORMATIONAL BRECCIA
-  INTRAFORMATIONAL CONGLOMERATE
-  CROSS-LAMINATED DOLOSTONE
-  PLANAR-LAMINATED DOLOSTONE
-  INTERBEDDED CROSS- & PLANAR-LAM. DOL.
-  FISSILE DOLOSTONE
-  SANDY INTRACLASTIC DOLOSTONE
-  BIOGENIC DOLOSTONE
-  DOLOMITIC BIOMICRITE
-  SANDSTONE
-  CHERT NODULES
-  SAMPLING SITE

G.S.C. GEOL. SURV. CANADA LOCATION

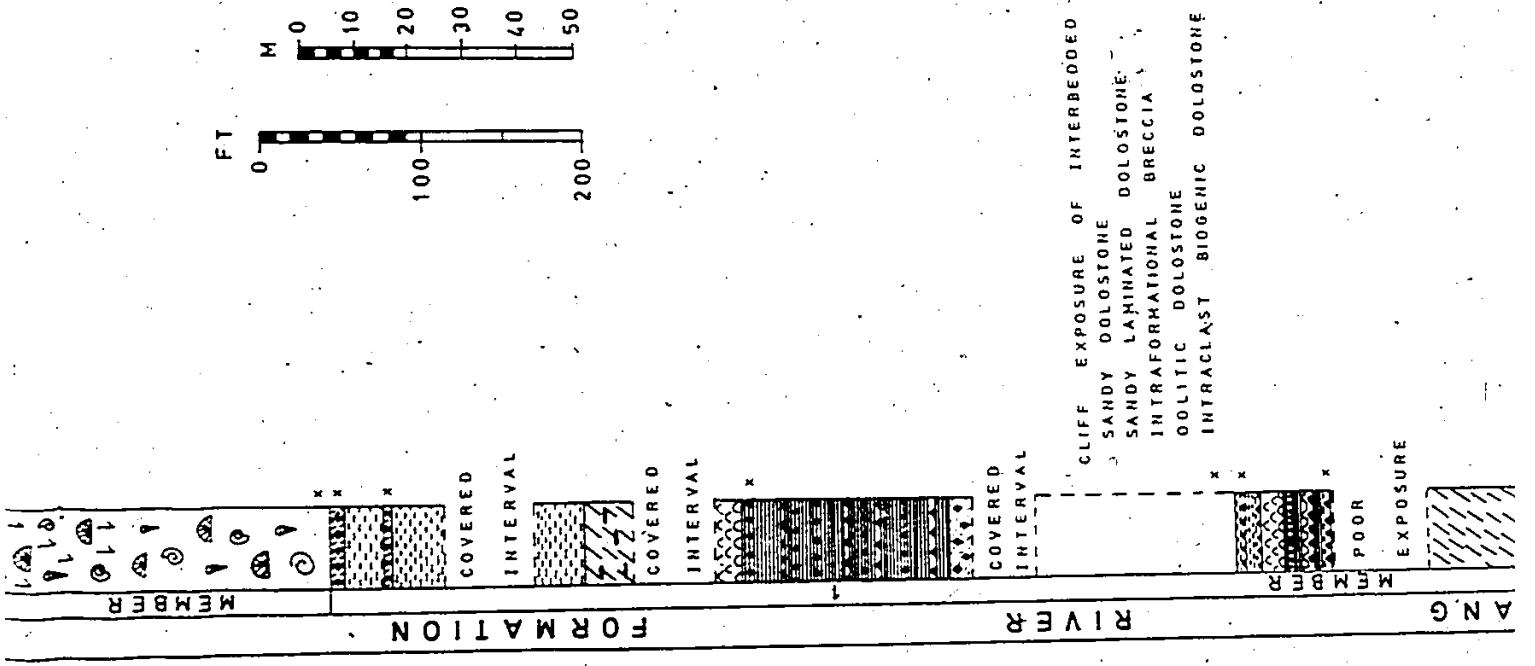
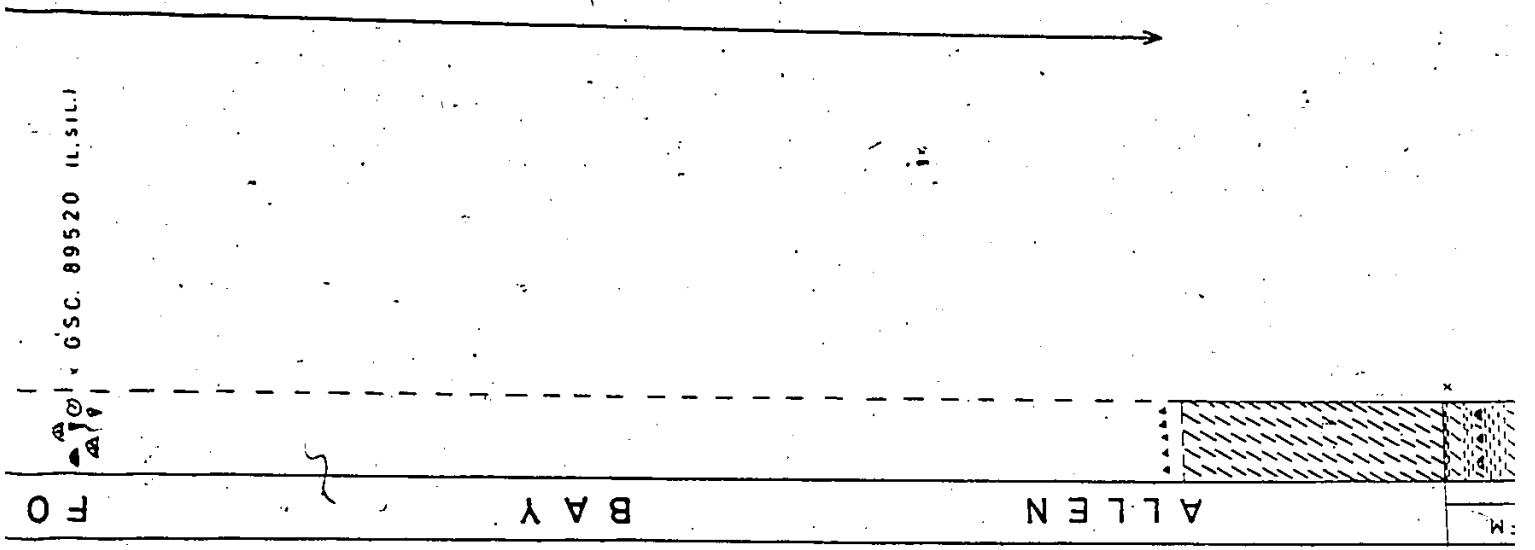
SECTION DISCONTINUED



* G.S.C. 89519 (U.ORDI)



LIMITED ACCESS TO GORGE DETAILED
 SUCCESSION NOT KNOWN: ROCK
 TYPES PRESENT ARE AS FOLLOWS:
 STRUCTURELESS DOLOSTONE
 LAMINATED DOLOSTONE
 STROMATOLITIC DOLOSTONE
 BIOGENIC DOLOSTONE
 (SAMPLES OF EACH TYPE COLLECTED)



G.S.C. 89520 (L.S.I.L.)

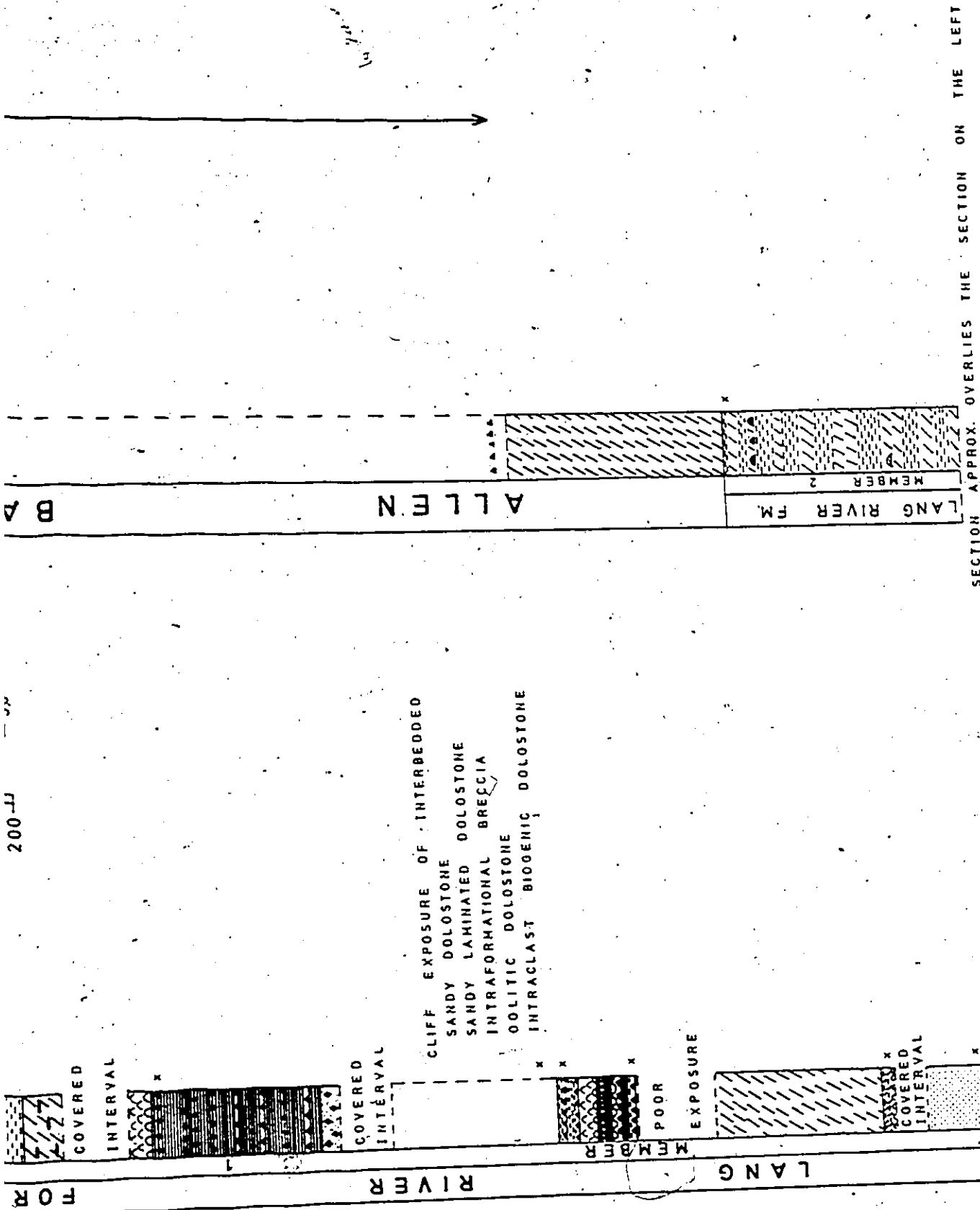


FIGURE 4 COMPOSITE SECTION AT LANG RIVER (LOCALITY Z) SOMERSET ISLAND.

3 of 3

significant amount of detrital material in either the remainder of the Lang River Formation or the whole of the Allen Bay Formation.

The basal bed of member 2 is a 7ft. (2.2m.) bed of yellowish-grey calcareous dolostone. Two discontinuity surfaces occur 6ins. (15.2cm.) and 3ft. (0.9m.) above the base of member 2 (Pl. 1). Member 2 rests on dark grey, yellow-grey or blue-grey, very thinly to thinly bedded dolostone with planar- and cross-laminations and a few intraformational breccia beds. The transition from member 1 into member 2 occurs within a few inches (8-15cm.). Gradually succeeding the calcareous dolostone are fossiliferous calcareous dolostone and dolomitic limestone, the lower 40ft. (12.2m.) of which consists of highly comminuted fossil debris in a very finely crystalline matrix. Large fossils, notably gastropods, are occasionally present but the majority of the whole or partial fossils occur above the basal 40ft. (12.2m.).

Four rock units can be recognised in member 2, as follows:

- i) transition beds,
- ii) barren dolostone facies,
- iii) fossiliferous dolostone facies,
- iv) dolomitic limestone (and calcareous dolostone) facies.

Discontinuous exposure made it difficult to determine with certainty the stratigraphic relationships of some of these

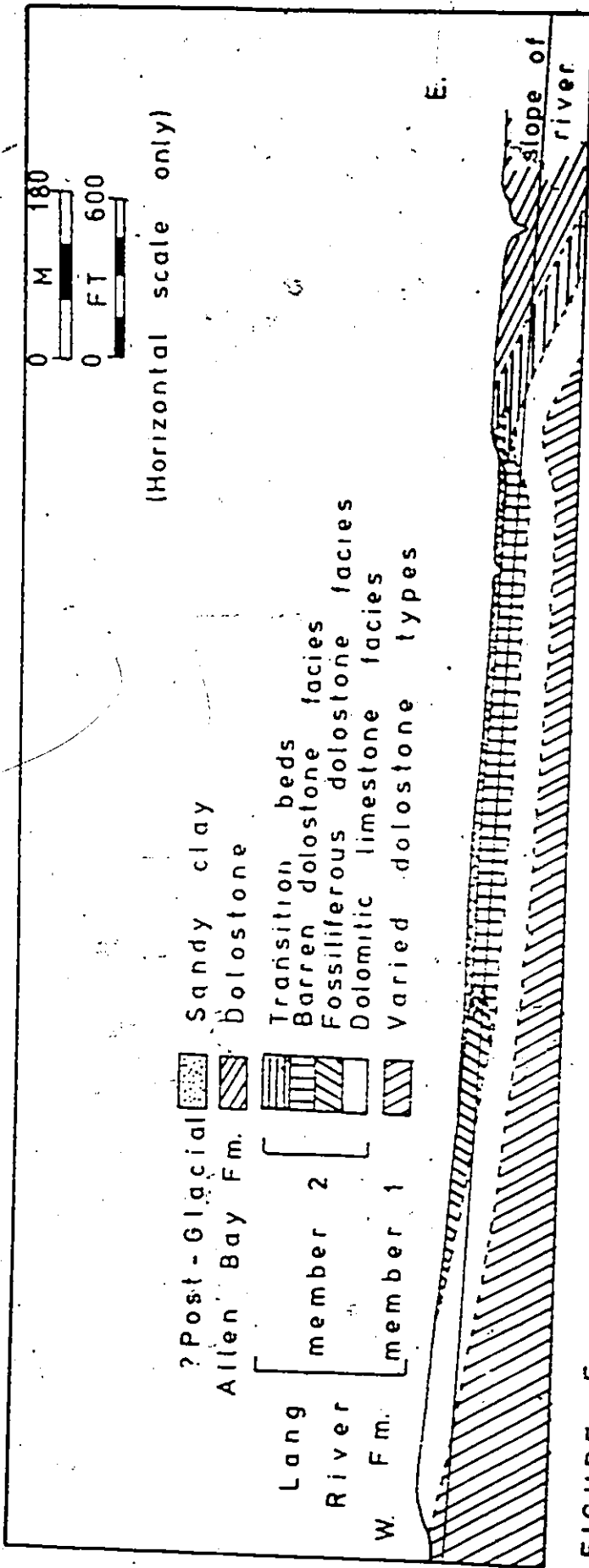


FIGURE 5 · DIAGRAMMATIC SECTION SHOWING THE DISTRIBUTION OF FACIES IN MEMBER 2 OF THE LANG RIVER FORMATION, LANG RIVER, SOMERSET ISLAND (LOCALITY Z)

rock units. However, the simplest interpretation, based on the field relationships of the units, is that some of them are laterally equivalent facies (fig. 5). The dolomitic limestone facies apparently is a continuous unit and contains an abundant fauna of the 'arctic' Ordovician type. In the west, overlying the dolomitic limestone, is fossiliferous dolostone. This buff-coloured dolostone weathers into thin-to-thickly parted blocks and contains a fauna consisting mostly of columnar stromatoporoids with occasional colonial corals. The fossiliferous dolostone appears to pass laterally (toward the east in a downdip direction) into barren, mediumly bedded, buff dolostone which in turn grades laterally into the lower transition beds (fig. 5). Although the critical areas are drift- or talus-covered the structural interpretation of the area suggests that the upper part of the transition beds overlies the barren dolostone and fossiliferous dolostone units.

The uppermost 182ft. (56m) of the Lang River Formation consists of various interbedded rock types in beds 2 to 4ft. (0.6-1.2m.) thick. These rocks are the transition beds of member 2 and the rock types present are as follows:

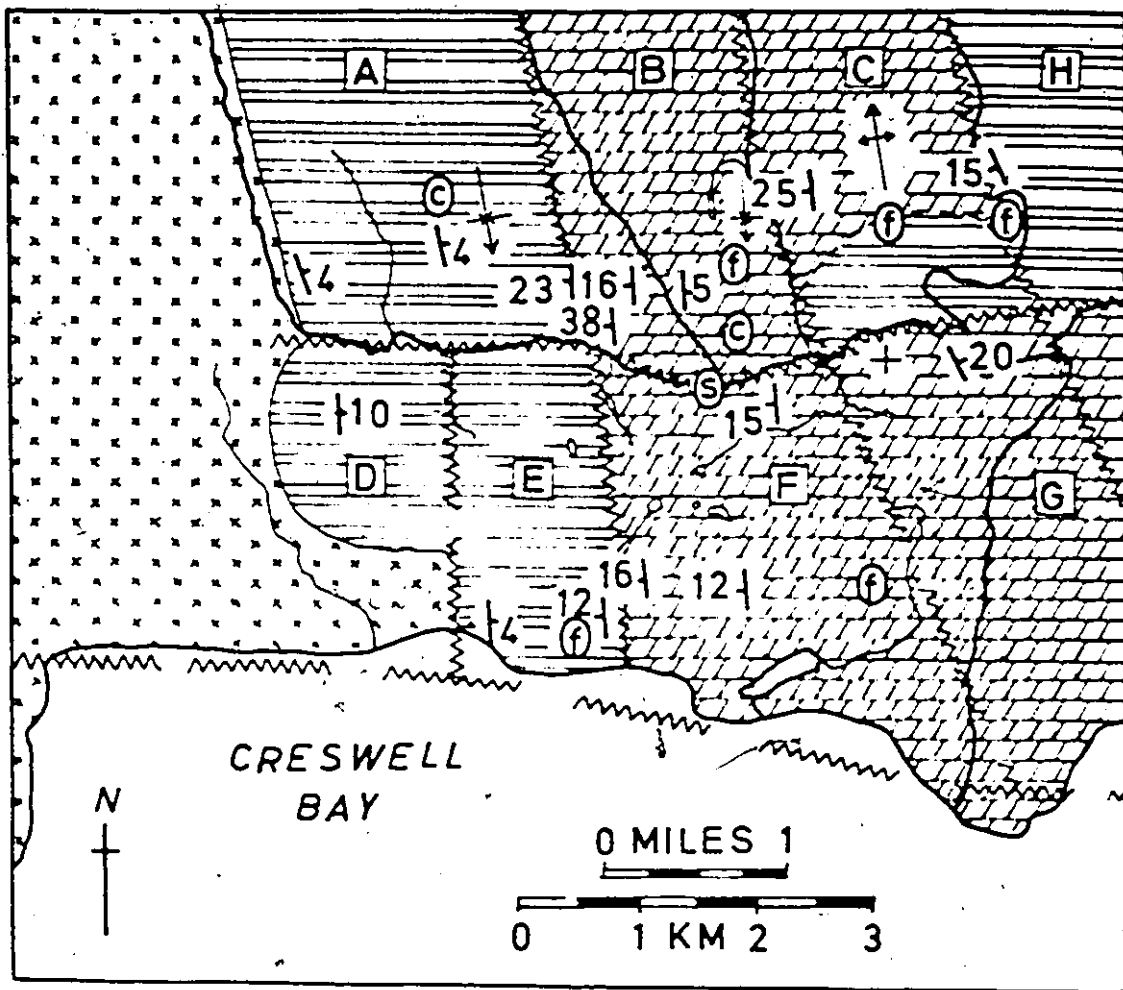
- a) rubbly weathering calcareous dolostone containing a few fossils,
- b) laminated dark grey, calcareous dolostone or dolostone,
- c) mediumly crystalline, vuggy dolostone occasionally containing fossil molds.

The amount of calcite in these rocks decreases towards

the top of member 2 and the upper part is mostly dolostone. The top of the Lang River Formation is placed at the top of a 2ft. (0.6m.) bed of dark grey, finely laminated dolostone which is overlain by thickly to very thickly bedded, structureless, buff dolostone of the Allen Bay Formation. Although the boundary may be located in the valley section, on the plateau a cover of probably post-glacial, dark coloured lacustrine sediments obscures the boundary. These dark-coloured sediments coincide with the area of shallow dips in the underlying rocks (figs. 3 and 5). The combination of these two features produces an anomalous break in the sequence when viewed on aerial photographs.

The generally massive, buff weathering dolostone of the Allen Bay Formation is best exposed in the Lang River gorge but the topographic relief of the gorge prevented completion of the measurement and study of the succession. A general, but incomplete, succession was compiled from exposures on the plateau and the accessible parts of the gorge (fig. 4). The dominant rock types in the Allen Bay Formation are planar- and cross-laminated dolostone and stromatolitic dolostone. Other rock types present are as follows:

- a) mediumly to coarsely crystalline dolostone in units 3 to 6ft. (0.9-1.8m.) thick; lacking or containing few internal stratification structures. Some of these units contain fossil molds.
- b) finely to mediumly crystalline, mediumly bedded dolostone with no fossils,



LEGEND







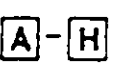
-  Allen Bay Fm
-  Lang River Fm
-  Precambrian basement
-  Cretaceous-Tertiary shale outlier
-  Fossil locality
-  Camp sites
-  A-H Fault blocks(see text)

FIGURE 6 Geological sketch map, Creswell Bay, Somerset Island (locality X).

- c) fossiliferous dolostone which occurs at least once in the succession somewhere between 1,600 and 2,000ft. (488-610m.) above the unconformity,
- d) intraformational breccia; usually associated with laminated dolostones.

Overlying the Allen Bay Formation is very thinly bedded, planar- and cross-laminated, greenish- or bluish-grey dolostone of the Young Bay Formation. The top of the Allen Bay Formation is placed at the top of a thickly bedded, mediumly crystalline dolostone. This dolostone contained rare crinoid ossicles but was otherwise devoid of fossils. Approximately 20 to 30ft. (6.1-9.1m.) above the top of the Allen Bay Formation there is a fish bed comparable to the fish beds present at localities A and B, Prince of Wales Island (Turner and Dixon 1971; Dixon, Williams and Turner 1972). Due to the inaccessibility of the lower reaches of the Lang River it was not possible either to verify the presence of the Read Bay Formation reported by Christie (1967, p.9) or to measure the thickness of the Young Bay Formation. However, considering the height of the cliffs (50-100ft., 15-30m.) and the dip of the strata (15-20°) there appear to be at least 200ft. (60.8m.) of Young Bay strata.

Creswell Bay, Somerset Island (locality X)

The succession north of the western end of Creswell Bay is considerably complicated by folds and faults (fig. 6) which have not previously been recognised. This structural

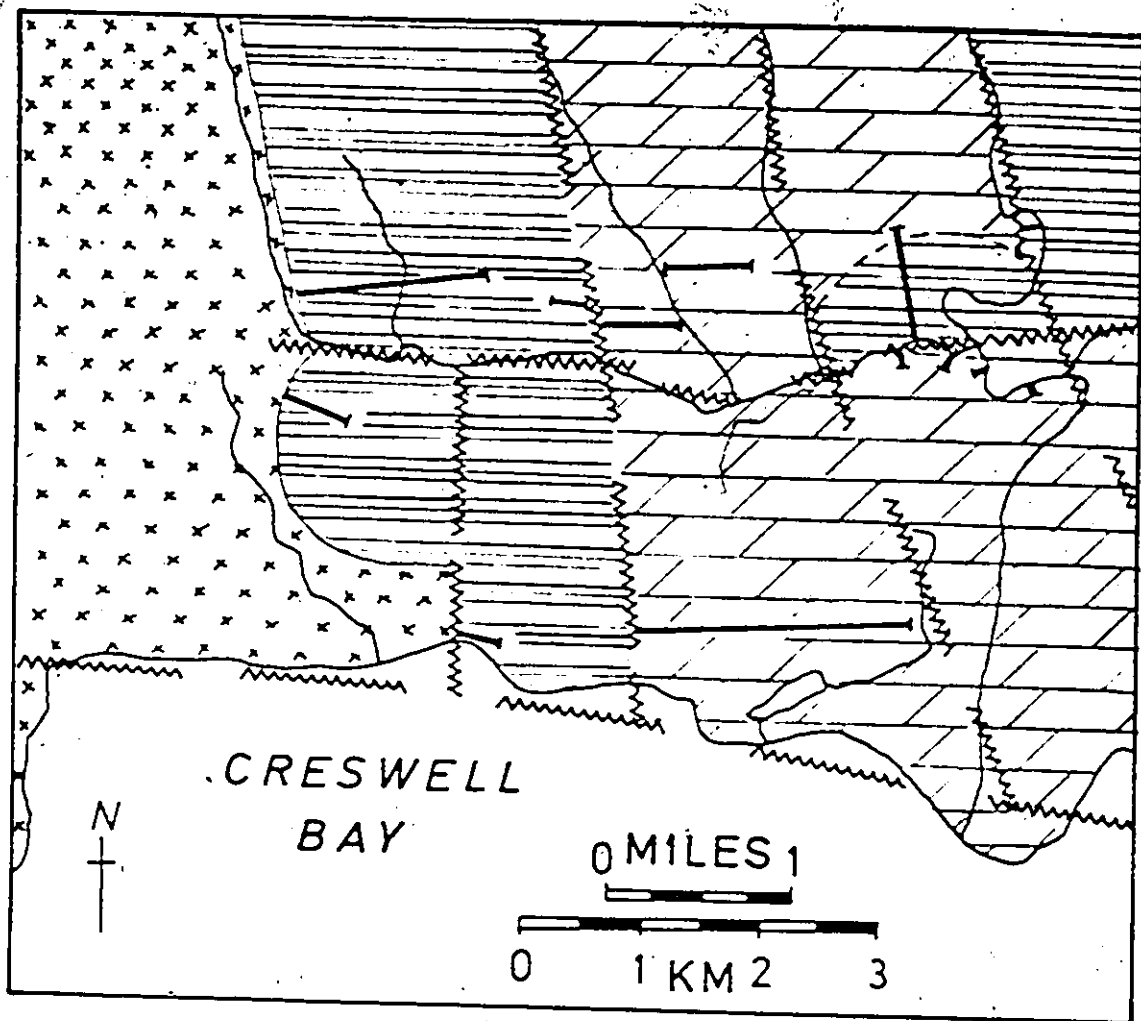





FIGURE 6A LOCATION OF
 MEASURED SECTIONS,
 CRESWELL BAY
 (LOCALITY X), SOMERSET
 ISLAND.













-  Allen Bay Fm.
-  Lang River
-  Precambrian basement

complication of strata which are only moderately fossiliferous made precise reconstruction of a stratigraphic sequence very difficult. Precise correlation between the fault blocks (identified by letters in fig. 6) is not possible, but by lithological comparisons, dating of the faunas and structural considerations it is possible to indicate the relative stratigraphic positions of each fault block. The following general stratigraphic conclusions are possible:

- i) fault blocks A, D and E contain lithologically similar strata which compare with the Lang River Formation at Lang River. Fault block E contains a Lower Ordovician fauna and fault block A contains comparable though sparse fossils,
- ii) fault blocks H and C contain an Upper Ordovician fauna,
- iii) fault block C also contains the lowest beds of the Allen Bay Formation. Fault block B contains strata of the Allen Bay Formation in which Lower Silurian fossils are present. The Allen Bay Formation of fault blocks B and G may be approximately equivalent,
- iv) strata of fault blocks F and G contain Middle Silurian fossils and are probably equivalent, but it is not known which fault block is downthrown relative to the other.

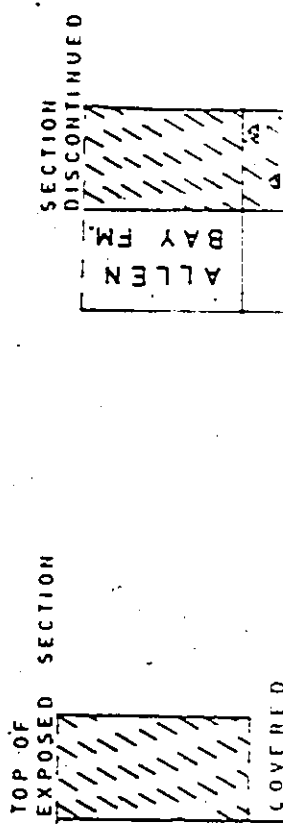
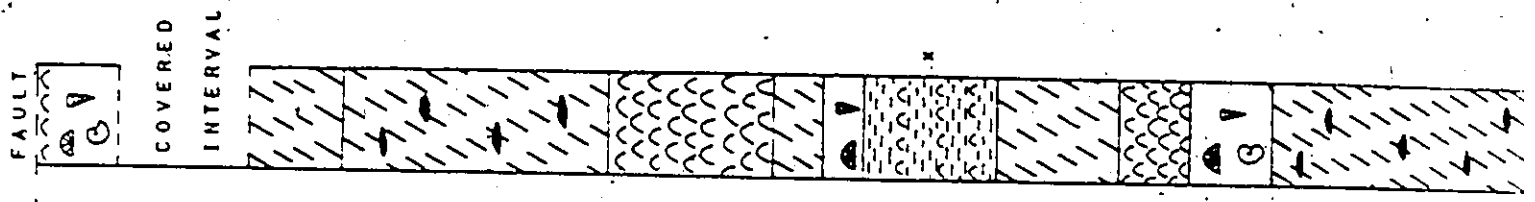
From the foregoing discussion on the sections in fault blocks A, C and ~~E~~ may be considered to succeed each other, which will indicate a minimum composite thickness of 2,185ft.

1 of 1

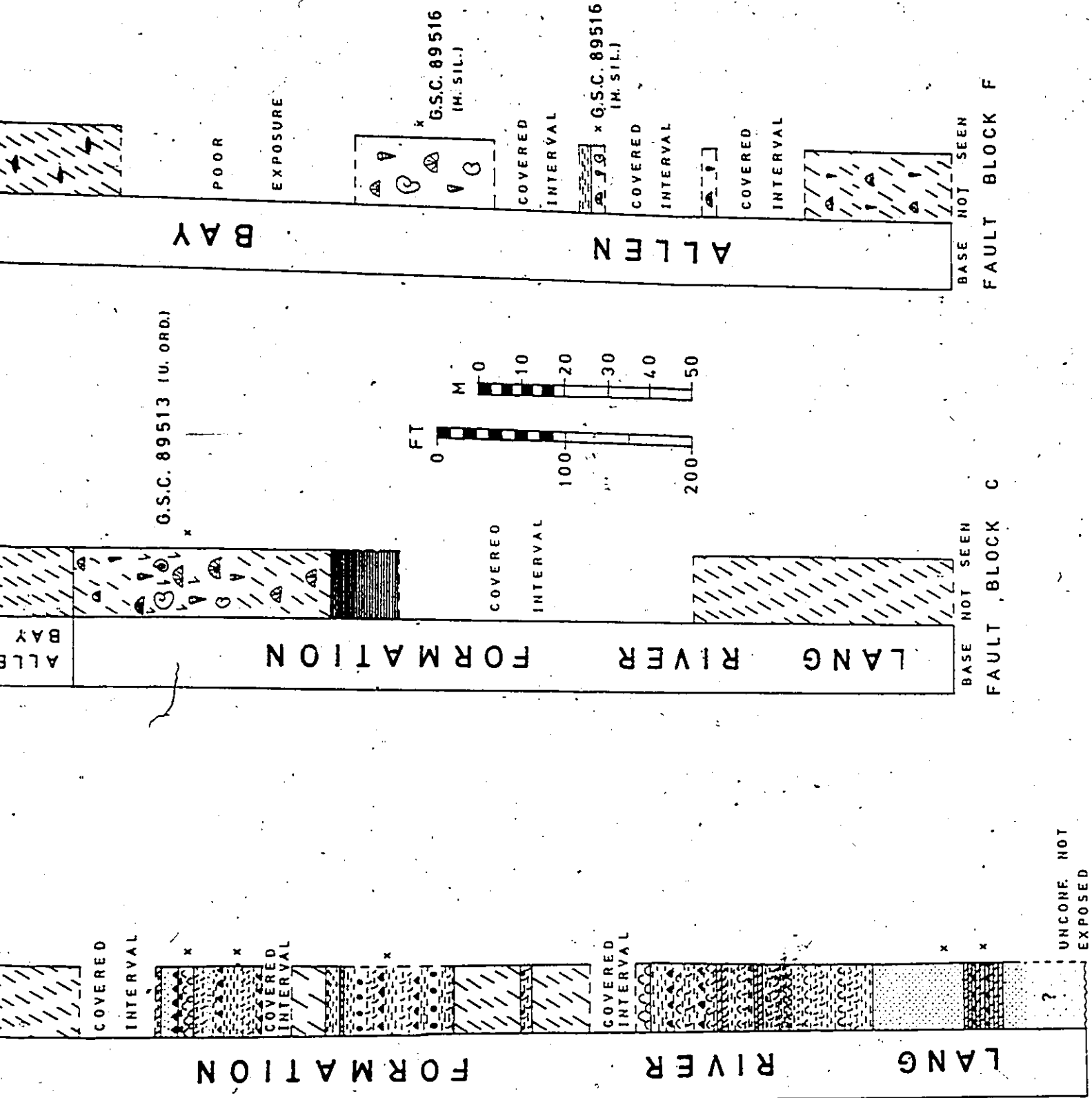
-  DOLOSTONE
-  INTRAFORMATIONAL BRECCIA
-  INTRAFORMATIONAL CONGLOMERATE
-  CROSS-LAMINATED DOLOSTONE
-  PLANAR LAMINATED DOLOSTONE
-  INTERBEDDED CROSS- & PLANAR-LAM. DOL.
-  STROMATOLITIC DOLOSTONE
-  BIOGENIC DOLOSTONE
-  DOLOMITIC BIOMICRITE
-  SANDSTONE
-  CHERT NODULES
-  FISSILE DOLOSTONE

G.S.C. GEOL SURV CANADA LOCATIONS
 * SAMPLING SITE

FORMATION



COVERED



UNCORE. NOT EXPOSED

PREC

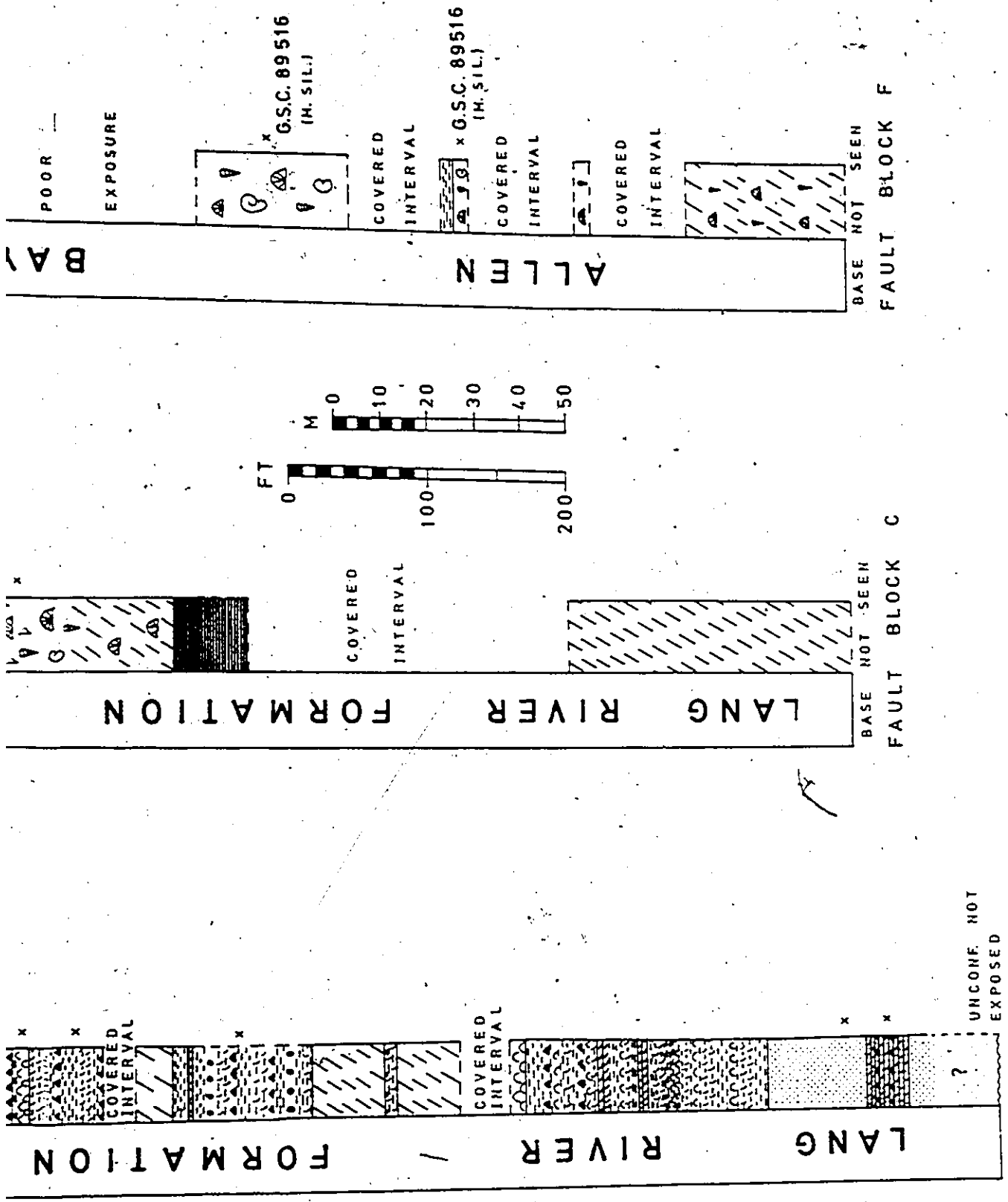


FIGURE 7 SELECTED SECTIONS, CRESWELL BAY (LOCALITY X) SOMERSET ISLAND.

3 of 3

(666m.) in this area (fig. 7).

The lithological units recognised at Lang River are also present at Creswell Bay. A lithologically varied basal sequence lies unconformably upon Precambrian metamorphic rocks. The unconformity is not exposed but from topographic considerations similar to the Lang River situation and the presence of sandstone in the lowest part of the sequence, which is comparable to the basal sandstone at Hunting River, the contact is most probably unconformable. The variable lowermost beds are overlain by fossiliferous limestone and together they comprise the Lang River Formation. Overlying the limestone is dolostone of the Allen Bay Formation.

Fault block A (fig. 6) exposes about 850ft. (259m.) of the Lang River Formation but this is probably much less than the total thickness. In fault block A the first 166ft. (50m.) of strata contain up to 80% white-to-grey sandstone. Above the sandstone the rock is mostly ripple- and planar-laminated dolostone, usually thinly to very thinly bedded. Other rock types present include intraformational breccia, flat pebble intraformational conglomerate, crystalline dolostone and stromatolitic dolostone. Approximately 800ft. (243m.) above the unconformity and occupying the core of the syncline in fault block A is a group of thickly bedded, buff dolostone beds containing rare nautiloids. Equivalent strata in fault block E contain poorly preserved, silicified nautiloids and gastropods of Lower Ordovician age. Fault blocks

A and E are faulted on their eastern margins against Silurian dolostone of the Allen Bay Formation. This fault line coincides with the upper boundary of the unnamed Middle Cambrian formation of Blackadar and Christie (1963).

At least 400ft. (122m.) of the upper part of the Lang River Formation are present in fault block C (Fig. 6). The Upper Ordovician fauna in this fault block suggests that most, if not all, of the exposed strata are stratigraphically above the Lower Ordovician strata of fault block A. This would indicate a minimum total thickness of about 1,200ft. (366m.) for the Lang River Formation.



Unlike the equivalent beds of the Lang River section the fossiliferous beds are only 50ft. (15.3m.) thick and are not distinguishable as a separate member. The fossiliferous beds are gradationally overlain by dolostone of the Allen Bay Formation which makes it difficult to define a precise boundary between the two formations on the ground and in aerial photographs.



The Allen Bay Formation examined at this location consisted entirely of dolostone. The dolostone types are mostly laminated, stromatolitic, or structureless and include a considerable number of fossil-bearing beds. The total thickness of the Allen Bay Formation is unknown but fault block F contains at least 1,300ft. (397m.) of exposed strata.


Hunting River, Somerset Island (locality Y)


In the Hunting River area Blackadar and Christie (1963)


1 of 2


-  CROSS-LAMINATED DOLOSTONE
-  PLANAR-LAMINATED DOLOSTONE


-  INTERBEDDED CROSS- & PLANAR-LAM. DOL.
-  INTRAFORMATIONAL BRECCIA


-  INTRAFORMATIONAL CONGLOMERATE

-  STROMATOLITIC DOLOSTONE

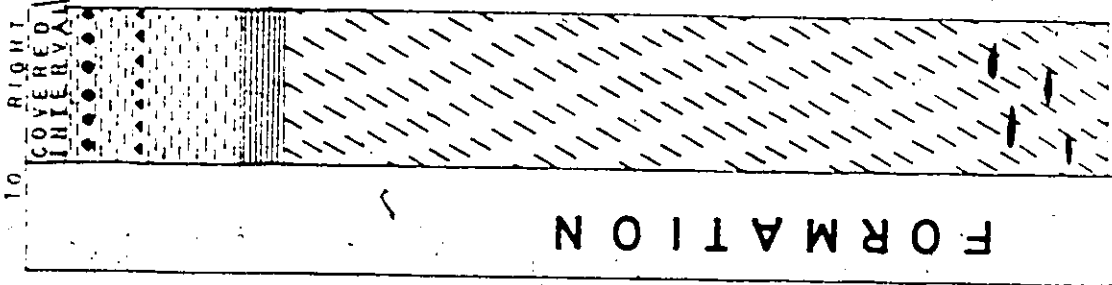
-  DOLOSTONE

-  CHERT NODULES

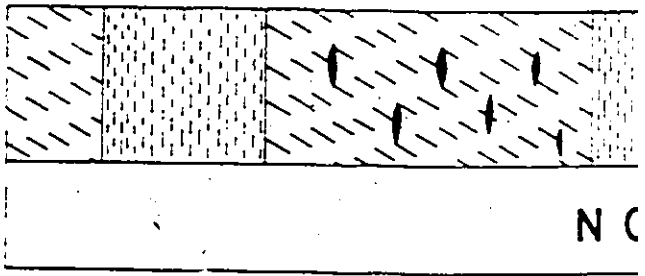
-  SANDSTONE

-  FISSILE DOLOSTONE
- * SAMPLE SITE

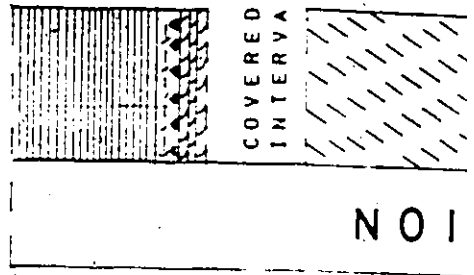
SECTION CONTINUED



SECTION DISCONTINUED



CORE OF SYNCLINE



COVERED INTERVAL

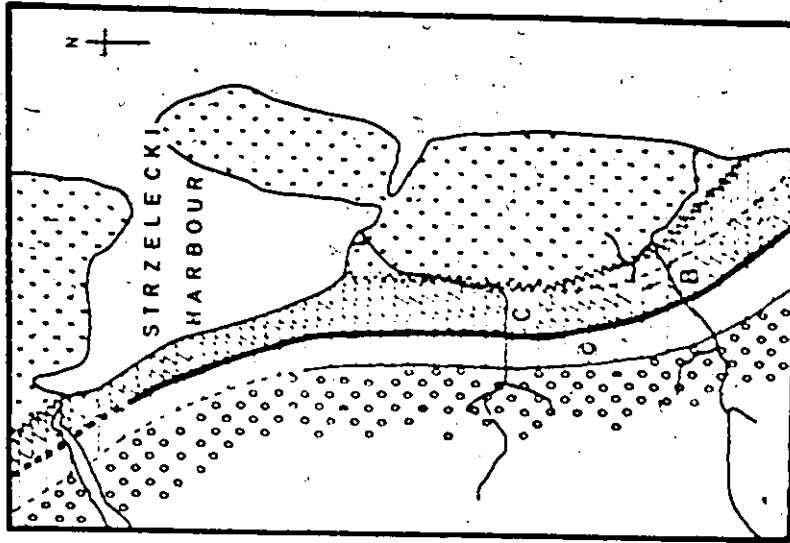
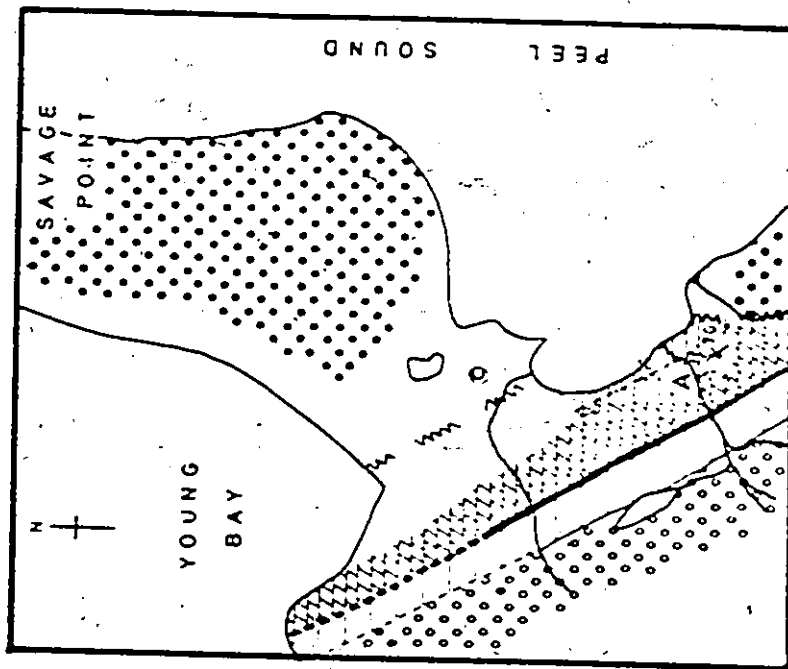
ION









NC

recognised strata with attitudes varying from generally eastward dipping near the Hunting River to horizontal approaching the Aston River. In fact the structure of the area is more complicated than this, as shown by the northward plunging syncline newly recognised east of the Hunting River (fig. 8). Strata on the plateau and in the Hunting River valley make up at least 1,923ft. (586m.) of continuous section in the Lang River Formation (section b, fig. 9). At an horizon calculated to be between 2,700 and 2,900ft. (828-884m.) above the base of the Lang River Formation there is a fossil-bearing calcareous dolostone (the fossil locality of fig. 8). Between the uppermost exposure at 1,923ft. (586m.) and the fossil horizon there was an extensive area of drift-covered plateau with only rare isolated exposures. The distances involved and the lack of exposed strata prevented further survey east of the fossil locality.


A basal white-to-grey sandstone of the Lang River Formation rests unconformably upon the Hunting Formation (Pl. 15, fig. 2). Previous reports considered the contact to be gradational and chose an arbitrary boundary (Blackadar and Christie 1963; Tuke et al. 1966).

The Lang River Formation is markedly thicker than in the southern localities on Somerset Island, a trend consistent with the regional geology whereby there is a northerly thickening of Paleozoic stratigraphic units. The Lang River Formation at this locality is approximately 2.25 times thicker than in the Lang River section. A proportional thickness increase of the Allen Bay Formation would make it approximately



-  Raised beach
-  Peel Sound Fm.
-  Read Bay Fm.
-  Young Bay Fm.
-  Allen Bay Fm.
-  Lang River Fm.
-  Aston Fm.
-  Basement rocks

A, B, C. Measured sections

 Camp site

0 MILES 1



FIGURE 10 GEOLOGICAL SKETCH MAPS, PRINCE OF WALES ISLAND LOCALITIES

3,350ft. (1,019m.) in the Hunting River area compared to 1,400ft. (427m.) at Lang River. The total thickness of the Lang River and Allen Bay Formations would then be about 6,250ft. (1,900m.). A very approximate calculation (based on measured dips and outcrop widths) from aerial photographs and the Blackadar and Christie (1963) map gave similar thicknesses. To the north on Cornwallis Island strata of the Cornwallis Group and Allen Bay Formation have a combined thickness of 18,200ft. (5,551m.) (Thorsteinsson and Kerr 1967).

Thus at Hunting River, rocks of the Lang River Formation occupy a considerable outcrop width due to increased thickness and repetition caused by simple folding. The boundary between the Lang River and Allen Bay Formations is approximately known from the ground survey but the extensive drift cover makes the boundary unrecognisable on the aerial photographs.

Savage Point, Prince of Wales Island (locality A)

The section near Savage Point containing the Lang River and Allen Bay Formations is 2,143ft. (654m.) thick (figs. 10A and 11). The lower beds of the Lang River Formation are faulted against the Aston Formation (Dixon et al. 1971).

The basal 700ft. (214m.) of the section is part of the Lang River Formation and contains sandstone, dolostone and a few fissile dolostone beds. The sandstone and dolostone are arranged in cyclothems in the lower part of the sequence. In the first 100ft. (30.4m.) of the sequence each cyclothem

of 1

SECTION CONTINUED TO RIGHT

FM.

BAY

ALLEN

N

COVERED

INTERVAL

FOOLITE

SECTION DISCONTINUED

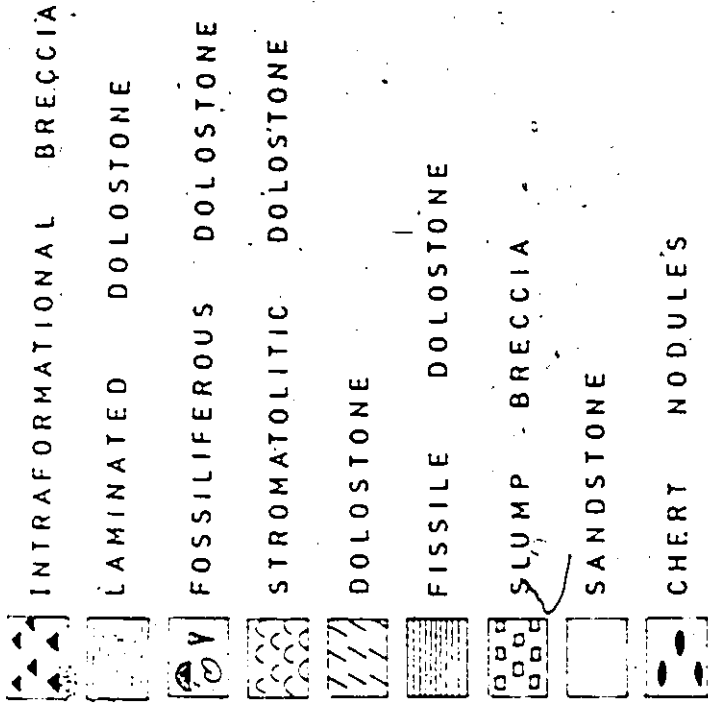
YOUNG BAY FORMATION

FORMATION

FISH BED

* G.S.C. 89510 (L.SIL.)

* FOSSILS (FRAGMENTARY)



SAMPLE SITE
G.S.C. GEOL. SURV. CANADA

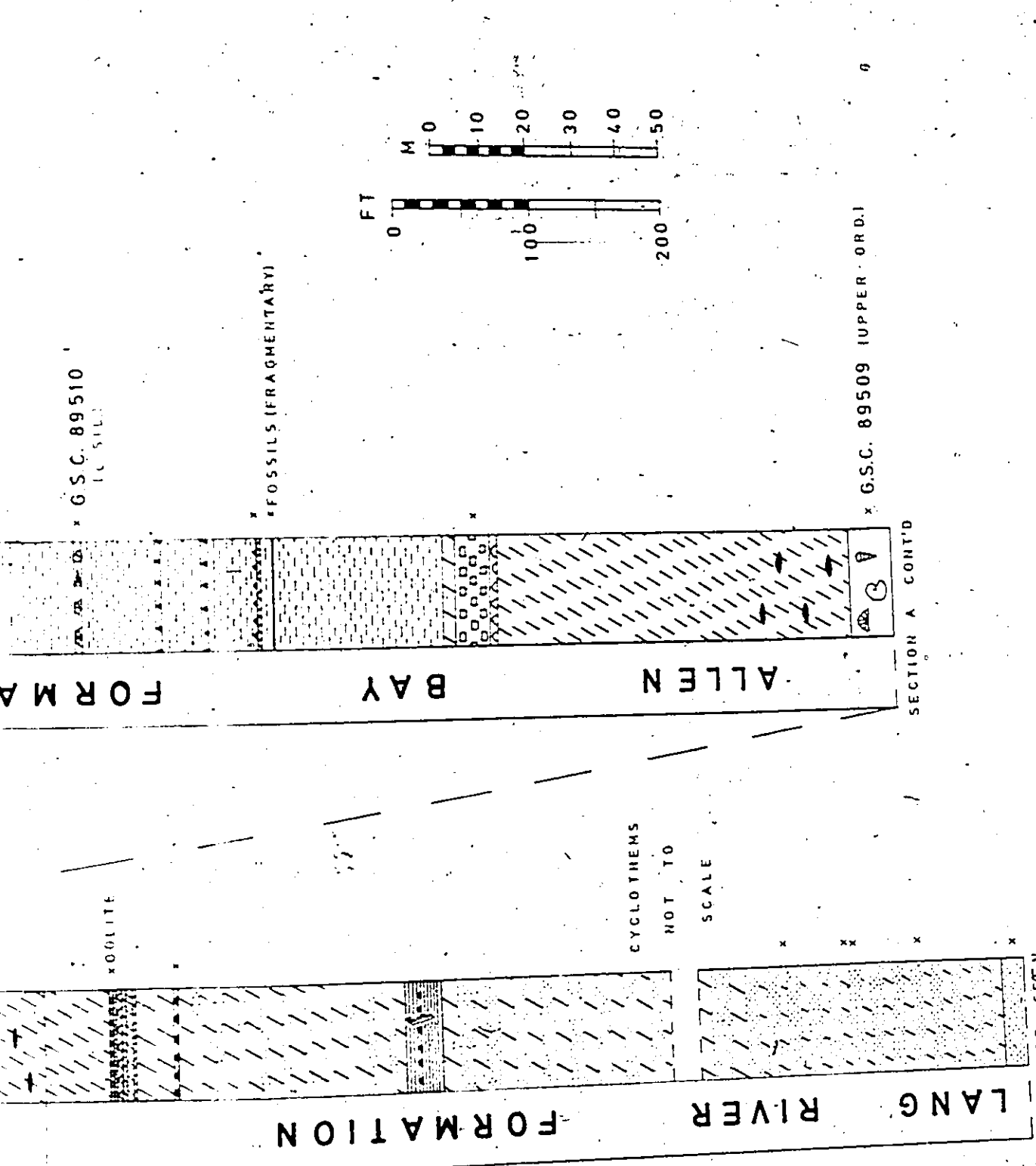


FIGURE 11 STRATIGRAPHIC SECTION; SAVAGE POINT (LOCALITY A), PRINCE OF WALES ISLAND.

generally contains a basal submature sandstone overlain by a thinly bedded dolomitic sandstone and only rarely is dolostone present. Between 100 and 300ft. (30.4-92m.) above the base of the section each of the cyclothem contains a dolostone member above the sandstone and towards the top of the formation the dolostone becomes the dominant lithology. The cyclothem are very irregular in thickness varying from a few inches to several feet (about 10cm.-2m.). Above the 300ft. (92m.) level the cyclothem are obscure and finally the sequence consists almost entirely of dolostone with a few fissile dolostone beds.

Above the Lang River Formation are 1,443ft. (440m.) of brown dolostone of the Allen Bay Formation. These rocks are mostly laminated dolostone (with both sedimentary and stromatolitic laminations) and only a few fossil beds. One such fossil bed occurs 1,185ft. (361m.) above the base of the measured section and contains an 'arctic' Ordovician fauna. However, the lithology is similar to the dolostone above and below and is therefore considered part of the Allen Bay Formation. Between 1,1481 and 1,853ft. (452-565m.) above the base of the section the dolostone contains abundant structures attributable to slumping and sliding (see chapter V).

The 200ft. (60.8m.) of Young Bay Formation typically consists of thinly to mediumly bedded dolostone and dolomitic limestone which weather recessively to form a distinct topographic depression. About 80ft. (24.4m.) above the base of this formation there is a fish bed comparable to ones present

SECTION DISCONTINUED

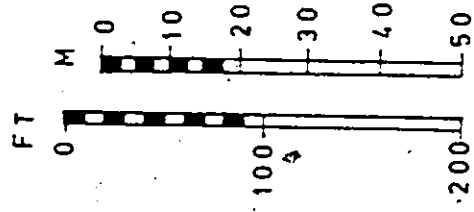
YOUNG BAY FORMATION

FORMATION

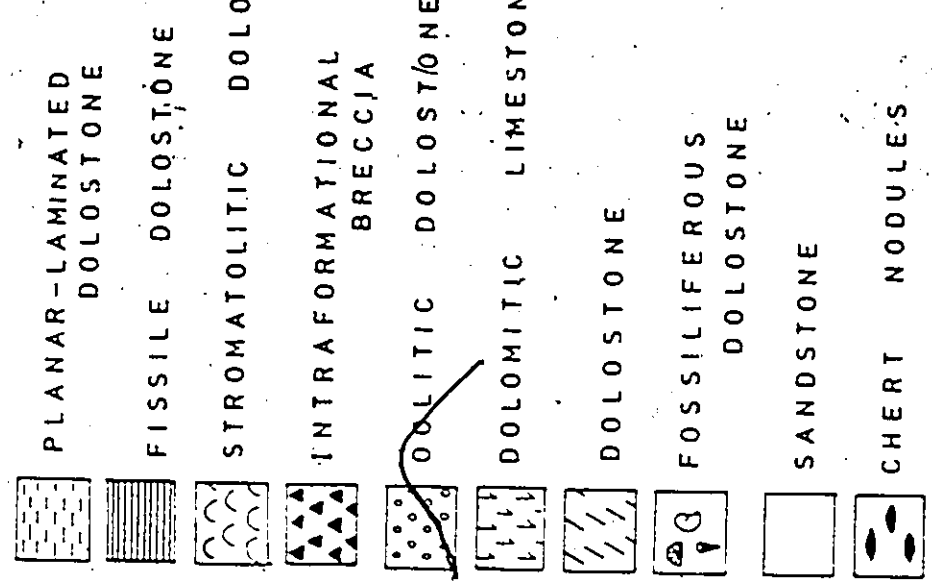
SECTION CONTINUED TO RIGHT

COVERED INTERVAL

COVERED INTERVAL



FISH BED



G.S.C. GEOL. SURV. CANADA
* SAMPLE SITE

COVERED INTERVAL

1 of 1

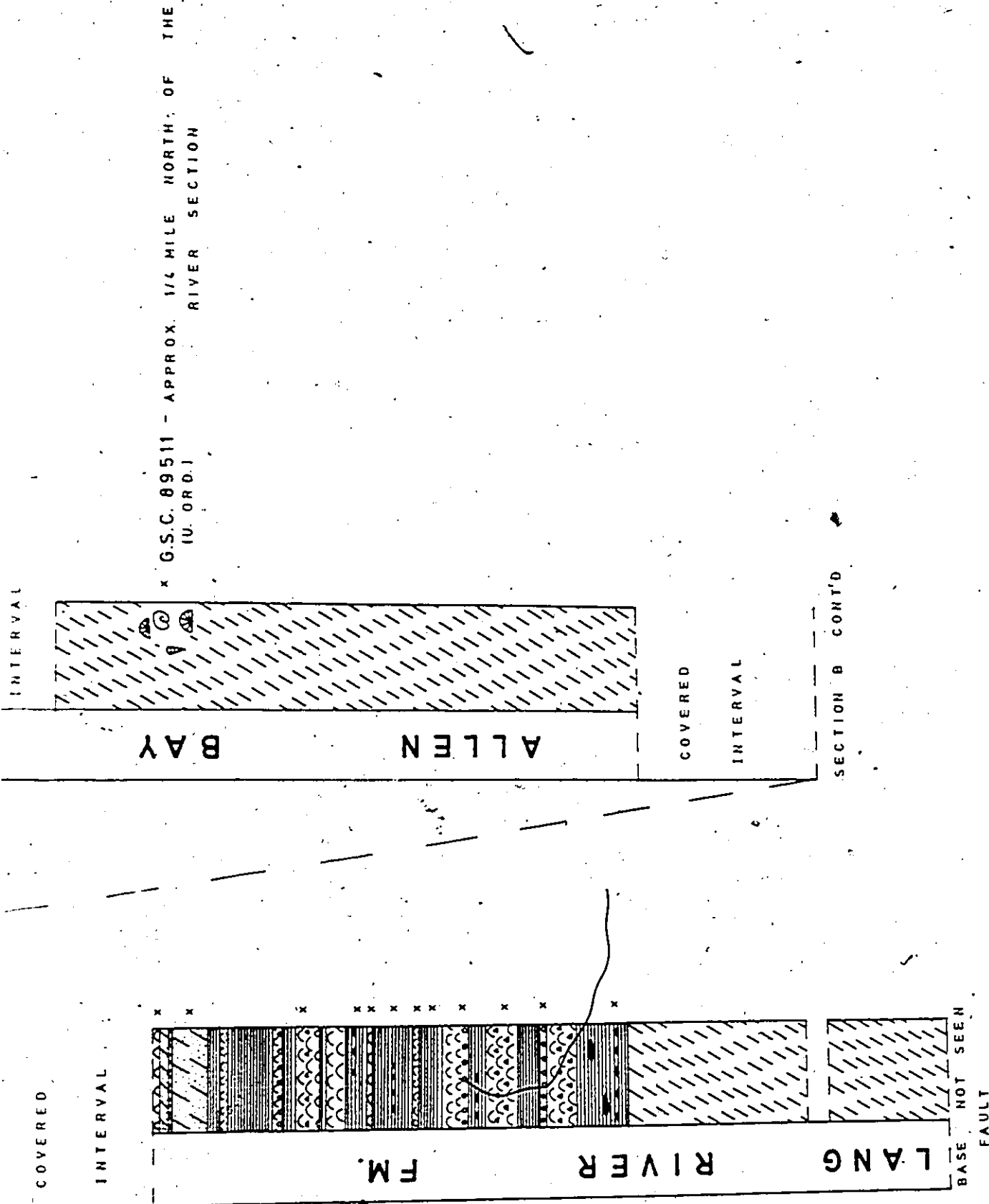


FIGURE 12 STRATIGRAPHIC SECTION, STRZELECKI HARBOUR (LOCALITY B) PRINCE OF WALES ISLAND.

at localities Z and B (Turner and Dixon 1971; Dixon et al. 1972).

Strzelecki Harbour, Prince of Wales Island

(localities B and C)

The section at locality B is similar to that near Savage Point in containing a basal 600ft. (183m.) of distinctive dolostone, fissile dolostone and sandstone succeeded by 1,755ft. (535m.) of massive, brown dolostone (fig. 12). The basal beds belong to the Lang River Formation and are faulted against Precambrian gneiss (fig. 10B). Although similar rock types are present at localities A and B their arrangement in the Lang River Formation is very different. The Lang River Formation at locality B consists of at least ten recessively weathering fissile dolostone units (informal use of the term unit) alternating with stromatolite-rich dolostone (Pl. 2, fig. 1). The fissile dolostone units vary from 5 to 40ft. (1.5-12.2m.) thick and contain intraformational breccia beds 0.5 to 9ins. (1.5-23cm.) thick and local thin stromatolite beds which usually pass laterally into the fissile dolostone.

The stromatolite-rich dolostone units vary in thickness from 5 to 42ft. (1.5-12.8m.). The last fissile dolostone unit is overlain by 40ft. (12.2m.) of sandstone and dolostone above which the talus and drift deposits cover a considerable thickness of strata. In the field the upper boundary of each fissile dolostone unit was placed where the shale-like dolostone is succeeded by more resistant dolostone, which usually coincided with either an oolite or intraform-

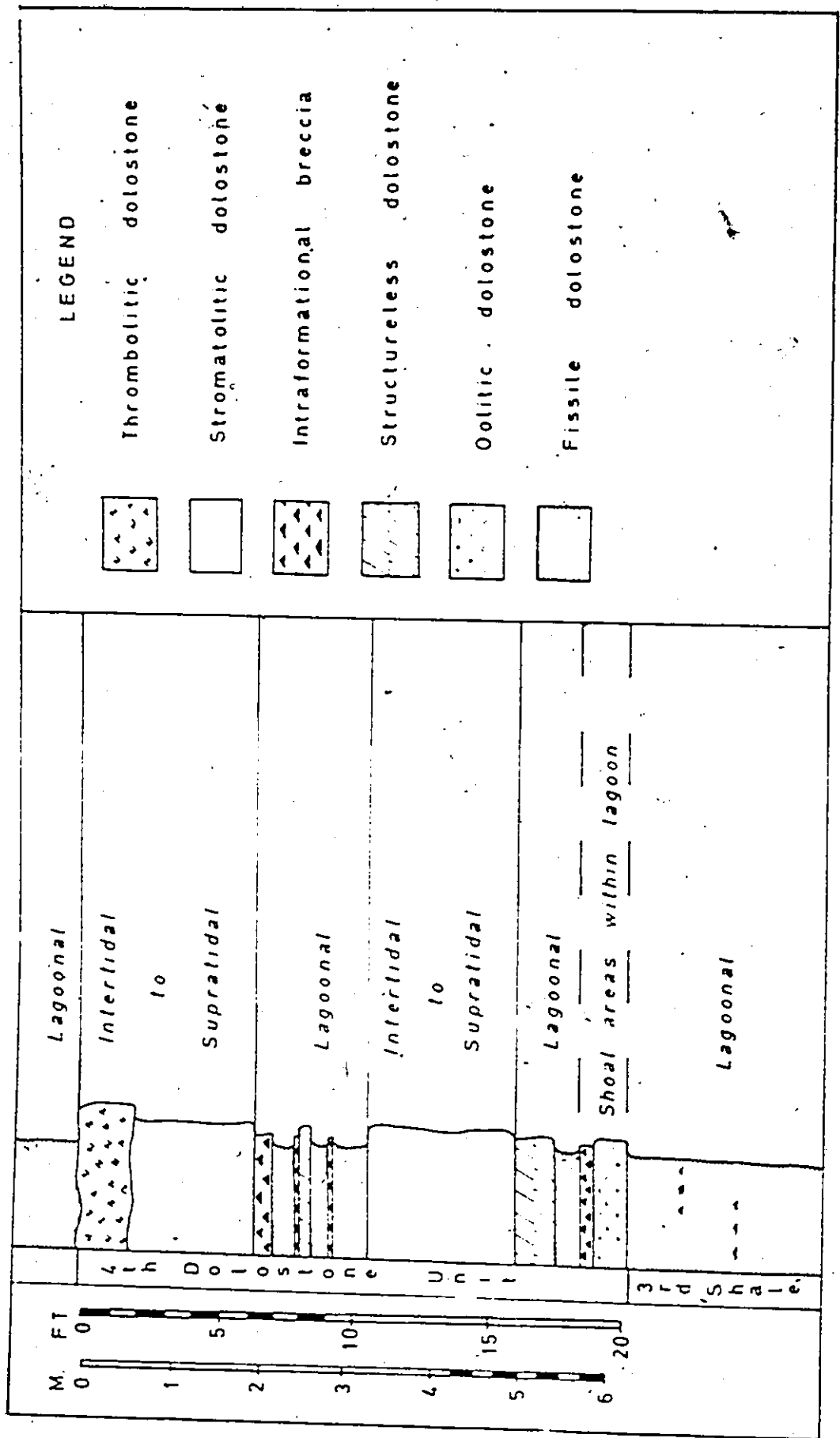


FIGURE 13 LITHOLOGY AND SUGGESTED DEPOSITIONAL ENVIRONMENTS OF THE 4M. DOLOSTONE UNIT, LOCALITY B, PRINCE OF WALES ISLAND.

ational breccia bed. Locally the upper boundary of some of the stromatolite-rich dolostone units is defined by the upper surface of a stromatolite or thrombolite bed (a non-laminated algal sedimentary rock with a clotted texture—see Aitken 1967). Figure 13 illustrates the fourth stromatolite-rich dolostone unit (as seen in the field) which in detail apparently consists of two cycles. The majority of the rock types present in these resistant units are stromatolitic; they are domal, columnar or cryptalgalaminar in morphology. Other lithotypes present, in decreasing order of frequency, are thrombolitic dolostone, intraformational breccia, oolite, fissile dolostone and sandstone.

Immediately above the lowest 600ft. (183m.) of exposed strata there are about 780ft. (237m.) of unexposed strata and consequently it is not known precisely where the Lang River-Allen Bay Formations boundary lies. From 1,384 to 2,356ft. (422-719m.) above the base of the section is dolostone of the Allen Bay Formation. This dolostone is similar to that present at locality A but apparently lacks slump or slide structures. An Upper Ordovician 'arctic' fauna is present in approximately the lower middle part of the Allen Bay Formation. These fossils were located in strata exposed on the plateau and consequently their precise stratigraphic position is unknown.

The overlying Young Bay Formation consists of about 140ft. (43m.) of thinly bedded dolostone and dolomitic limestone

typical of this formation. Fossil fish were found in the talus and the position of this material indicated the fish beds to be between 100 and 130ft. (30.4-39.7m.) above the base of the formation.

About one half mile (0.81Km.) to the north of locality B a small stream exposes rocks of the Allen Bay, Young Bay, Read Bay and Peel Sound Formations (locality C, fig. 10B). About 762ft. (232m.) of Allen Bay Formation and 200ft. (61m.) of Young Bay Formation are present. Exposure of the Young Bay Formation was hidden by talus and no fish beds were located.

Discussion

Lithostratigraphic correlation of the five major sections is presented in figure 14. Detailed explanatory notes and interpretation of the lithotypes and sedimentary successions were avoided in this chapter but are dealt with in greater detail in the following two chapters.

III PETROLOGY

Introduction

In both the Lang River and Allen Bay Formations dolostone predominates. Folk's (1962; 1968) carbonate classification scheme was applied to the dolostones, although there are limitations inherent in the scheme (see Ham and Pray 1962, Lindholm 1969). Folk's classification has not been used much in recent literature concerning dolostone sedimentology. This may be due to the emphasis placed on understanding dolomitisation (Newell et al. 1953; Adams and Rhodes 1960; Cotter 1966; Friedman and Sanders 1967; Jodry 1969) and the environmental interpretation of dolostone (Bluck 1965; Matter 1967; Gutstadt 1968; Braun and Friedman 1969) rather than on dolostone petrography.

Folk's (1962; 1968) spectral classification of carbonate rocks uses both descriptive terminology and symbols, but the latter have not been used very much. There are five basic classes (denoted as I to V) and the first three refer to limestone. These first three classes are divided on the basis of the ratio of allochems, sparry calcite and microcrystalline calcite within a rock (I is sparry allochemical, II is microcrystalline allochemical and III is microcrystalline). Class IV refers to in situ biogenic carbonates and class V is replacement dolomite. Allochems are identified by letters, for example pellets are p and fossils are f: using the

size of the allochems one can classify the limestones as either calcirudites or calcarenites. Grain size in dolostone is divided into seven categories, ranging from aphanocrystalline (less than 0.0039mm.) to extremely coarsely crystalline (greater than 4.0mm.). Thus a biomicrite would be IIb:La, or an intraclastic pellet limestone would be IIp(i):La, where the pellets are the major allochems. Further examples may be found in the text of this chapter.

Although in Folk's classification there are categories for dolomitic and dolomitised limestone (less than and greater than 10% dolomite respectively) there are no categories for dolostone containing calcite. Consideration of these types of dolostone indicates two possible origins for the calcite, either a pre-dolomitisation origin in which the calcite would be a remnant of an original limestone, or a post-dolomitisation origin. Both types of calcite are usually readily distinguished. On subsequent pages the prefix calcareous and the symbol l will be used to indicate pre-dolomitisation calcite. Post-dolomitisation calcite will be indicated by the prefix calcitic and the symbol L. For example a calcareous finely crystalline pellet dolostone would be Vp:lD3, or a calcitic finely crystalline dolostone would be V:L D3. If the calcite cannot be distinguished as pre- or post-dolomitisation then the prefix limy is proposed and the symbol C, such that a limy medium crystalline dolostone would be V:CD4.

The rock types identified from the Lang River and Allen Bay Formations are listed in table 2. Both formations contain similar rock types but the Lang River Formation differs from the Allen Bay Formation in four main aspects:

- i) the presence of sandstone and sandy material almost exclusively in the Lang River Formation,
- ii) the presence of fossiliferous dolomitic limestone and calcareous dolostone in the Lang River Formation, although this rock type is apparently restricted to Somerset Island,
- iii) the rapid alternation of lithotypes in the Lang River Formation, in contrast to the more uniform appearance of the Allen Bay Formation dolostone, although petrographically the latter also contains several dolostone lithotypes,
- iv) the presence of fissile dolostone (a shale-like dolostone) in the Lang River Formation which is apparently absent in the Allen Bay Formation.

With the exception of a 14ft. (4.3m.) thick sandstone bed at locality C the five sections in which the Allen Bay Formation is present consist entirely of dolostone. Dolostone types and sedimentary structures are similar to those in the Lang River Formation but differ in their relative abundance. In order not to duplicate descriptions, the rock types in the Allen Bay Formation are listed with only short notes.

Although systematic collecting of rock samples throughout each section was not always feasible, the samples taken are considered to be representative of the rock types

TABLE 2

Rock types in the Lang River and Allen Bay Formations

Name	Occurrence	
	Lang River Formation	Allen Bay Formation
Very finely to finely crystalline dolostone, V:D2-3	X	X
Medium to coarsely crystalline dolostone, V:D4-5	X	X
Pellet dolostone, Vp:D2-4	X	
Intraclastic pellet dolostone Vp(i):D2-4	X	X
Oolitic dolostone, Vo:D2-4	X	
Intraclastic dolostone, Vi:D2-4	X	X
Sandy intraclastic dolostone, TsVi:D2-4	X	
Biogenic dolostone, Vb:D2-4	X	X
Dolomitic biomicrite, IIb:dLa	X	
Calcareous biogenic dolostone, Vb:lD1-2	X	
Sandy biogenic intraclastic dolostone, TsVi(b):D2-4	X	
Stromatolite biolithite, IV:D2-4	X	X
Fissile dolostone, V:D1	X	
Sandstone	X	X

recognisable in the field. The following descriptions indicate the variety of rock types present in the two formations and include unusual and infrequently occurring rock types as well as descriptions of the more common rock types.

Lang River Formation

Very finely to finely crystalline dolostone, V:D2-3

Fine grained dolostone is probably the most abundant lithology in the Lang River Formation. However, classification hides the variety of sedimentary structures present in these rocks. Only infrequently are they structureless. Usually they are either cross- or planar-laminated (Pl. 2, fig. 2; Pl. 3, fig. 1; Pl. 4, figs. 2,3). The cross-laminations usually define asymmetric ripples most of which have their crests aligned subparallel to the trend of the Boothia Arch, that is approximately north-south. Cross-laminated dolostone is particularly abundant on Somerset Island but is not as common on Prince of Wales Island.

Planar-laminated dolostone (the term laminated used in a broad sense) consists of individual beds up to 1cm. thick. The stratification is essentially subparallel although low angle truncation is a common feature (Pl. 4, fig. 2) and minor undulatory erosion surfaces also occur. Undulose laminae, usually less than 2mm. thick, may be due to differential compaction or are possibly cryptalgalaminae (Aitken 1967), but it is often difficult to distinguish between sedimentary and algal laminations. Often these finely laminated dolostones pass laterally into small domal strom-

atolites suggesting that some of the subparallel laminae were also probably stromatolitic. In much of the finely laminated dolostone from Prince of Wales Island organic material (bitumen) is commonly distributed parallel or subparallel to the laminations. Often in thin sections this material is the only trace of original bedding in an otherwise homogenous dolostone. Evaporite mineral casts (gypsum/anhydrite) were present locally in the more thinly laminated dolostone, especially at Hunting River.

In both the cross- and planar-laminated dolostones silt- to sand-sized quartz grains are common. The quartz occurs in stringers, lenses, or as isolated grains disseminated throughout the dolostone (Pl. 4, fig. 3). This sand content occurs only in the lower part of the Lang River Formation. No fossils were found in these rocks but burrows were locally present.

Ripples are common structures in marine environments where wave, tidal or marine currents have sufficient energy to build these bed forms. There are at least two possible origins for planar-laminated dolostone. Firstly it could have accumulated by the settling of suspended material or by precipitation of calcite or aragonite from water (Cloud 1962). The minor truncations and erosion surfaces could have been caused by tidal action, wave scour or marine currents. The second alternative is that it represents storm deposits accumulated in the supratidal zone (Ball et al. 1967; Laporte 1967,

pp.78-79; Matter 1967, p.601; Roehl 1967, pp.1998-2002). Laminated deposits of the supratidal zone are generally found in association with stromatolites, intraformational breccia, evaporite mineral casts and mudcracks (Roehl 1967, pp.1998-2002). Such associations are common in the Lang River Formation, except for evaporite mineral casts which are uncommon. However, much of the planar-laminated dolostone is not directly associated with the above features and it is not always apparent if it is supratidal, intertidal or subtidal in origin.

Medium to coarsely crystalline dolostone, V:D4-5

Some of the planar-laminated dolostone falls into this category due to a slightly greater grain size, but for the purposes of discussion it will be considered to belong to the previous category. The remaining medium to coarsely crystalline dolostone is generally structureless and occurs as thickly to very thickly bedded units. In thin section the rock appears as a grain mosaic of dolomite. Rocks of this type are present at all five localities and at Creswell Bay some of them contain silicified fossils.

The original sediment type is difficult to determine but it may have been thick accumulations of carbonate mud or sand. Dolomitisation of originally fine grained carbonate usually results in finely crystalline dolostone retaining details of sedimentary structures (Murray 1964). Thus it is suspected that some of this dolostone may once have

been finegrained sand.

Pellet dolostone, Vp:D2-4 and intraclastic pellet dolostone,

Vp(i):D2-4

Only a few of the samples collected from the Lang River Formation are pellet-bearing dolostone but it is believed that they are probably more abundant than the collection indicates. This apparent infrequency is probably due, in part, to the difficulty of recognising these rocks in the field. However, pellets and grapestone are also common constituents of sandy intraclastic dolostone (intraformational breccia and conglomerate of other authors).

The pellets may be poorly defined to moderately well defined ovoid structures, 0.25 to 0.75mm. in diameter (Pl. 5, fig. 1). Some pellets are distinguished from the matrix by slightly finer grain size, or in others the dolomite is cloudier than the matrix dolomite, or the pellets may be defined by small pyrite crystals around the perimeter. Some of the pellet dolostone contains well rounded, fine to medium grained quartz sand grains, but these rarely exceed 10% of the total.

Occasionally the pellets are clustered into grapestone intraclasts and may comprise as much as 20% of an intraclastic pellet dolostone. However, grapestone intraclasts are not a common component of the rock types studied.

Purdy (1963, pp:342-343) recognised faecal pellet carbonate mud in shallow subtidal environments west of

Andros Island in the Bahamas. He noted that pellet muds occur where stable bottom conditions prevail and where the bottom currents are of sufficient energy to winnow out the finer mud particles but insufficient to cause removal of the pellets. Laporte (1967, pp.82-83) also considered that pellets could be deposited in the intertidal zone.

Oolitic dolostone, Vo:D2-4

Oolite beds are present at all the localities but they do not constitute an important proportion of the total rock types. The oolite beds occur in the lower part of the Lang River Formation as beds a few inches to several feet thick (0.1-1.0m.)

Preservation of the oolites is variable, in some only the outlines are visible (Pl. 6, fig. 2) but in others the preservation is excellent (Pl. 6, fig. 1). The nuclei of the oolites are usually silt-sized to fine sand-sized quartz grains, although many apparently have a carbonate nucleus of indeterminate origin. Well-rounded, silt-sized to medium sand-sized quartz grains are also disseminated throughout the matrix. Sorting of the oolites is variable, examples from Prince of Wales Island tended to be poorly to moderately well sorted (Pl. 6, fig. 1). The irregular shape of some of the oolitic structures examined from Prince of Wales Island suggests that some of them may be oncolites (Pl. 6, fig. 1).

Oolites are known to form in shallow shoal areas where

oscillatory currents are of sufficient energy to agitate the sediment. Freeman (1962), however, described calm-water oolites from the Laguna Madre, Texas, and Davies (1966) compared the Laguna Madre oolites with calm-water oolites from the Lower Ordovician of Minnesota. Davies noted that high energy oolites are distinguished on the following criteria:

- i) generally good sorting,
- ii) high sphericity,
- iii) the oolite rings are concentric about the nucleus.

In contrast the calm-water oolites are usually distinguished by the following:

- i) moderate sorting,
- ii) low to moderate sphericity,
- iii) the oolite rings abut against the nucleus.

According to these criteria some of the Lang River Formation oolites are of the high-energy type and others may in fact be oncolites.

Sandy intraclastic dolostone, TsVi:D2-4

The sandy intraclastic dolostone is the rock type most commonly known as intraformational breccia or conglomerate. These rocks are common throughout the Lang River Formation, although volumetrically they are not significant. Two types of sandy intraclastic dolostone are present, namely, intraformational breccia and intraformational flat-pebble conglomerate. The term breccia is applied to those rocks with

slightly angular, tabular clasts which are distinct from the rounded, disc-shaped clasts of the conglomerate.

The intraformational breccia contains tabular clasts in a matrix of coarse silt-sized to medium sand-sized quartz grains and replacement dolomite (Pl. 7, figs. 1-3; Pl. 14, fig. 3). Most of the clasts range from a few millimetres to about 15cm. in length, although larger clasts do occur. The clasts are mostly of laminated sandy dolostone aligned parallel or inclined to the bedding. Roehl (1967, pp.2006-2009) discussed the significance of three types of intraformational breccia in terms of energy levels during deposition. These three types he called edge-wise breccia, graded breccia and float breccia. All three types occur in the Lang River Formation but graded breccia (Pl. 7, fig. 3) and float breccia are the dominant types.

The intraformational flat-pebble conglomerate, apparently present only on Somerset Island, contains disc-shaped clasts in a matrix of quartz sand and replacement dolomite (Pl. 3, fig. 2). Most of the clasts do not exceed 7cm. in diameter and have a thickness rarely in excess of 5mm. The clasts are of coarse siltstone, or very fine-grained sandstone, or finely to mediumly crystalline dolostone, all of which are often superficially stained red by iron oxides. If the ratio of clasts to matrix is high the clasts tend to be imbricated.

At locality Z approximately 290ft. (88.2m.) above the

unconformity there is a thin bed of green stained flat-pebble conglomerate. This rock fills depressions on the top surface of a low-amplitude domal stromatolite bed. The rounded flat clasts are usually no greater than 2cm. in diameter and rarely exceed 1.5mm. in thickness. The extremely thin clasts are distorted, probably an effect of compaction. The clasts are randomly orientated between horizontal and vertical.

The matrix of this green-stained intraformational conglomerate consists of very fine to fine quartz sand. Dolomite replacement has pitted the margins of the quartz grains, imparting a degree of angularity to the quartz grains and making it difficult to distinguish original angularity from secondary effects. However, there is some indication that originally the quartz grains were at least sub-rounded.

The green colour is a superficial stain on the clasts and it is not always visible in standard thin sections. The green substance has an extremely fine grain size which makes positive optical identification difficult, although the mineral is probably either chamosite or glauconite.

Despite the differences between the breccia and the conglomerate the two intraclastic dolostone types have similar origins as intrabasinal erosion products. The common association of intraformational breccia with laminated dolostone and stromatolites indicates the origin of the clasts (Pl. 7, fig. 1). On the other hand the intraform-

ational conglomerate is most commonly associated with fissile dolostone or extra thinly parting, laminated dolostone. These associations probably reflect the duration of transport.

The breccia was probably transported only short distances from its site of origin, in fact some breccia beds contained clasts that could be matched to the underlying rock type.

The conglomerate was probably transported further from its source into other environments. This difference in distance of transportation would account for the roundness and shape of the clasts in the intraformational conglomerate.

Roehl (1967, p.2007), in his study of the Stony Mountain Formation, considered the clasts in intraformational breccia and conglomerate to be derived from algal mats and stromatolites broken up by dessication and subsequently accumulated into thin beds during storms or local high-energy tidal conditions.

Dolomitic biomicrite, I1b:d1a and calcareous biogenic dolostone, Vb:1D1-2

The dolomitic biomicrite and calcareous biogenic dolostone are restricted to the fossiliferous rocks of member 2 and equivalent strata of the Lang River Formation. They are considered together because the biogenic dolostone is the result of dolomite replacement of the biomicrite. As the name implies, both rock types consist of abundant fossil material in a micrite or very finely crystalline dolomite matrix. The whole or partial fossils are mainly colonial corals, cephalopods and stromatoporoids which together make up approximately 75% of the total macrofauna. Gastropods, brachiopods, trilobites, bryozoa and crinoid fragments make

up the remainder. The trilobites and crinoids are usually present as fragmentary material mixed with the other fauna. In the Lang River occurrence they are the major fossil fragments in the first 40ft. (12.2m.) of member 2, Lang River Formation.

About 50% of the rock consists of fossils or fossil fragments larger than 5mm.; the remainder is highly comminuted fossil debris, micrite or very finely crystalline dolomite. The majority of the colonial corals and lamellar stromatoporoids are in their original growth positions. These rocks probably had a subtidal origin in which accumulation involved very little transport of material. Sedimentary structures are not apparent in these rocks and the heterogeneity of the constituents could have been produced by bioturbation. The micrite may have been derived by precipitation from sea water (Illing and Wells 1964) or by the disintegration of shelly material by boring organisms and scavengers (Bathurst 1972, pp.87-88).

Sandy biogenic intraclastic dolostone, Tsvi(6):D2-4

In the Lang River section between 275 and 545ft. (93-166m.) above the unconformity there is a series of diverse dolostone types which includes thin beds of sandy biogenic intraclastic dolostone (Pl. 8, figs. 1-3). Only two of these units were seen in the field although other similar rock types may be present in this part of the Lang River Formation. No comparable rock type was observed at the other localities.

Plate 8, figures 1 and 2, illustrates one such bed. The

rock consists of a variety of clasts in a matrix of sandy, mediumly crystalline dolomite. The ratio of clasts to matrix is about 3:2. There are at least four types of clasts present, as follows:

i) About 50 to 65% of the clasts are grapestone intraclasts. The grapestone clasts are stained brown and the rims of the clasts are a darker brown. They range in size from 0.6 to 2.5mm. The pellets within the grapestone are not distinct in transmitted light but are best seen in reflected light. None of the pellets on the periphery of the grapestone clasts appeared to be broken or abraded.

ii) Fragments of shelly material which make up about 15 to 20% of the total clast content. The fragments are 0.1 to 0.15mm. thick and up to 5mm. in length. There is no detectable microstructure in the shelly material but the approximate age of these rocks (Cambro-Ordovician) may indicate that the fragments are brachiopod remains. The shell debris is poorly imbricated.

iii) Solitary pellets comprise about 15% of the clast content. The dolomite of the pellets is also stained brown and the rims of the pellets are darker brown. The pellets range in size from 0.25 to 0.5mm. in diameter.

iv) Five to 10% of the clasts are rounded fragments of sandy dolostone. These clasts contain silt- to fine-sand sized quartz grains in a mediumly crystalline dolomite matrix and are similar in dimensions to the grapestone intraclasts.

Single pellets are usually present in these clasts.

The quartz grains in both the matrix and intraclasts have straight to slightly undulose extinction and are usually well rounded. The matrix contains 15-20% of medium-sized quartz grains.

Purdy (1963) discussed at length the origin of grapestones and their depositional environment on the Great Bahama Bank. He concluded that stable bottom conditions were required for grapestone formation and that they may be deposited in the intertidal to shallow subtidal zones. The apparent imbrication of the shelly material and the mixing of various types of clasts in the sandy intraclastic biogenic dolostone of the Lang River Formation indicates some movement of material. However, the absence of abraded or broken pellets or grapestone intraclasts suggests that the transportation was brief and/or of low energy.

The shell debris in this type of intraclastic dolostone is direct evidence for the presence of a shelly fauna during the deposition of an otherwise unfossiliferous lower Lang River Formation.

Stromatolite biolithite, IV:D2-3

Folk (1968, p.163) restricted the use of biolithite to rocks consisting of organic remains essentially in situ which form a rigid framework. In the present discussion the only organic remains fitting this description are stromatolites. A considerable amount of literature exists about stromatolites of which the paper by Logan et al. (1964) has probably contributed the most useful information on strom-

atolite growth and depositional environments. Logan et al. (1964) also discussed a morphological classification scheme for stromatolites in which they recognised the following three basic types:

- i) laterally linked hemispheres (type LLH),
- ii) discrete, vertically stacked hemispheres (type SH),
- iii) spheroidal structures (oncolites).

The first two categories were further subdivided and it was their contention that all non-spheroidal stromatolites could adequately be described by using combinations of these basic types, although new forms could readily be added to their classification.

Aitken (1967) in his discussion of cryptalgal limestone and dolostone defined two additional categories of algal deposits. The first are called cryptalgalaminates, consisting of planar laminations formed by algal activity and designated by the letter P. The second category was termed thrombolites which are algal structures lacking distinct laminations but characterised by a microscopic clotted or spongy texture. Aitken (op. cit.) recognised the following five morphological forms:

- i) hemispheroidal,
- ii) egg-shaped,
- iii) loaf-shaped with overhanging sides,
- iv) pancake-shaped with or without a raised rim,
- v) ellipsoidal.

Non-spheroidal stromatolites occur in abundance throughout the Lang River Formation on both islands (Pl. 9, figs. 1,2). Cryptalgalaminated stromatolites can be difficult to distinguish from some sedimentary laminations. Many of the thinly planar-laminated dolostone beds pass laterally into small domal stromatolites. In the Strzelecki Harbour section two samples were collected which have a thrombolitic microscopic texture. Plate 5, figure 2 illustrates one of the samples taken from a 3cm. thick bed at locality B (between 390-407ft., 118-122m. above the base of the section). Although the clotted appearance is most apparent, in detail the texture is a combination of irregular short laminae (lower left of the figure) and clots of dolomite crystals. The second example (not illustrated) fits more closely to Aitken's (1967) definition in consisting of irregular patches of dolomite. This second example, also from locality B, occurs as a laterally continuous bed of variable thickness (30-60cm. thick) located between 333-357ft. (101-108m.) above the base of the section. The type of bed in which these two thrombolite examples occur does not readily fit into any of Aitken's thrombolite shapes. Sampling from the five localities revealed the presence of thrombolites at only Strzelecki Harbour and Hunting River.

Logan et al. (1964) discussed in detail the environmental significance of stromatolite morphology in terms of energy levels in the intertidal zone. It is considered that their conclusions are valid and therefore useful sedimentological tools. Biostratigraphic significance of the Lang River Formation stromatolites is considered to be negligible

due to the local distribution of the stromatolite beds.

Whereas laminated stromatolites are dominantly sedimentary structures of the supratidal and intertidal zones Aitken (1967) considered that thrombolites are typical of low intertidal and shallow subtidal environments. Studies of some Recent laminated stromatolites from Bermuda (Gebelein 1968, 1969) have shown that they may also form in the subtidal environment. Achauer and Johnson (1969) described subtidal stromatolites from the Lower Cretaceous James Reef complex. However, associated sediments and stromatolite morphology clearly differentiate supratidal, intertidal and subtidal stromatolites.

Fissile dolostone

Fissile dolostone is a shale-like dolostone splitting along extremely thin parting planes. This rock type is common in the Lang River Formation especially at Strzelecki Harbour (Pl. 2, fig. 1). These fissile dolostones are usually associated with very thinly parted, planar- and cross-laminated dolostone and beds of intraformational breccia or conglomerate.

A sample from one of the shale intervals at Strzelecki Harbour was analysed using the X-ray diffractometer in an attempt to detect the presence of clay minerals. The analysis indicated a composition of dolomite and minor amounts of quartz but no clay minerals. Clay minerals are apparently not of any significance in the Lang River Formation rocks and the characteristics of the shaly beds in the other sections

indicate that they are also fissile dolostone.

Folk (1968) considered aphanocrystalline dolostone to be probably of primary origin. Associated rock types indicate that the fissile dolostone is marine in origin, possibly deposited in a lagoon, or a protected embayment, or a sheltered part of a tidal flat. However, the idea that the dolomite is a primary precipitate is almost impossible to prove and, furthermore, modern studies on dolomite formation do not support such extensive precipitation of dolomite. Skinner (1963) described primary dolomite from a very saline lagoon in south-eastern Australia but he considered that the formation of the dolomite was due to seasonal fluctuations in pH caused by plant activity. Furthermore, the dolomite precipitated was not true dolomite but a calcium-rich dolomite. It is concluded that the fissile dolostone was originally deposited as calcite or aragonite mud and has undergone dolomitisation. The fissility is probably due to closely spaced bedding planes along which clay-sized to silt-sized quartz grains are probably concentrated.

Sandstone

Sandstone is common in the lower part of the Lang River Formation at all the localities visited. The following discussion will emphasize two types of sandstone, firstly that of the basal sandstone from Somerset Island and secondly that from the cyclothem in the Savage Point section.

The Somerset Island basal sandstone occurs immediately above the unconformity and thereafter is interbedded with dolostone in the lower part of the Lang River Formation. Eventually, discrete sandstone units cease to occur but quartz grains are present as a constituent of the dolostone. The basal sandstone is white to grey in colour and consists of fine- to medium-sized quartz grains. The quartz grains are mostly single crystals, rounded with a high sphericity and are usually well sorted. These properties are characteristic of a mature to supermature sandstone (Folk 1968, pp.102-105). Fine laminations are visible in thin sections and are produced by slight grain size variations. Extinction of the quartz is moderately undulose to straight. The cement consists of finely crystalline dolomite but in most cases the cement is weak and the sandstone is very friable. Trough and festoon cross-bedding, usually less than 2ft. (60cm.) in height, are characteristic sedimentary structures. Transport directions from these cross-beds indicate both easterly and westerly components. This sandstone was deposited during the early phase of the transgression across the Boothia Arch, probably as small sand bars.

The second type of sandstone, from locality A, Prince of Wales Island, has different petrographic properties (Pl. 5, fig. 3). The quartz grains vary from fine to coarse sand-size although medium sand-sized grains are predominant. Quartz pebbles are present locally in some of the lower

sandstone beds. This range in grain size results in a poorly sorted sandstone. The quartz grains are mostly single crystals, angular to sub-rounded with moderate sphericity. Extinction is moderately undulose to straight.

These petrographic properties are typical of a submature sandstone (Folk 1968, pp.102-104).

Macro-sedimentary structures are not common although a few symmetric ripples were observed on some bedding surfaces. However, in thin section irregular bedding is defined by grain size variations and these microscopic bedding units occur as thin laminae, lenses or stringers. The sandstone beds are members of a sandstone-dolostone cyclothemic sequence to be discussed in the following chapter.

Sandstone also occurs in the section at locality B but it usually has a high dolomite content. Similarly on Somerset Island dolomitic sandstone and sandy dolostone are present and are genetically related either to the quartz sandstone or to the various dolostone types.

Discontinuity surfaces in member 2, Lang River Formation

Discontinuity surfaces of the type illustrated in Plate 1 are present throughout the biogenic dolostone and limestone of member 2 at locality 2. The illustrated example is located in the lowest 7ft. (2.1m.) of member 2. These features consist of a planar surface interrupted by channels, hollows and tunnels of a complex nature concentrated within 5cm. of the planar surface.

The discontinuity surface of figure 1, Plate 1 is shown in detail in figure 2, Plate 1 and was studied using thin sections and serial cuts from a hand specimen. The serial cuts showed a complex system of channels and tunnels which pinch and swell, twist and die out. The sediment must have been cohesive, perhaps even partially lithified before the tunnel system was formed in order to maintain such a complex system with thin overhanging ledges and partitions.

The example illustrated in Plate 1 occurs in finely crystalline dolostone. The dolostone contains undulose, anastomosing laminae defined by organic particles which are truncated at the tunnel margins. The tunnel margins and the planar discontinuity surface are usually well defined and are commonly outlined by a concentration of pyrite crystals at or near to the margins.

At least three phases of deposition are recognisable above the discontinuity surface in the illustrated example (Pl. 1, fig. 2). The initial phase filled most of the tunnels and partly filled the surface channels. This initial fill consists of finely crystalline dolostone containing 30-40% comminuted and unidentifiable fossil debris. Also present are circular structures (as seen in thin section) either as voids or containing clear, finely crystalline dolomite. The origin of these structures is uncertain but some may be remnants of crinoid ossicles. There are a few indications there may have been a minor initial infill prior to

the above which consisted of a thin layer of fine sediment at the bottom of some of the tunnels and channels.

The second phase of sedimentation filled in the remaining channels and covered the discontinuity surface to a depth of at least 2cm. This material also consists of finely crystalline dolomite but contains only 10-15% fossil debris. Also present are circular voids similar to those present in the first phase of sedimentation. Overlying this sediment type on a sharp but irregular erosion surface is the material of the third sedimentary phase consisting of finely crystalline dolomite with 30-40% fossil debris. The fossil fragments are generally impossible to identify although a small gastropod was present and other fossil debris may be gastropod or ostracode fragments.

These structures are very similar to discontinuity surfaces known as hardgrounds, which existed as hard submarine surfaces (see Bathurst 1971, pp.394-409 for a review of these structures). Hardgrounds are believed to form by submarine lithification, ".... during prolonged exposure of the sea floor to sea water when sedimentation is exceptionally slow" (Bathurst 1971, p:399). The tunnel system in hardgrounds is the result of burrowing and boring organisms and corrosion. The Lang River Formation examples commonly provided a suitable substrate on which colonial corals and lamellar stromatoporoids could grow.

Allen Bay Formation

Very finely to coarsely crystalline dolostone, V:D2-5

The finer crystalline dolostone is mostly of the planar- and cross-laminated types (Pl. 4, fig. 1) but the planar-laminated dolostone is by far the most common of the two. Evaporite mineral casts (gypsum/anhydrite, Pl. 10, fig. 1) rarely occur. Structureless, coarsely crystalline dolostone is also abundant and commonly contains molds of brachiopods or colonial corals.

Intraclastic dolostone, Vi:D2-4 (intraformational breccia)

Intraclastic dolostone is usually found in association with laminated dolostone and stromatolites but unlike the intraclastic dolostone of the Lang River Formation it does not contain detrital quartz. Also it is not as common a rock type as in the underlying formation.

Intraclastic pellet dolostone, Vi(p):D2-4

Dolomitisation of intraclastic pellet dolostone usually prevents identification in hand specimens and even in thin sections only a few ghost structures remain to indicate the original composition. (Pl. 3, fig. 3). The difficulty of recognising this rock type in hand specimen prevents any assessment of its relative abundance.

Biogenic dolostone, Vb:D3-5

Although not abundant, fossiliferous dolostone is present throughout the Allen Bay Formation. Usually this dolostone type is medium to coarsely crystalline and contains

poorly preserved fossils and fossil molds. The fossils are mostly colonial corals, lamellar stromatoporoids and brachiopod molds. On Prince of Wales Island a biogenic dolostone contains a halysitid-rich Upper Ordovician fauna, whereas at Lang River and Creswell Bay there are several biogenic dolostones containing Silurian faunas.

Stromatolite biolithite, IV:D2-3

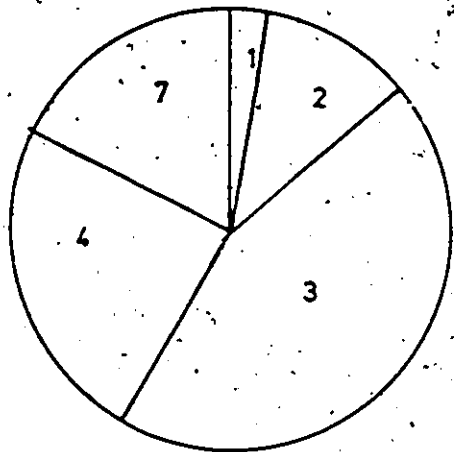
Stromatolite beds make up an important part of the Allen Bay Formation and consist mainly of the domal types (Pl. 10, fig. 2) or the cryptalgal type. Thrombolites are not known to occur in the Allen Bay Formation.

Features resembling birdseye structures are present in some of the cryptalgalaminated stromatolites (Pl. 11, fig. 1). Shinn (1968) suggested that bubble-like vugs are made by gas bubbles and that planar vugs are the result of shrinkage during desiccation. Figure 1, Plate 11, illustrates vugs possibly of the planar type. Shinn (op. cit.) also noted that birdseye structures are best preserved in supratidal and occasionally in intertidal sediments.

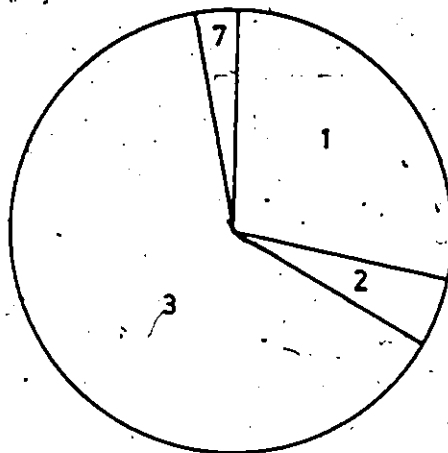
Sandstone

About 22ft. (6.7m.) above the base of section C, Prince of Wales Island, there is a 14ft. (4.3m.) thick sandstone unit in the Allen Bay Formation. This is the only sandstone known to occur in the Allen Bay Formation in the five sections containing this formation.

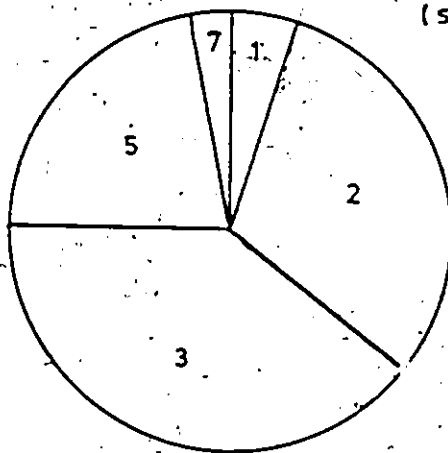
Most of the sandstone body consists of a poorly sorted quartz sandstone. The quartz grains are mostly single, well



Locality Z



Locality A
(sst. estimated)



Locality B

- 1 Sandstone
- 2 Fissile dolostone
- 3 Undifferentiated dolostone
- 4 Fossiliferous dolomitic timestone
- 5 Stromatolitic dolostone
- 7 Covered intervals

FIGURE 15 RELATIVE ABUNDANCE OF ROCK TYPES IN THE LANG RIVER FORMATION (based on measured sections)

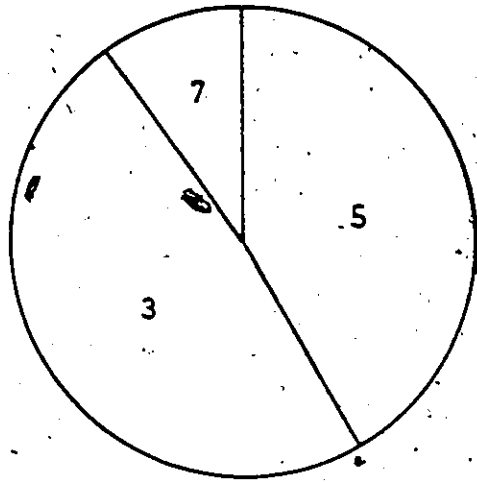
crystals, ranging from coarse silt-size to coarse sand-sized (60-65% fine to medium sand-sized, 30-35% silt-sized and less than 10% coarse sand. Extinction of the quartz is moderately undulose to straight. The properties of this sandstone suggest textural inversion (Folk 1968, p.105: ".... poorly sorted but well rounded grains") which may have resulted from mixing of sands within the depositional basin or perhaps from bioturbation. There are no signs to indicate the latter.

The top part of the sandstone body consists of a super-mature, medium-grained quartz sandstone. The quartz grains are well rounded and well sorted and are cemented by syntaxial rims of silica. Macro- and micro-sedimentary structures are absent.

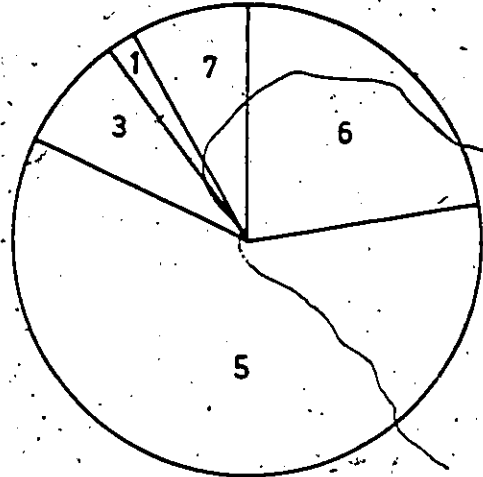
Petrological Summary

Figures 15 and 16 illustrate the relative abundance of broad lithological groups within the two formations and are based on the field data of each section. Undifferentiated dolostone and stromatolitic dolostone are the most common rock types. A qualitative assessment of the sections indicates that laminated and grain mosaic, structureless dolostone are the dominant rock types in the undifferentiated dolostone group.

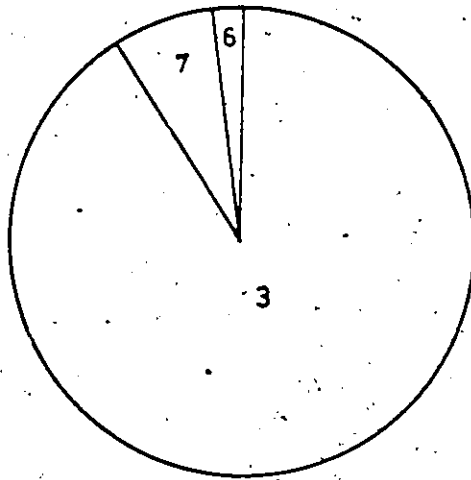
The presence of detrital material either as sandstone beds or as dispersed sand grains in the dolostone of the Lang River Formation helps to distinguish it from the Allen



Locality B



Locality C



Locality A

- 1 Sandstone
- 3 Undifferentiated dolostone
- 5 Stromatolitic dolostone
- 6 Fossiliferous dolostone
- 7 Covered intervals

FIGURE 16 RELATIVE ABUNDANCE OF ROCK TYPES IN THE ALLEN BAY FORMATION (based on measured sections)

Bay Formation. In addition fissile dolostone is apparently absent from the Allen Bay Formation.

IV DEPOSITIONAL ENVIRONMENTS AND SEDIMENTARY HISTORY

Introduction

Prince of Wales and Somerset Islands lie within the Arctic Lowlands, an area containing Proterozoic to Devonian shallow water, epicontinental sedimentary rocks (Dineley 1971). The Arctic Lowlands are divided into sedimentary basins by several tectonic arches of which the Boothia Arch is one. The Boothia Arch separates two sedimentary basins, the Jones-Lancaster to the east and the Victoria to the west.

Kerr and Christie (1965) and Brown et al. (1969) discussed the influence of the Boothia Arch on sedimentation. Three movements have directly affected sedimentation. The first movement of the Arch preceded the deposition of the Aston and Hunting Formations. The second was a gentle uplift resulting in a regression after the deposition of the Hunting Formation, (late Proterozoic or ?early Cambrian). This was followed by a transgression and sedimentation continued until Devonian times when further uplift occurred. Compared to the earlier tectonic activity the Devonian movements were much more intense and resulted in the deposition of the syn-tectonic Peel Sound Formation, a succession of terrestrial red beds (Miall 1970).

The first sediments deposited adjacent to the Arch were the late Proterozoic Aston and Hunting Formations.

On Somerset Island these formations outcrop only in the vicinity of Aston Bay. The Aston Formation is also present in fault blocks along the western margin of the Arch on Prince of Wales Island (Dixon et al. 1971).

The Aston Formation consists mostly of detrital material derived from the erosion of the Boothia Arch. Also present are dolostone and shale. The succeeding Hunting Formation is predominantly carbonate and the change to carbonate deposition reflects the denudation and subsequent decreased sediment supply from the Arch. The Aston and Hunting Formations were deposited in a shallow marine environment (Tuke et al. 1966, pp.707-708; Dixon et al. 1971, pp.739-741).

Unconformably overlying the Hunting Formation and overstepping on to the Precambrian basement is the predominantly carbonate succession of the Lang River, Allen Bay, Young Bay and Read Bay Formations. Only on Somerset Island is there a complete sequence above the Hunting Formation; on Prince of Wales Island the Lang River Formation and younger formations are faulted against either the Aston Formation or basement rocks.

Although the rocks under discussion occur in two sedimentary basins, the rock types and sedimentary history are similar. For the purposes of discussion the Somerset Island succession will be used to relate the events and general conclusions, with special reference to the Lang River section.

Somerset Island

The post-Hunting regression and period of erosion was followed by a transgression and deposition of a supermature sandstone above the unconformity. Otherwise the lower part of the Lang River Formation contains little detrital material. This scarcity of detrital sediment probably reflects the low topography of the source area even though there had been some uplift prior to the deposition of the Lang River Formation. The basal sandstone apparently blankets the unconformity, at least from Hunting River to Lang River and the unconformity was probably a relatively planar, gently sloping surface. The sedimentary structures of the sandstone suggest deposition by migration of small sand bars or sand waves with superimposed cut-and-fill channels. Sediment transport directions obtained from the cross-beds indicate movement in both easterly and westerly directions perpendicular to the trend of the Boothia Arch. The quartz grains in the basal sandstone were probably derived from the metamorphic terrain of the Arch and possibly some by the reworking of the Aston and Hunting Formations.

Above the basal sandstone of the Lang River Formation, the remaining succession characteristically consists of repeatedly alternating dolostone types and a few beds of detrital sediment. As the rocks of the Arch were worn down the supply of detrital sediment decreased and carbonate deposition became dominant. Occurring with the carbonates

are only minor amounts of detrital sediment usually dispersed through the carbonate beds.

The carbonates consist mostly of planar- and cross-laminated dolostone, stromatolite biolithite, intraformational breccia and fissile dolostone. These rock types and associated sedimentary structures are comparable to the modern carbonate deposits of the Bahama Bank (Purdy 1963; Irwin, 1965) especially those of Andros Island (Shinn, Lloyd and Ginsburg 1969). Similar depositional environments have been recognised in the stratigraphic record elsewhere in North America (Bluck 1965; Laporte 1967; Matter 1967; Braun and Friedman 1969).

Fissile dolostone was probably deposited in lagoons or sheltered embayments of tidal flats as carbonate mud. Interbedded intraformational breccia and conglomerate beds suggest that periodic storms or strong tidal activity breached the lagoon barriers and deposited thin layers of clasts. Locally some of the fissile dolostone beds grade upwards into cross- or planar-laminated dolostone which could represent a gradual filling of the lagoon or tidal flat pond until the sediments were brought into the influence of wave activity.

Extensive subtidal deposits are uncommon in the lower part of the Lang River Formation (fig. 17). However, some of the structureless dolostone may have been subtidal carbonate sands, such as the Lower Ordovician, fossil-bearing,

FIG. 17B

Fm.		Dominant rock types	sub-tidal	inter-tidal	supra-tidal
PRINCE OF WALES ISLAND	YOUNG BAY	Interbedded: fossiliferous lst. planar- & X-laminated dol. stromatolitic dol.	[shaded area]	[shaded area]	[shaded area]
	ALLEN BAY	Interbedded: planar- & X-laminated dol. fossiliferous dol. stromatolitic dol.			

FIG. 17A

SOMERSET ISLAND	LANG RIVER	fossiliferous lst. & dol. Interbedded: planar- & X-laminated dol. fissile dol. intraformational breccia	[shaded area]	[shaded area]	[shaded area]
	LANG	stromatolitic dol. sandy dol. sandstone			
PRECAMBRIAN					

FIGURE 17 DIAGRAMMATIC REPRESENTATION OF THE SPECTRA OF DEPOSITIONAL ENVIRONMENTS IN THE LANG RIVER, ALLEN BAY & YOUNG BAY FORMATIONS

massive dolostone at Creswell Bay. Pellets, grapestone intraclasts and shell fragments are commonly mixed in one rock unit or occur as components of intraformational breccia; both resulted from the mixing of subtidal and intertidal sediments. Thus, although some of the sedimentary particles originated in shallow subtidal environments, their occurrence in the Lang River Formation suggests they were deposited in the intertidal zone as wave-accumulated deposits. Oolite deposits are of the turbulent water type deposited in shallow water shoal areas.

Thus in the lower part of the Lang River Formation, after the initial transgression, shallow subtidal to supratidal deposits accumulated on a tidal flat complex (fig. 17). The repeatedly alternating facies may be accounted for by an unstable, laterally migrating shoreline (Laporte and Imbrie 1964). A tidal flat may have a very low gradient and any eustatic changes, or basin subsidence, or carbonate build-up would cause the shoreline to shift, resulting in widespread changes of facies distribution (Laporte 1971). Energy levels appear to have been normal for the environment suggested and only during periods of storm activity exceeded the level required to build ripples.

On Somerset Island the upper part of the Lang River Formation (member 2 at Lang River) is predominantly subtidal fossiliferous limestone and dolostone. This unit was apparently widespread along the western margin of the Jones-Lancaster Basin as shown by the occurrence of equivalent

strata at all three Somerset Island localities. The change from intertidal to subtidal deposition is best seen at Lang River where intertidal planar- and cross-laminated dolostone and intraformational breccia are abruptly overlain by calcareous biogenic dolostone (Pl. 1, fig. 1). At Hunting River and Creswell Bay the transition into the fossiliferous strata is covered by drift or talus. Equivalent strata are present at all three localities and it is assumed similar conditions prevailed.

The fauna of the fossiliferous carbonates indicates a normal marine environment occupying at least the flanks of the Boothia Arch during the Upper Ordovician. The abundant fauna is dominated by colonial corals, stromatoporoids and cephalopods; the first two commonly occur in their original growth positions. Trilobite and brachiopod remains are usually restricted to thin beds containing only their remains. This was especially noted at Creswell Bay where there are several horizons rich in trilobite fragments and at Lang River where several beds contain only *Plectorthis inaequiconvexa*. Other organisms present are gastropods, bryozoans, solitary corals and *Receptaculites*.

At Creswell Bay the fossiliferous beds grade upwards into barren dolostone of the Allen Bay Formation but at Lang River vertical and lateral facies changes are more complex (fig. 5). The dolomitic limestone is apparently continuous down-dip but the overlying beds shown lateral

facies changes. In the western part of the exposure of member 2, gradationally overlying the dolomitic limestone, is a buff-coloured fossiliferous dolostone (fig. 5). This dolostone contains a very distinctive fauna of columnar stromatoporoids (*Aulacera* spp.) associated with less abundant colonial corals, notably *Catenipora* spp., embedded in a finely crystalline dolomite. Down-dip this dolostone grades laterally into a barren, mediumly bedded dolostone which in turn passes laterally into the transition beds.

The lower fauna consists of a diverse normal marine assemblage of sessile benthonic and pelagic species whereas the less diverse upper fauna appears to have existed in more restricting conditions. The upper fauna consists almost entirely of *Aulacera undulata* and long, smooth and slender species of *Aulacera*. These columnar stromatoporoids attain heights of at least 18ins. (45cm.) but do not occur in their growth positions. In some instances clusters of smooth, slender *Aulacera* species lie parallel to the bedding planes with their long axes parallel to the trend of the Boothia Arch. This type of alignment has been produced experimentally where closely packed rods became oriented with their longest axes perpendicular to the current direction (Nagle 1967). Also present in this fossiliferous dolostone are 2-4ins. (5-10cm.) thick beds of stromatoporoid debris, probably deposited during storms.

The environment occupied by the columnar stromatoporoids was apparently unfavourable for the establishment of a normal

and diverse marine biota. Perhaps the substrate was muddy and only the columnar stromatoporoids could keep above the loose sediment-water interface. However, the presence of some colonial corals does indicate that the environment was not totally devoid of other sessile organisms. This may indicate that the generally unfavourable conditions were perhaps related to sea-water chemistry rather than to a muddy substrate.

The fossiliferous dolostone grades laterally into a fine-grained, barren dolostone. Sedimentary structures are absent, possibly destroyed by dolomitisation, and this barren dolostone is interpreted as being originally carbonate mud. It is tentatively suggested that the fossiliferous and barren dolostone were deposited in a lagoon with limited water circulation. In this lagoon the stromatoporoids and local corals grew where there was some circulation of sea water with normal salinities. The barren dolostone was probably deposited in very calm conditions in which slightly higher salinities of the sea water and muddy substrate prevented the establishment of an epifauna.

The subtidal conditions prevalent during the deposition of the upper part of the Lang River Formation were gradually succeeded by a more restricted environment in which the Allen Bay Formation was deposited (fig. 17). Tidal flat conditions returned and the general environmental framework envisaged for the underlying Lang River Formation

was repeated. Subtidal incursions are represented by fossiliferous beds containing a fauna ecologically comparable to that of the fossiliferous carbonates in the upper part of the Lang River Formation. The succession in fault block B, Creswell Bay (see fig. 6 for fossil locality), contains a fossiliferous bed consisting mainly of a lamellar stromatoporeid, *Actinostroma* sp., associated with *Halysites labyrinthicus* and a few brachiopods and bryozoans. *Actinostroma* forms a laterally extensive framework on which the other faunal elements are attached. This type of growth is biostromal in character.

Much of the Allen Bay Formation dolostone is planar-laminated dolostone or stromatolite biolithite. These rock types indicate a predominance of sedimentation in the intertidal zone (Laporte 1967). Supratidal deposits (Pl. 11, fig. 1) do not appear to make up much of the total carbonate sediment. Evidence of extensive subaerial exposure is lacking and only local examples of mudcracks and evaporite mineral casts (gypsum/anhydrite) were present (Pl. 10, fig. 1).

Silt- and sand-sized detrital material is not known in the Allen Bay Formation on Somerset Island. From this it can be concluded that the Boothia Arch was completely covered by carbonate sediments, or remained as a low-lying peninsula, or consisted of a few low-lying islands (Brown et al. 1969, fig. 9). Sedimentary structures indicate that energy levels of transportation and deposition rarely exceeded those

required to produce ripple forms or minor erosion. This is further supported by the infrequency of intraformational breccia beds within the Allen Bay Formation. An areally extensive tidal flat complex such as that envisaged for the deposition of the Allen Bay Formation could have such a low gradient that the energy of any storm waves or tidal flow would soon be dissipated as they moved across the tidal flat. Thus although the Lang River and Allen Bay Formations were deposited in similar environments the variability of rock types and the greater abundance of intraformational breccia and conglomerate beds indicates that energy levels or basin (tectonic) stability were more variable during the deposition of the Lang River Formation.

A further difference in the Allen Bay Formation is the presence of grain mosaic dolostone containing fossil molds or dolomite-replaced fossils; this is especially common at Creswell Bay. Such rock units are usually no greater than a few feet (1.0-1.5m.) thick and may contain brachiopods (notably *Conchidium* sp.), or small *Favosites* colonies (5-10cm. in diameter), or molds of a phaceloid coral. These dolostone beds represent short phases of subtidal deposition. In the succession of fault block G, Creswell Bay, some of these beds pass laterally into planar-laminated or stromatolitic dolostone. These rocks from fault block G were probably deposited in a tidal pool or channel and the laminated dolostone in the intertidal zone. In Florida Bay,

channels between the small low islands may contain less than 10cm. of water towards their margins at low tide (personal observation). The fauna within these channels, in part, consists of small colonial corals resting upon a muddy carbonate sand substrate. Within 300ft. (92m.) of the channel supratidal algal mats occur, often separated from the channel by mangrove plants in the intertidal zone. A situation comparable to the Florida Bay example, without the mangroves, may account for the fossil-bearing dolostone of fault block G, Creswell Bay, in which small domal stromatolites may have occupied the intertidal zone.

Overlying the Allen Bay Formation is the dolostone and limestone of the Young Bay Formation. Cross- and planar-laminated dolostone is abundant in the lower part of this formation but towards the top, fossil-bearing limestone beds are intercalated. Also present in notable abundance are stromatolite beds. Thus a similar tidal flat environment is suggested but with increasing subtidal marine incursions in the upper part of the formation (fig. 17).

The rapid vertical alternation of rock types in the Young Bay Formation produces thin-to medium-sized beds (1-12ins., 3-30cm.) which tend to make this formation weather recessively. The Young Bay Formation represents a transitional phase between the dominantly intertidal sedimentation of the Allen Bay Formation and the dominantly subtidal sedimentation of the Read Bay Formation.

Prince of Wales Island

The general sequence of events and environmental conditions suggested for Somerset Island can be recognised on Prince of Wales Island with only minor and local differences. The restricted faunal evidence suggests that the timing of the major sedimentary events was also comparable. One important difference is the absence of comparable fossiliferous limestone strata in the Lang River Formation on Prince of Wales Island.

The basal unconformity is not exposed on Prince of Wales Island but the lowest beds of the Lang River Formation contain much detrital sediment and repeatedly alternating rock types, and by comparison to the Somerset Island succession these lowermost beds are thought to be stratigraphically near the unconformity. The detrital sediment content decreases upward and carbonate rocks predominate in the upper part of the Lang River Formation and in the entire Allen Bay Formation.

Although the Lang River Formation contains similar rock types on both islands the sequence differs quite considerably. The two sections containing the Lang River Formation on Prince of Wales Island also differ from each other. At locality A, Savage Point, sandstone and dolostone beds in the lower part of the formation are arranged cyclothemically and at locality B, Strzelecki Harbour, stromatolite-rich dolostone beds alternate with at least

ten fissile dolostone units.

The cyclothems at locality A are interpreted as repeated transgressive sequences (Pettijohn 1957, p.611) with each basal sandstone member representing a beach sand deposited high in the intertidal zone. The overlying dolostone member was deposited in the intertidal to shallow subtidal zones. This may be a grain mosaic or laminated dolostone and some contain ghost structures possibly biogenic in origin. The laminations may be either algal or sedimentary and it is often difficult to distinguish between the two. Each cycle is apparently sharply overlain by the succeeding dolostone.

One of the major problems in the interpretation of the cyclothems is the lack of information concerning their lateral distribution. Beyond the well-exposed river valley, glacial drift and talus deposits cover most of the bedrock. However, the absence of similar cyclothems at Strzelecki Harbour suggests a local distribution. Three factors may have influenced the formation of the cyclothems: firstly eustatic sea level changes; secondly a migrating strand line due either to sea level changes or to basin subsidence; and thirdly a variable supply of detrital sediment. If the shale-dolostone cyclothems at locality B were deposited at approximately the same time it seems probable that the factors causing cyclicity were operative along the length of the eastern margin of the Victoria Basin. In this case basin subsidence was probably the dominant factor but whether the

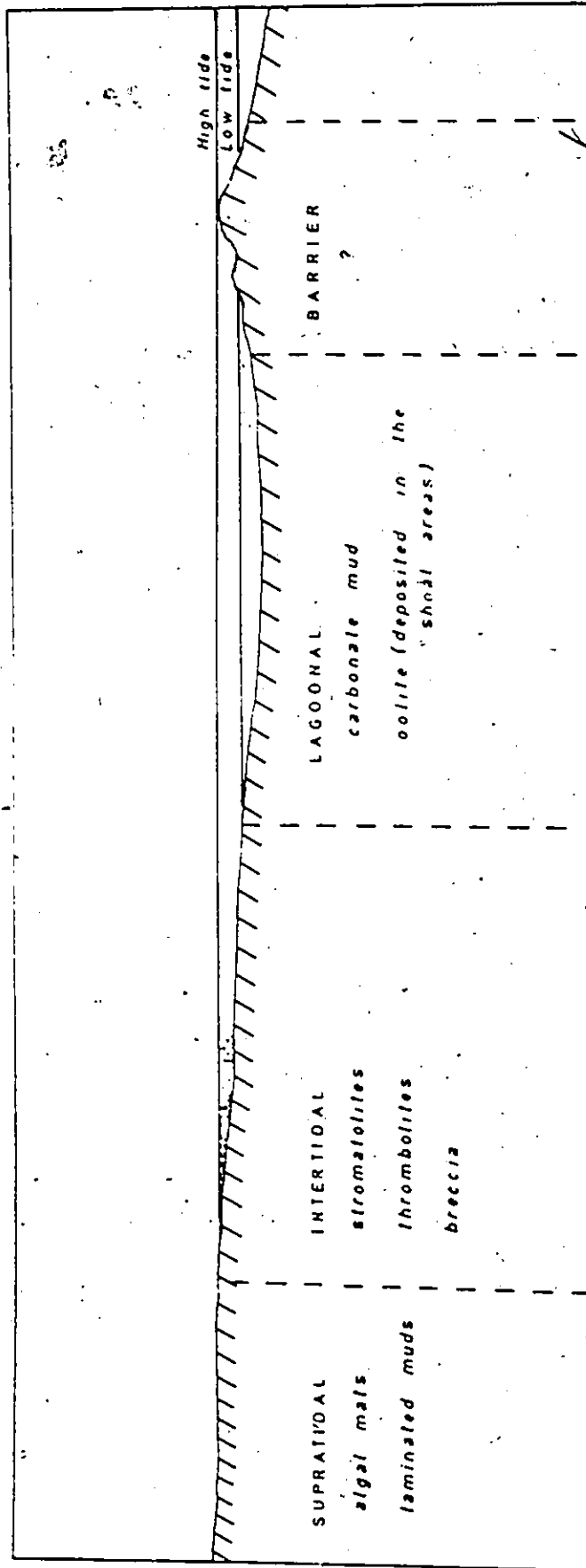


FIGURE 18 DIAGRAMMATIC DISTRIBUTION OF LAGOONAL AND ASSOCIATED CARBONATES.

subsidence was tectonic or due to sediment loading is not obvious. However, local factors such as the supply of detrital sediment also seem to have been operative which would account for the two different types of cyclothem. Probably no single factor controlled the cyclic sedimentation but rather a combination of factors in a subsiding sedimentary basin with local variations in sedimentation and strand line migration.

The fissile dolostone beds at locality B were probably deposited in a relatively calm water environment, such as a lagoon, or sheltered embayment but were subject to occasional periods of greater water turbulence during which intraformational breccia and oolite beds were deposited. Seaward of the lagoon there may have existed a barrier of indeterminate nature. An X-ray diffraction pattern obtained from a sample of a fissile dolostone gave a composition of dolomite and minor amounts of quartz. The quartz may be wind-borne material. Illing et al. (1965) have shown that substantial amounts of quartz of this grain size may be incorporated in carbonate sediments in the Persian Gulf.

A model proposed for the environment of deposition is illustrated in figure 18. In this reconstruction the stromatolites are restricted to the intertidal and supratidal zones and the mode of growth is related to their relative positions in these littoral zones (Logan et al. 1964). Some of the planar-laminated dolostone beds may be supratidal storm deposits (Ball et al. 1967) and contain cryptogalaminated stromatolites. Under suitable conditions the stromatolites

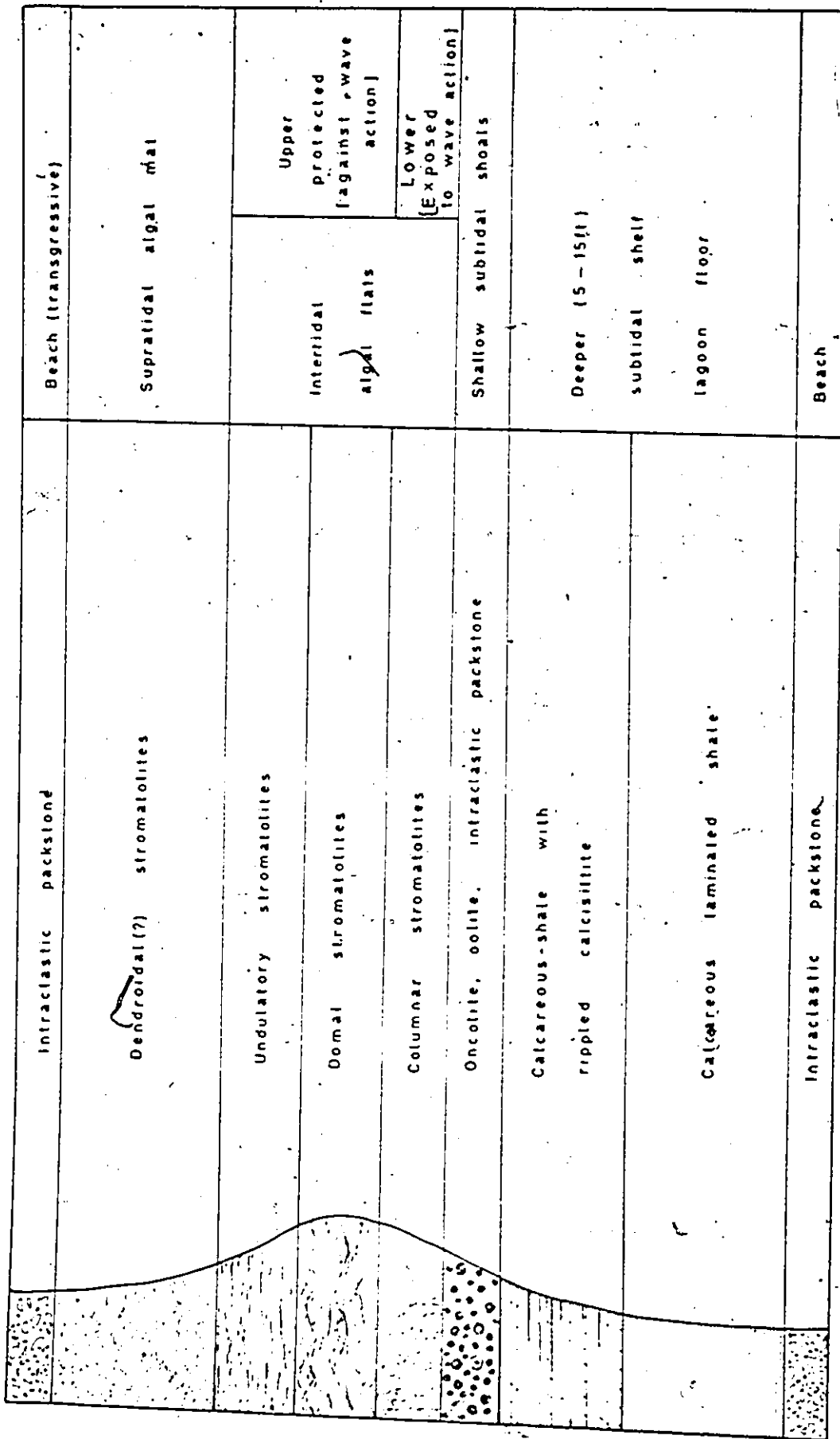


FIGURE 19 CYCLIC, SHOALING UPWARDS, CARBONATE SHELF, SEDIMENTATION (Hoffman 1970, Eastern Canada Biostratigraphy Conference, Sudbury)

would tend to advance over the lagoonal deposits accumulating in time and space as an essentially horizontal, lenticular body. A critical point would be reached at which lateral growth would cease due either to increased water depth or to wave erosion of the leading edge becoming greater than lateral growth.

If the overburden of the stromatolitic carbonates on the underlying lagoonal muds caused compaction, subsidence would ensue and the stromatolites would be flooded and lagoonal conditions would return. This process would be repeated and a cyclic arrangement of carbonate-shale and stromatolite-rich carbonate would result similar to those present at Strzelecki Harbour. Such a model is necessarily simple and the variety of rock types present, especially in the resistant dolostone beds, probably reflects local environmental differences or variable energy levels of deposition.

The above model is based on an idea presented to the Ottawa University Geology Department (1970) and the 1970 Eastern Canada Biostratigraphy Conference at Sudbury by Dr. P.F. Hoffman (fig. 19). Comparison of figures 13 and 19 show a close similarity, although details of the sequence of stromatolites are not accurately known from Strzelecki Harbour.

Cyclic sedimentation at locality B was terminated by an influx of detrital sediment. At locality A the cyclothemetic sedimentation was gradually succeeded by carbonate

deposition in the intertidal and subtidal zones with the reduction in the supply of detrital sediment from the Boothia Arch.

The Allen Bay Formation contains almost identical rock types on both islands and therefore similar environmental conditions must have been widespread during this time (Upper Ordovician to Middle Silurian). Similarly the Young Bay Formation has comparable rock types on both islands although the formation tends to be thicker on Somerset Island.

Discussion

The Lang River and Allen Bay Formations apparently have their closest modern counterpart in the Bahama Bank (Purdy 1963), in particular the tidal flat of western Andros Island (Shinn et al. 1969). The absence of extensive mudcracking and evaporite mineral casts seems to indicate a humid climate similar to that of the Bahamas and not a dry hot climate as exists in the Persian Gulf. Furthermore, no unmistakably sebkha-type sediments (Wood and Wolfe 1969) have been recognised in either the Lang River or Allen Bay Formations. Cumming (1971, fig. 4) inferred that the two islands were positioned in an Upper Ordovician 'northern temperate moist climatic zone'. The climatic zones of Cumming (op. cit., fig. 5, p.196) were based on the positioning of the Ordovician equator by Strakov (1967, p.231) and Fell (1968). The Ordovician equator was positioned by studying the distribution

of red beds, gypsum and Ordovician faunas. This led Strakov (1967) and Fell (1968) to place the Ordovician equator parallel to the eastern coastline of North America. Paleomagnetic data has suggested that the Ordovician equator passed through Hudson Bay in a northeasterly direction, which would position Prince of Wales and Somerset Islands in tropical or subtropical zones (Hood et al. 1968). Troedsson (1928, p.187), Flower (1946, p.126) and Nelson (1959a) considered the 'arctic' Ordovician fauna to be a tropical or equatorial assemblage. At the present state of knowledge either of the paleoequators may be correct although it is safe to assume the Ordovician paleoequator did pass through this general area of North America. The abundant and diverse fauna and the extensive carbonate deposition would suggest that the 'arctic' fauna lived in tropical or subtropical seas and perhaps may have extended to warm temperate seas.

Apart from the work of Trettin (1965, 1969) there are few detailed sedimentological accounts of Lower Paleozoic rocks from the Arctic Lowlands. This prevents any detailed regional sedimentological comparisons. Trettin (1965, 1969) described a mostly carbonate succession of Lower Paleozoic strata deposited in the Admiralty Basin on north-western Baffin Island. His lithological descriptions and sedimentological conclusions indicate sedimentary environments similar to those represented by the Lang River, Allen Bay and Young Bay Formations. Furthermore, the Cambrian beds

(the Admiralty Group), rich in detrital sediments, are succeeded by a dolostone succession and finally a limestone sequence which is essentially similar to the overall successions on Prince of Wales and Somerset Islands.

On the other islands of the Arctic Lowlands only general stratigraphic and lithological descriptions are available. Banks, Victoria and Stefansson Islands have similar sequences of rock types (Thorsteinsson and Tozer 1962). Cornwallis Island also has comparable strata but being closer to the Franklin Geosyncline the succession is considerably thicker (Thorsteinsson and Kerr 1967). Fortier et al. (1963, p.44) listed the known occurrences of the Allen Bay Formation, which extends to Devon and southern Ellesmere Islands. In many of these locations the general lithology of the Lower Paleozoic successions is very similar to that of Somerset and Prince of Wales Islands.

From the distribution of the Lower Paleozoic strata it is evident that shallow marine environments were widespread in local basins of deposition. The configuration of these basins was controlled by Precambrian tectonic arches and the proximity to the Franklinian Geosyncline. Although distinct sedimentary basins were present they were not isolated, as the faunal elements show a strong degree of similarity, notably the Ordovician 'arctic' fauna and the Silurian fauna.

V. POST-DEPOSITIONAL CHANGES

Introduction

The Lang River and Allen Bay Formations have undergone considerable change subsequent to deposition and to avoid the semantics of diagenesis all these changes are grouped together as post-depositional phenomena. Where possible the relative timing of the changes will be discussed. The most important and widespread post-depositional change is undoubtedly dolomitisation; the other changes to be described are of lesser importance and many are only of local significance. Most of the post-depositional changes discussed are on a macro-scale and microscopic textural changes were not studied in detail.

Dolomitisation and Calcification

Approximately 90% of the Lang River and Allen Bay Formations is dolostone. One of the significant features of this dolostone is the generally good preservation of sedimentary structures in the finer grained varieties. In some cases even dolomitised fossils are well preserved, although more commonly fossils are poorly preserved. In those dolostones with good preservation of sedimentary structures and fossils the grain size rarely exceeds finely crystalline (0.06mm.) whereas the dolostone with larger grain size usually does not retain much of its original texture. It appears that the original grain size has controlled to some

extent the effects of dolomitisation and the grain size of the dolomite crystals. Penecontemporaneous dolomitisation, for example, usually occurs in fine grained carbonates and may retain details of the primary sedimentary structures. The grain size of coarser dolostone probably reflects original grain size but it is also possible that it may originate by recrystallisation and/or grain growth from a finer grained dolostone. The latter origin may not be easy to distinguish.

There are three main problems concerning dolomitisation which need to be reviewed, namely:

- i) the relative timing of the dolomitisation,
- ii) the derivation of the magnesium,
- iii) the extent of the dolomitisation.

All three problems are inter-related and will be discussed as such. To attempt any explanation of these problems it is necessary to consider modern environments in which dolomite occurs.

At least four major occurrences of Recent dolomite in marine environments have been reported: the Persian Gulf (Illing et al. 1965); Andros Island, Bahamas (Shinn et al. 1965); Florida (Shinn 1964) and Bonaire Island (Deffeyes et al. 1965; Murray 1969). Two other occurrences are worthy of note, one in South Australia (Alderman 1965; Skinner 1963) and the other at Deep Spring Lake, California (Peterson et al. 1963; 1966). Although the last two occurrences are not

marine they have added considerable understanding to the problem of dolomite formation and dolomitisation. Excellent reviews of the dolomite problem are to be found in Friedman and Saunders (1967) and Bathurst (1971) and rather than repeat what these authors have done so adequately this report will only consider points relevant to the present problem.

All of the modern dolomite occurrences have one common requirement, the enrichment of Mg^{2+} relative to Ca^{2+} in the water. In the Bahamas, Florida and the Persian Gulf the precipitation of $CaSO_4$ apparently is required before the Mg^{2+}/Ca^{2+} ratio is increased. Gypsum and anhydrite crystals are abundant in the dolomite-forming areas of the Persian Gulf but the absence of this association in the Bahamas and Florida has been attributed to solution of the gypsum/anhydrite by rain water. Two additional common features of these areas are the non-ideal composition of the dolomite and the disordered crystal lattice structure. The dolomite of these areas has been termed protodolomite (Graf and Goldschmidt 1956; Bathurst 1971, p.238) or calcian dolomite. Finally, the majority of the Recent marine dolomite occurrences are in supratidal sediments where intense evaporation encourages precipitation and increases the Mg^{2+}/Ca^{2+} ratio in the sea water.

The interpretation of the depositional environments of the Lang River and Allen Bay Formations includes some supra-

tidal deposition. Therefore, there is some comparison with modern dolomite-forming environments, and penecontemporaneous dolomitisation could account for some of the dolomite in these two formations. However, many of the deposits are intertidal or shallow subtidal in origin and dolomite precipitation and/or penecontemporaneous replacement is not known to occur readily in these environments. A later diagenetic dolomitisation caused by the redistribution of Mg^{2+} by percolating solutions is advocated for the origin of the majority of the dolostone present in the Lang River and Allen Bay Formations. The original sediments were probably already enriched in Mg^{2+} , especially those of the supratidal and high intertidal zones. There is some evidence to suggest that algal stromatolites may enrich the sediment in Mg^{2+} by aiding the precipitation of high-magnesian calcite (Monty 1967, pp.73-76; Bathurst 1971, pp.225-226). It has also been suggested that algae may directly aid the precipitation of dolomite (Gebelein and Hoffman 1969).

The majority of the carbonates are completely dolomitised with the exception of the Upper Ordovician fossiliferous strata of the Lang River Formation, in which dolomitisation affected only parts of the rock. Generally the fossils remained calcitic and the original micritic matrix was replaced by dolomite. Murray and Lucia (1967) noted that in a sequence of carbonate mud and sand the former is preferentially dolomitised. This observation may be applicable

to the fossiliferous rocks in which the finer micrite is preferentially dolomitised.

The fact that the fossiliferous strata have been only partly dolomitised may have some bearing on the nature of the dolomitisation. It could possibly indicate that some of the processes of dolomitisation may have been operable only within a restricted vertical and lateral distance. Thus because the fossiliferous sediment probably was not rich in Mg^{2+} the dolomitisation processes were not complete within these beds. However, there are completely dolomitised fossiliferous beds, especially in the Allen Bay Formation, which attest to the widespread redistribution of Mg^{2+} .

Calcite was detected by staining with Alizarin Red S solution. There were only very few instances in which secondary calcite was present and these were usually in the red intraformational conglomerate beds of the Lang River Formation. The calcite occurs as patches or isolated clear rhombic crystals. The calcite was observed to have replaced the dolomite of the intraclasts and also the dolomite cement.

Silicification

Chert nodules are abundant throughout the Lang River and Allen Bay Formations. Apparently the occurrence of chert is not restricted to any particular type of

dolostone. Three morphologic types of chert nodule can be distinguished, namely:

- i) disc-shaped nodules, usually less than 50cm. in diameter,
- ii) laterally extensive nodules and tabular sheets,
- iii) branching vermiform nodules.

Branching vermiform nodules were seen only in the massive dolostone of the Lang River Formation at localities X and Z (Pl. 11, fig. 2). These nodules rarely exceeded 2cm. in diameter and occurred only on bedding planes. They usually covered a large area of the bedding plane and were cindery in appearance when weathered.

Silicification of fossils is also common, especially in parts of the Allen Bay Formation, and the fossils are usually poorly preserved. In some instances silicified fossils are present without chert nodules occurring in the same bed.

At locality B disc-shaped chert nodules are very common in the dolostone-shale sequence and one particular occurrence in an oolite bed was useful for determining the relative timing of the silicification. The chert had preserved the oolites and at the margins of the nodule incompletely enclosed oolites were part silica and part dolomite. Residual dolomite was detected in some of the silicified oolites indicating that silicification occurred after dolomitisation. Although this example is only a local occurrence it is considered that most of the silicification took place after

dolomitisation.

Patterned Dolostone

The name "patterned dolostone" is coined for this diagenetic feature as no other similar feature is known to the author. Plates 12 and 13 illustrate the appearance of patterned dolostone - a complex association of light and dark coloured areas in dolomite beds.

It is known to occur at three localities on Prince of Wales and Somerset Islands, two of which are in the Young Bay Formation. The patterned dolostone is present in the Lang River Formation at locality Z (Pl. 12, fig. 3), 369ft. (112.5m.) above the base of the section. Other examples occur in the Young Bay Formation at locality A (Pl. 12, figs. 1, 2; Pl. 13, figs. 1, 2) and locality B. Samples from localities A and Z were examined in detail.

At locality Z (Lang River) the patterned dolostone occurs in a 1ft. (30.5cm.) thick bed overlain and underlain by laminated dolostone. The Young Bay Formation examples are similarly associated with laminated dolostone. Other rock types stratigraphically near are stromatolite and intraformational breccia beds.

The figures illustrate the variability of intensity and magnitude of the patterning and they also indicate a degree of parallelism of the patterning and the sedimentary laminations. The sample from locality Z (Pl. 12, fig. 3)

has a much coarser pattern than those from locality A.

All three samples consist of very finely to finely crystalline dolomite (0.004-0.06mm.) and the two Young Bay Formation samples also contain 5 to 10% detrital quartz. X-ray diffraction and X-ray powder photographs of the Young Bay Formation samples failed to reveal any other minerals in significant quantities. No more than 5% of small pyrite crystals are also present.

Sedimentary structures include planar-laminations with minor truncations (Pl. 13, fig. 2), although the laminae of one of the specimens from locality A were slightly disrupted (Pl. 12, fig. 2). Laminations in the sample from locality Z were obscure. Although samples from only two sites were obtained, field examination of the occurrence at locality B indicated an almost identical rock type to those collected from locality A.

The pattern is most obvious in hand specimens but scarcely distinguishable in thin sections. There were no detectable grain size differences within each sample and no significant differences between samples, and consequently the patterning could not be attributed to grain size variation. Two of the samples (TB-10 and Z27) showed a greater concentration of pyrite in the darker dolomite areas but this was not apparent in the third sample (TB-9). A brownish stain on the naturally weathered surface of sample Z27 reflects the varied concentration of iron. This stain is

much darker in the areas of the darker dolomite which suggests a greater concentration of iron in these areas.

Polished and etched surfaces were examined at low power with a binocular microscope. This verified previous observations and also showed that the light-coloured zones contained a milky coloured dolomite, whereas the dark zones contained a greater proportion of grey, transparent dolomite.

Staining of etched surfaces with an acidified solution of potassium ferricyanide (Friedman 1959; Dickson 1965) provided little conclusive evidence. However, where successful, the stain indicated that ferroan dolomite was the only carbonate mineral present. This method does not detect subtle differences of the Fe^{3+} content in the ferroan dolomite which in this case may have been significant. The fact that iron in the form of pyrite is concentrated in the darker areas may reflect the concentration and distribution of Fe^{3+} in the dolomite. However, with the study methods available, this task is beyond the scope of the present study although this approach may well prove useful in any further study.

Within the limits of the methods used, the following facts are apparent:

- i) the patterned dolostone is diagenetic in origin and the fact that the patterning is superimposed upon the dolomite suggests that the patterning developed after dolomitisation,
- ii) this feature is apparently limited to fine-grained

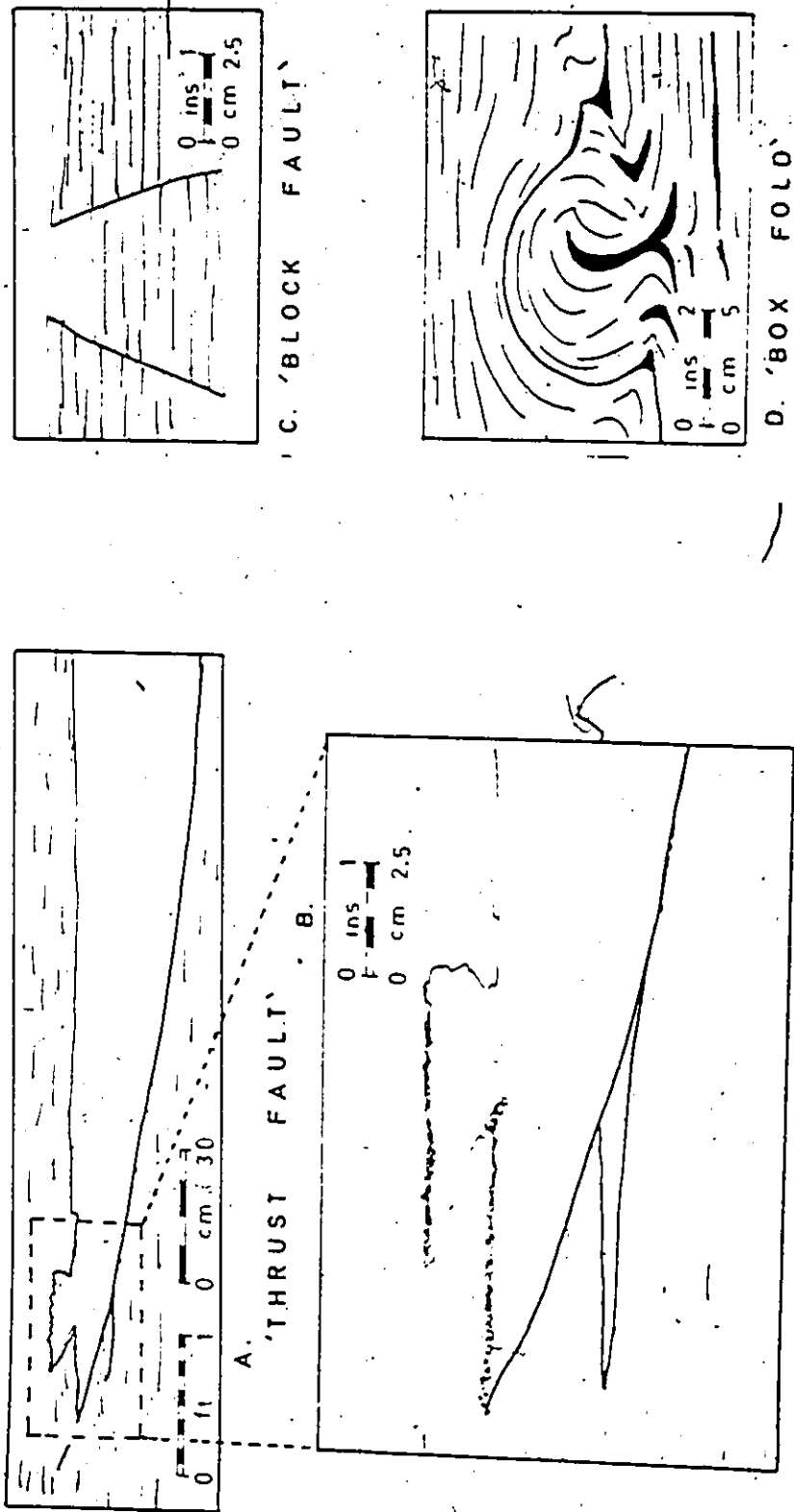


FIGURE 20 EARLY DEFORMATION STRUCTURES IN THE ALLEN BAY FORMATION, LOCALITY A, PRINCE OF WALES ISLAND.

(rock types: light and dark coloured laminated dolostone)

dolomite,

- iii) the original sediments were laminated, although specimen 227 indicates that the degree of lamination need not be great,
- iv) the shape, distribution and magnitude of the patterning is, in part, controlled by the original bedding characteristics,
- v) there appears to be a relationship between the pattern and the distribution and concentration of pyrite.

This unusual feature needs further study before a real understanding is possible. It is tentatively suggested that the patterned dolostone may have been produced by leaching and perhaps some redistribution of iron. The process(es) which could bring this about may have been percolating solutions. While this feature may be related to dolomitisation, the petrographic evidence does not confirm this.

Early Deformation

At locality A, between 1,481ft. (452m.) and 1,853ft. (565m.) above the base of the section some of the beds of the Allen Bay Formation are disrupted by premetamorphic folding and faulting (fig. 20). A brecciated bed is the oldest sign of disturbance in this part of the succession and above the breccia about 25% of the remaining 368ft. (112m.) of disturbed beds show folding and faulting. The majority of the disturbed beds and the most intense

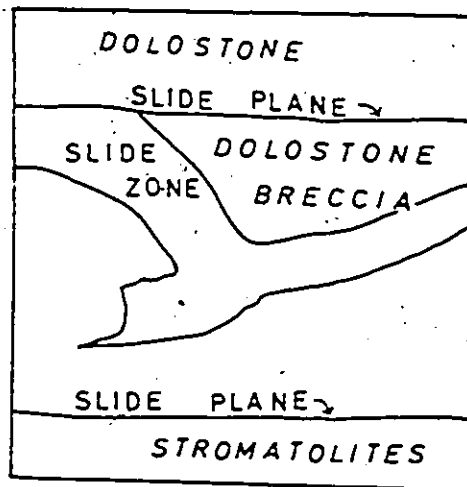
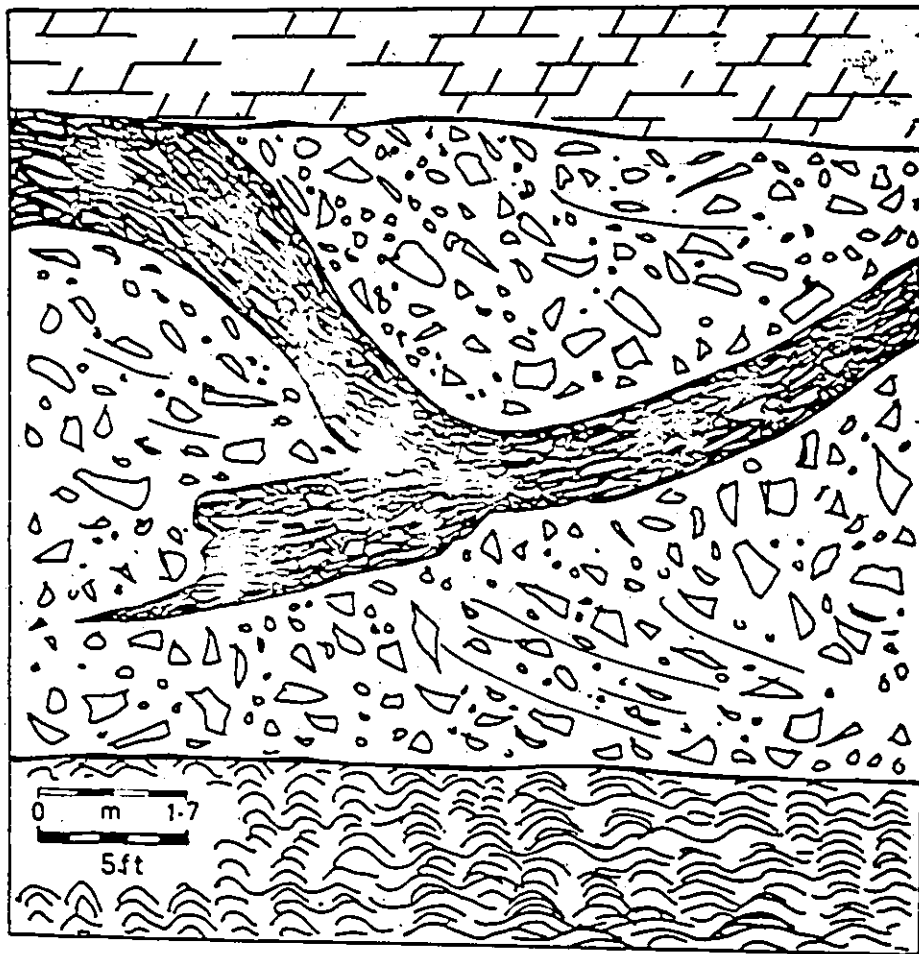


FIGURE 21 SLUMP BRECCIATION IN THE ALLEN BAY FORMATION, LOCALITY A, PRINCE OF WALES ISLAND. (EARLY DEFORMATION)

deformation occur within the lower 160ft. (49m.) of the section. Above the lower 160ft. (49m.) the beds have undulose laminae, small faults and 'box-folds' (fig. 20c,d). The rocks are mostly laminated dolostone with at least two bioclastic dolostone beds and one bed of domal stromatolites.

Figure 21 illustrates the essential elements of the breccia. The bounding surfaces of the breccia are slide planes; the lower truncates columnar stromatolites beneath. Within the breccia bed there is an additional slide zone in which the clasts have a marked linear orientation parallel to the bounding surfaces of the internal slide zone. The rock is dolomitic throughout and colour variations reflect grain size variations, the finer grains being darker.

These structures are the result of both plastic and brittle deformation which suggests that the beds were in a semi-consolidated or cohesive state at the time of deformation. The structures apparently formed in beds which were covered by an unknown thickness of sediment, as indicated by the fact that some of the folds die out upwards.

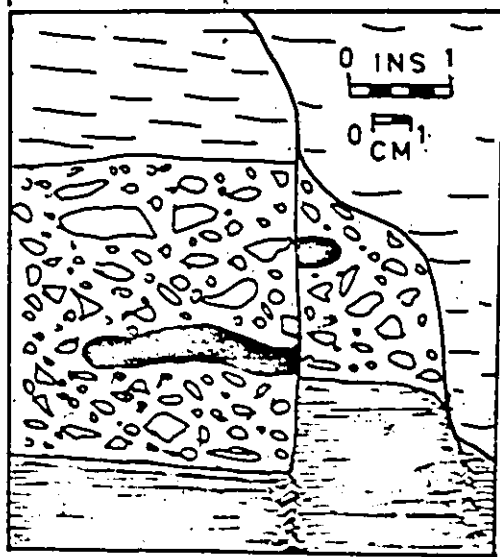
Although three-dimensional views of these structures are not common the few found seemed to indicate that the principal stress was compressive in a north-south direction. This direction parallels the trend of the Boothia Arch which in turn influenced the depositional strike of the Paleozoic rocks. It is considered that the structures predate the

local tectonic folding in early Devonian times and are therefore probably related to the depositional history. Such deformation features may have been the result of slumping on either a local depositional dip or one produced by sediment or basin subsidence. The resulting type of structure would depend upon the bed competence and the confining pressure of the overlying sediments. The dolomitisation features in the related rocks suggest that the sediments at the time of deformation may have been at least in a stage of incipient dolomitisation.

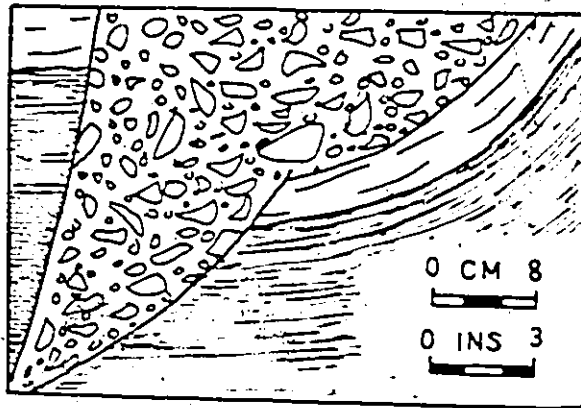
Late Deformation

One rock sample from locality X superficially resembles an intraformational breccia (Pl. 14, fig. 2) but the brecciation is regarded as secondary in origin. The rock is fractured and consists of angular 'clasts' 1 to 15mm. in length. The 'clasts' are composed of finely to mediumly crystalline dolomite which is clearer and slightly coarser than the dolomite matrix. The boundaries of the 'clasts' are sharp and are fracture lines along which the dolomite has been granulated. This accounts for the darker appearance and finer grain size of the breccia matrix. The fractures are irregular in length and distribution and commonly pass through both 'clasts' and the matrix. This would account for the irregular shape and variable size of the 'clasts'.

Although the fracturing may have destroyed any original



A



B



Intraformational breccia



Fissile dolostone



Laminated dolostone



Chert nodule

FIGURE 22 LATE DEFORMATION
 STRUCTURES IN THE LANG RIVER
 FORMATION, LOCALITY B, PRINCE OF
 WALES ISLAND.

textural features, the 'clasts' suggest that the pre-fractured rock was a grain mosaic, mediumly crystalline carbonate. The granulation of the dolomite along the fracture lines is evidence that the fracture breccia originated after dolomitisation. This example occurs in a sequence of unfractured, coarsely crystalline, fossil-bearing dolostones. The susceptibility to fracturing may be somehow related to grain size and texture.

The Creswell Bay area is highly faulted (fig. 6) and the stresses which produced the faulting may also have affected individual beds to such an extent that brecciation occurred.

Fault and fold structures limited in scale to the thickness of one or two beds (30-60cm.) occur in the Lang River Formation at locality B. Faulting is more common (fig. 22a,b) and there is at least one example of a 'thrust-faulted recumbent fold' (Pl. 14, fig. 1).

Figure 22a illustrates an example of faulting in which a chert nodule has been displaced, therefore the structure is post-lithification. All these features occur in a sequence of alternating competent dolostone and incompetent fissile dolostone beds. These structures are apparently related to the phase of folding which produced vertical beds in Devonian times.

Carbonaceous Deposits

Deposits of a black, powdery substance are present in the Allen Bay Formation in fault block G, locality X. Two of these deposits are situated approximately 300ft. (91.5m.) west of the confluence of the two major rivers (fig. 6). The first of these occurrences was observed in the cliff-forming dolostone of the valley wall where the black powder occupied large cavities within the dolostone. The second deposit - a thin film of powder on a bedding plane - occurs above the river valley, where the plateau and valley slope intersect.

A third deposit was present on the opposite side of the river (i.e. on the north). An isolated rock pinnacle is separated from the main mass of rock to the north by a ridge. This ridge consists of material within the fault zone that extends along the east-west valley (fig. 6). The material of the ridge is an irregular mixture of quartz sand, irregularly shaped silica nodules and an abundance of black powder.

X-ray powder photographs and X-ray diffraction patterns were obtained for samples of all three deposits and the diffraction patterns suggested a dominantly amorphous substance. Weight loss during combustion (105°C) was as much as 90% suggesting that the black powder was mostly carbon. Quartz, dolomite and iron impurities were detected in minor amounts.

The carbonaceous deposits in the Allen Bay Formation appear to have been transported from the fault zone by circulating groundwater along joints and bedding planes. There still remains the origin of the carbon, the answer to which may lie within the fault zone.

To the west of the carbonaceous deposits and within the same fault zone there is an outlier of Cretaceous black calcareous shale and interbedded thin limestone beds (fig. 6 and appendix 2). The black colour of these Cretaceous rocks is attributed to a high content of organic material. Thus there is the suggestion that these Cretaceous rocks could have supplied the carbon during the intense 'mastication' of these rocks in the fault zone. Furthermore, to the west at Stanwell Fletcher Lake, the Cretaceous Idlotak Formation (Dineley and Rust 1968) contain locally abundant plant-rich beds (B.R. Rust, pers. comm.) which could have been a further source of the carbon. The quartz sands within the fault zone may also be derived from the Cretaceous rocks.

A second possibility is that the carbonaceous material is pyrobitumen accumulated during seepage of petroleum from a leaky reservoir. Further evidence to suggest the presence of an oil reservoir in this area is not available.

VI BIOSTRATIGRAPHY

Introduction

The scarcity of stratigraphically useful fossiliferous strata does not allow precise dating and correlation. Consequently other less precise means of relative dating and local correlation must be employed, such as lithological comparisons and the recognition of time-equivalent sedimentary events. These two methods are not always separable entities but are inter-related. Considering that the Boothia Arch has played a significant role in the Paleozoic history of this area, especially during the deposition of the Lang River Formation, it seems probable that the sedimentary events may well be broadly synchronous. Problems arise when different lithologies or sequences resulted from one movement of the Arch or when several sedimentary events are recognised in one section but fewer in other sections. Fortunately on Prince of Wales and Somerset Islands the sedimentary sequences are similar.

Three distinct faunal groups are present in the Lang River and Allen Bay Formations. These are faunas of Lower Ordovician, Upper Ordovician and Silurian age.

Lower Ordovician Fauna

The only fauna of Lower Ordovician age occurs in fault block

TABLE 3

Lower Ordovician fauna from Creswell Bay, Somerset Island
(locality X). Lang River Formation. G.S.C. locality
89512 (see page 127).

Name	Pl./fig.	No. of specimens collected.
?Caseoceras sp.	32/8	2
?Dakeoceras sp.	32/5	2
Ellesmeroceras sp.1	32/9,11	2
Ellesmeroceras sp.2	32/7	35
ellesmerocerids indet.		24
?Quebecoceras sp.	32/10a,b	16
unidentifiable nautiloids		2
Schizopea sp.	32/2a,b	4
?Liospira sp.	32/4a,b	4
Euconia sp.	32/1	1
Sinuopea sp.	32/3	2

E near Creswell Bay (fig. 6). The fossils consist entirely of poorly preserved nautiloids and gastropods replaced by silica. They occur at two places on opposite limbs of a syncline; the first site is indicated on figure 6 and the second is about 1/4 mile (402m.) to the west. In both cases the fossils occur on the chert-covered bedding planes of a massive, buff-coloured dolostone. The chert nodules are small and irregular in shape. The two occurrences are possibly equivalent or stratigraphically only a few feet apart (1-2m.). Table 3 lists the identified Lower Ordovician fauna from this locality.

The four nautiloid genera are Canadian in age and *Ellesmeroceras*, *Dakeoceras* and *Caseoceras* are more specifically from the lower Canadian Series. Of the four gastropod genera *Schizopea* and *Sinuopea* range from the Upper Cambrian to the Lower Ordovician; *Euconia* is known from the Lower Ordovician and *Liospira* has been tentatively reported from the Lower Ordovician (Knight et al., in Moore, 1960 p.1201) although the genus is known to range from the Middle Ordovician to the Silurian. Therefore it is concluded that this faunal group is Canadian in age and most probably lower Canadian.

Upper Ordovician Fauna

This group of fossils has been widely referred to as the 'arctic' Ordovician fauna. The term 'arctic' was

originally assigned to the fauna from the Red River Formation of south-eastern Manitoba and its stratigraphic equivalents. Later usage has also included the fauna of the overlying Stony Mountain Formation and its stratigraphic equivalents. The main reason that these two faunal groups were considered together is their remarkable similarity and consequently stratigraphers have had difficulties in distinguishing the two in some areas.

On Somerset Island there are four known occurrences of the 'arctic' fauna, one each at Hunting River and Lang River and two at Creswell Bay. At Creswell Bay the fossils occur in fault blocks C and H (fig. 6). At all four localities the fauna occurs within strata of the Lang River Formation. However, on Prince of Wales Island an 'arctic' fauna was present in the lower part of the Allen Bay Formation.

Table 4 lists the 'arctic' faunal elements from Somerset and Prince of Wales Islands. The Hunting River collection (G.S.C. locality 89518) is not large but those from Creswell Bay (G.S.C. localities 89513-14) and Lang River (G.S.C. locality 89519) are considerably larger and more varied. Thirty-seven genera, one of which is believed to be new; thirty-four species of which eight are considered to be new; and four subspecies, two of which are possibly new, have been identified. There are numerous specimens in the collection which are unidentifiable at a specific

TABLE 4: Upper Ordovician fauna from Somerset and Prince of Wales Islands.

L.R.= Lang River Formation.

A.B.= Allen Bay Formation.

Location numbers refer to Geological Survey of Canada locations which are described on pages

Horizons: 2 - upper Lang River Formation.

3 - lower Allen Bay Formation.

4 - lower to middle Allen Bay Formation.

Name	Location	Fm.	Hori -ZON	Pl./fig.	Reference
<i>Receptaculites</i> sp.	89518	L.R.	2	-	Roy 1941
	89519	L.R.	2	-	
	89509	A.B.	3	-	P.165
	89511	A.B.	4	26/1	
	89514	L.R.	2	-	
	89513	L.R.	2	-	P.166
	89519	L.R.	2	26/2	
	89509	A.B.	3	-	p.168
	89511	A.B.	4	28/3	
	89513	L.R.	2	27/1	
	89509	A.B.	3	27/3	p.169
	89513	L.R.	2	27/2	
	89519	L.R.	2	-	

Gatunipora aequabilis (TEICHERT)

C. agglomeratiformis (WHITFIELD)

C. delicatula (WILSON)

C. cf. delicatula

TABLE 4 (cont'd)

Name	Location	Fm.	Hori -zon	Pl./fig.	Reference
<i>Catenipora robusta</i>	89514	L.R.	2	28/4	
	89509	A.B.	3	-	
	89511	A.B.	4	28/1	p.172
<i>C. rubra</i> SINCLAIR and BOLTON	89513	L.R.	2	28/2	
	89519	L.R.	2	-	
	89513	L.R.	2	21/1,2	p.173
<i>C. n.sp.1</i>	89519	L.R.	2	16/1,2	p.176
<i>C. n.sp.2</i>				30/4	
	89513	L.R.	2	30/3	p.178
<i>C. n.sp.3</i>	89513	L.R.	2	27/4	p.182
<i>Manipora amicarum</i> SINCLAIR				29/1	
	89514	L.R.	2	-	
	89519	L.R.	2	29/2,3	
<i>M. amicarum</i> n. subsp. A	89511	A.B.	4	-	p.183
	89513	L.R.	2	-	p.184
<i>M. fieldeni</i> (ETHERIDGE)	89519	L.R.	2	25/4	
<i>?M. n.sp.1</i>	89509	A.B.	3	30/1	p.187
				31/1-3	
<i>Calapoecia canadensis</i> BIRLINGS	89513	L.R.	2	-	Bassler 1950
	89519	L.R.	2	-	
	89518	L.R.	2	-	

TABLE 4 (cont'd)

Name	Location	Fm.	Hori -zon	Pl./fig.	Reference
<i>Calapoetia canadensis</i>	89518	L.R.	2	-	
<i>C. anticostiensis</i> BILLINGS	89513	L.R.	2	-	Bassler 1950
	89514	L.R.	2	-	
	89519	L.R.	2	-	
<i>C. cf. anticostiensis</i>	89509	A.B.	3	-	
<i>Coccoseris astomata</i> FLOWER	89513	L.R.	2	-	Flower 1961
<i>Paleofavosites kirki</i> STEARN	89514	L.R.	2	-	Stearn 1956
<i>P. okulitchi</i> STEARN	89514	L.R.	2	-	Stearn 1956
	89519	L.R.	2	-	
<i>P. poulsenii</i> TEICHERT	89513	L.R.	2	-	Teichert 1937
	89514	L.R.	2	-	
	89519	L.R.	2	-	
<i>Favosites</i> sp. form 2	89513	L.R.	2	-	p.203
<i>F. sp.</i>	89514	L.R.	2	-	
<i>Protrochiscolithus kiaeri</i> TROEDSSON	89513	L.R.	2	25/5	Nelson 1963
<i>Paleophyllum halysitoides</i> (WILSON)	89519	L.R.	2	-	p.137
	89509	A.B.	3	-	
<i>P. halysitoides</i> n. subsp. A	89514	L.R.	2	18/6	p.138
<i>P. halysitoides</i> n. subsp. B	89513	L.R.	2	24/1	p.138
<i>P. cf. halysitoides</i>	89514	L.R.	2	-	p.139
<i>P. parvum</i> STEARN	89509	A.B.	3	-	p.140

TABLE 4 (cont'd)

Name	Location	Fm.	Hori -zon	Pl./fig.	Reference
<i>Paleophyllum vaurealensis</i> TWENHOFEL	89513	L.R.	2	24/2,3	p.143
<i>P. raduguini</i> NELSON	89509	A.B.	3	24/5	p.141
	89514	L.R.	2	23/2	
	89519	L.R.	2	-	
<i>P. aff. raduguini</i>	89511	A.B.	4	24/4	p.142
<i>P. aff. thomi</i> (HALL)	89519	L.R.	2	25/1	p.144
<i>P. n.sp.1</i>	89509	A.R.	3	18/1,2	p.145
<i>Sarcinula</i> sp.	89513	L.R.	2	25/3	p.146
	89519	L.R.	2	25/2	
<i>Streptelasma</i> sp. form 1	89509	A.B.	3	-	p.202
	89511	A.B.	4	-	
<i>S.sp. form 2</i>	89509	A.B.	3	-	p.202
	89514	L.R.	2	-	
	89519	L.R.	3	22/10	
<i>S. sp. form 3</i>	89519	L.R.	2	22/1,2	p.202
<i>S. sp. form 4</i>	89509	A.B.	3	-	
	89513	L.R.	2	22/4,8	p.202
	89519	L.R.	2	-	
<i>S. sp. form 5</i>	89519	L.R.	2	22/3	p.202

TABLE 4 (cont'd)

Name	Location	Fm.	Hori- zon	Pl./fig.	reference
<i>streptelasma</i> sp. form 6	89514	L.R.	2	22/5,6,9	p.202
?s. sp. form 7	89513	L.R.	2	22/7	p.202
s. spp. indet.	89511	A.B.	4	-	-
<i>Lobocorallium trilobatum</i> NELSON	89513	L.R.	3	23/1	p.203
	89519	L.R.	2	-	-
<i>Grewingkia</i> sp.1	89519	L.R.	2	23/3	Nelson 1963
<i>Bighornia bottei</i> NELSON	89513	L.R.	2	-	Nelson 1963
<i>Bighorni</i> sp.1	89514	L.R.	2	23/5	-
<i>Aulacera nodulosa</i> (BILLINGS)	89519	L.R.	2	-	Nelson 1963
<i>A. undulata</i> (BILLINGS)	89514	L.R.	2	-	Galloway 1957
<i>A. cf. cylindrica</i> (FOERSTE)	89519	L.R.	2	-	Nelson 1963
	89514	L.R.	2	-	Galloway and St. John 1961
<i>A. n. sp.1</i>	89519	L.R.	2	18/1	p.130
<i>A. ?n. sp.2</i>	89519	L.R.	2	18/2	p.132
<i>A. sp. indet.</i>	89514	L.R.	2	-	-
<i>Clathrodictyon</i> sp.1	89519	L.R.	2	19/4	-
<i>C. sp.2</i>	89513	L.R.	2	20/1	-
<i>C. sp. indet.</i>	89513	L.R.	2	-	-
	89514	L.R.	2	19/7	-
	89519	L.R.	2	19/4	-

TABLE 4 (cont'd)

Name	Location	Fm.	Hori -zon	Pl./fig.	Reference
<i>Cryptophragmus antiquatus</i> RAYMOND	89513	L.R.	2	-	Raymond 1914
New genus A n.sp.1	89519	L.R.	2	19/1	p.133
New genus A n.sp.2	89519	L.R.	2	19/2,3	p.135
<i>Actinoceras</i> sp.1	89513	L.R.	2	-	
A. sp.2	89513	L.R.	2	-	
actinocericid sp. indet.	89511	A.B.	4	-	
<i>Armenoceras australe</i> FLOWER	89513	L.R.	2	34/8	Flower 1957
A. cf. arcticum TROEDSSON	89513	L.R.	2	34/6	Troedsson 1926
A. cf. richardsoni (STOKES)	89513	L.R.	2	-	Foerste 1929
<i>Armenoceras saxosum</i> FOERSTE	89519	L.R.	2	34/9	
A. cf. saxosum	89519	L.R.	2	34/7	Foerste 1929
A. sp.1	89513	L.R.	2	-	
	89513	L.R.	2	33/2	p.190
	89319	L.R.	2	33/1	
A. sp.2	89514	L.R.	2	-	p.191
	89518	L.R.	2	-	
A. sp.3	89513	L.R.	2	-	p.192
	89519	L.R.	2	33/3	
A. sp.4	89514	L.R.	2	-	p.193
	89519	L.R.	2	-	

TABLE 4 (cont'd)

Name	Location	Fm.	Hori- -zon	Pl./fig.	Reference
Armenoceras sp.5	89519	L.R.	2	33/7	p.195
A. sp.6	89519	L.R.	2	33/4	p.196
A. sp.7	89513	L.R.	2	33/5	p.197
A. cf. sp.7	89513	L.R.	2	33/6	p.198
A. sp.8	89513	L.R.	2	-	p.198
A. spp. indet.	89513	L.R.	2	-	-
	89514	L.R.	2	-	-
	89509	A.B.	2	-	-
Cyclendoceras ?n.sp.1	89519	L.R.	2	34/5	p.200
Cyrtogomphoceras cf. baffinense FOERSTE	89518	L.R.	2	-	Foerste 1928
C. cf. rotundum MILLER	89519	L.R.	2	-	Miller 1932
Deistoceras sp.	89518	L.R.	2	-	-
Digenoceras latum (FOERSTE)	89513	L.R.	2	-	Foerste 1929
Kochoceras bailliei NELSON	89519	L.R.	2	-	Nelson 1963
K. cf. ellipticum TROEDSSON	89513	L.R.	2	-	Troedsson 1926
K. sp. indet.	89514	L.R.	2	-	-
Lambeoceras cf. baffinense MILLER et al.	89519	L.R.	2	-	Miller et al. 1954
Westonoceras gouldi FOERSTE	89513	L.R.	2	-	Miller et al. 1954
Geisonoceras sp.	89509	A.B.	3	-	p.204
Oonoceras ?n.sp.1	89519	L.R.	2	34/1	p.199
Liospira sp.	89518	L.R.	2	-	-
Hormotoma sp.	89519	L.R.	2	-	-

TABLE 4 (cont'd)

Name	Location	Fm.	Hori -zon	Pl./fig.	Reference
<i>Maclurites acutus</i> (PARKS)	89513	L.R.	2	-	Troedsson 1928
	789519	L.R.	2	-	
<i>M. acutus</i> subsp. <i>major</i> TROEDSSON	89513	L.R.	2	-	Troedsson 1928
	89519	L.R.	2	-	
<i>M. crassus</i> ULRICH and SCOFIELD	89519	L.R.	2	-	Teichert 1937
<i>M. ungava</i> WILSON	89513	L.R.	2	-	Nelson 1963
	89518	L.R.	2	-	
<i>M. manitobensis</i> (WHITEAVES)	89518	L.R.	2	-	Nelson 1963
<i>M. cf. manitobensis</i>	89509	A.B.	3	-	
<i>M. sp. indet.</i>	89513	L.R.	2	-	
	89518	L.R.	2	-	
<i>Trochonema umbilicatum</i> (HALL)	89513	L.R.	2	-	Troedsson 1928
? <i>Austinella</i> sp.	89519	L.R.	2	-	
<i>Plectorthis inaequiconvexa</i> ROY	89519	L.R.	2	-	Roy 1941
<i>Lepidocyclus capax</i> (CONRAD)	89519	L.R.	2	-	Howe 1965
<i>Rhynchotrema</i> sp.	89519	L.R.	2	-	
<i>Strophomena cf. planodorsata</i> WINCHELL and SHUCHERT	89519	L.R.	2	-	Winchell and Shuchert 1893
orthid brachiopod <i>indet.</i>	89513	L.R.	2	-	
	89518	L.R.	2	-	

TABLE 4 (cont'd)

Name	Location	Fm.	Hori -zon	Pl./fig.	Reference
orthid brachiopod indet.	89519	L.R.	2	-	
	89509	A.B.	3	-	
spiriferid brachiopod indet.	89519	L.R.	2	-	
Calymene meeki FOERSTE	89519	L.R.	2	18/4	Foerste 1910
Sumastus sp. indet.	89513	L.R.	2	-	
Unidentified bryozoa	89514	L.R.	2	-	
	89519	L.R.	2	-	
<i>Catenipora robusta</i> (WILSON)	89509	A.B.	3	-	p.170
	89513	L.R.	2	-	
	89514	L.R.	2	28/4	
	89518	L.R.	2	-	

level and some so poorly preserved as to be generically unidentifiable.

By far the commonest genera are the corals (13 genera) and the nautiloids (9 genera). This generic dominance is also reflected in the number of species in these two groups - seventeen identified coral species and four nautiloid species, and also a considerable number of unidentifiable nautiloid species. *Catenipora*, *Paleophyllum* and *Streptelasma* are the only genera common to all the occurrences of the 'arctic' fauna. There are no known common species although if the two islands are compared as a whole there are eight common to the two islands.

On Somerset Island only the genera *Calapoecia* and *Catenipora* are common to all four occurrences. However, the larger collections from Creswell Bay and Lang River have the following genera in common: *Catenipora*, *Manipora*, *Calapoecia*, *Paleofavosites*, *Paleophyllum*, *Streptelasma*, *Clathrodictyon* and *Armenoceras*. At a specific level the Creswell Bay and Lang River assemblages show less similarity, with only three or four common species. The assemblage from fault block C, Creswell Bay, contains *Lobocorallium* and *Maclurites* which are also present at Lang River but not in fault block H, Creswell Bay. Furthermore, the assemblage from fault block C has a greater number of species in common with Lang River than that of fault block H. Lang River and fault block C have at least twelve common species.

1 of

SOMERSET AND PRINCE OF WALES ISLANDS (SELECTED FAUNA)	BAFFIN IS	SILLIMAN'S FOSSIL MT.	BAFFIN IS.	PITMAN HIGHLANDS	N.W. GREENLAND	HUDSON BAY (SW)		HUDSON BAY (SE)	MONTOY FM (U.S.A)	RED RIVER FM	STONY MT. FM	BIGHORN FM (U.S.A)	CORNWALLIS IS.
	0	X	X	?	?	CHURCHILL GROUP	BAD CACHE RAPIDS GROUP	0	0	0	0	0	0
<i>Receptaculites</i> sp.	0												X
<i>Calenipora aequabilis</i>	X		X				X						X
<i>C. agglomeratiformis</i>						X	X						
<i>C. delicatula</i>						X	X						
<i>C. robusta</i>						X	X						
<i>C. rubra</i>	?					X	X						
<i>Manipora amicarum</i>						X	X						
<i>M. fieldeni</i>				X		X	X						
<i>Calapoecia canadensis</i>	X					X	X						X
<i>C. anticosiense</i>						0	0						
<i>Coccoseris astomata</i>						0	0						
<i>Favosites</i> sp.						0	0						
<i>Paleofavosites kirki</i>						X	X						
<i>P. pokulitchi</i>						X	X						
<i>P. poulsenii</i>						X	X						
<i>Protrochiscolithus klaeri</i>						X	X						
<i>Paleophyllum halysitoides</i>						X	X						
<i>P. radugini</i>						X	X						
<i>Sarcinula</i> sp.				0		X	X						
<i>Lobocorallium trilobatum</i>						X	X						
<i>Grewingkia</i> sp.						X	X						
<i>Bighornia bottlei</i>						X	X						
<i>Streptelasma</i> spp.	0					X	X						
<i>Aulacera nodulosa</i>						X	X						
<i>A. undulata</i>						X	X						
<i>Actinoceras</i> spp.	0					X	X						
<i>Armenoceras australe</i>						X	X						
<i>A. saxosum</i>						X	X						
<i>A. cf. arcticum</i>				X		X	X						

Table 5 compares the 'arctic' fauna from Somerset and Prince of Wales Islands with the 'arctic' Ordovician faunas from several other well-known localities. It is evident that the fauna compares very favourably with the previously described 'arctic' faunas. More specifically a close comparison exists with the Red River and Stony Mountain faunas and also the faunas from the Bad Cache Rapids and Churchill Groups of Hudson Bay.

The presence of *Lobocorallium trilobatum*, *Bighornia bottei*, *Bighornia* sp. and *Paleofavosites* spp. is more indicative of Stony Mountain and Churchill equivalence. Nelson (1959b) placed great emphasis on the presence of *Lobocorallium trilobatum* as an indicator of Stony Mountain equivalence. The abundance of *Aulacera* spp. and *Armeñoceras* spp. is also taken to be more indicative of a Stony Mountain fauna.

Clathrodictyon spp. has not been previously reported from the 'arctic' Ordovician and although this genus is known from rocks as old as the Cambrian it is more common to Silurian and Devonian faunas. *Cryptophragmus antiquatus* has been reported mostly from the Middle Ordovician and as far as is known this is the first record of an Upper Ordovician occurrence.

Most authors have considered the age of the Stony Mountain fauna and its equivalents to be Richmondian. Macomber (1970) in a study of the Bighorn Formation of

Wyoming correlated the upper Bighorn Formation with the Stony Mountain Formation, in accordance with most previous authors (Nelson 1959b; Ross 1957; Miller 1930). However, unlike the other authors Macomber (1970) believed that the upper Bighorn Formation was Maysvillian in age. He stated (op. cit., p.425): "The similarity of the Bighorn macrofauna to that of the Richmond Group has been consistently overemphasised in the past, and too little attention has been paid to the fact that such similarity as exists is the result of a migration of 'arctic' forms into the Ohio valley during Richmondian times." This view has also been advocated by Stone and Furnish (1959, p.219) who stated that, ".... the conodont fauna of the Leigh Member [upper Bighorn] is significantly different from that of the Richmond but quite similar to North American and European faunas that are considered to be Maysville-Eden equivalents. A Maysvillian age seems most likely for the Upper Bighorn, by a process of elimination. No more precise correlation of these Upper Ordovician conodonts seems justifiable at present."

A major problem facing Ordovician stratigraphers in North America is that during the Middle and Upper Ordovician Epochs three distinct faunal provinces existed, an Atlantic, an Arctic and a Pacific province. Poor mixing of the faunal elements among the three provinces has created a problem in continent-wide correlation. The

North American biostratigraphic divisions were first studied in the eastern and east-central parts of the continent and consequently correlation between the Atlantic and Arctic provinces is fraught with difficulties. Many workers studying the Red River fauna have considered its age to be Edenian or Maysvillian although direct correlation is impossible as the Eden and Maysville stages represent a northward migration of the Atlantic fauna which, however, did not extend into the Arctic province.

Some of the Upper Ordovician faunal elements of Somerset Island have been reported from the Stonewall Formation of Manitoba which overlies the Stony Mountain Formation. Species of *Paleofavosites* are common in the Stonewall Formation but unfortunately the taxonomic status of the species is not considered to be clear. *Aulacera undulata* is also common to the Stonewall Formation but this is a long-ranging species throughout the Upper Ordovician. The following common genera are also present in the Stonewall Formation: *Calapoecia*, *Catenipora*, *Paleophyllum*, *Streptelasma*, *Liospira*, *Trochonema*, *Hormotoma* and *Kochoceras*. However, these genera are also common to the Red River and Stony Mountain Formations. Stearn (1956) correlated the Stonewall Formation with the Ellis Bay and possibly part of the Vaureal Formations which are Richmondian strata on Anticosti Island.

The similarities of the Red River, Stony Mountain and

Stonewall faunas are not conducive to accurate correlation. At present the dating of the Red River and Stony Mountain faunas is entirely dependant upon one's view of whether the common elements of the type Richmond and the 'arctic' fauna are indicative of contemporaneity or whether they are the result of a southeastward migration of a pre-existing 'arctic' fauna during the Richmondian. The fauna from Somerset and Prince of Wales Islands sheds very little light on this problem although the comparison of some of the fauna with that of the Stonewall Formation and the presence of *Clathrodictyon* spp. may favour a Richmondian age but does not rule out the possibility of a late Maysvillian age.

On Prince of Wales Island a fauna of the 'arctic' type occurs in the Allen Bay Formation at localities A and B (fig. 14 and table 4). Once again the corals dominate the faunal assemblages, which may be partly the result of preservation as well as an original dominance. The fauna compares very closely to that of Somerset Island. The only unique species are *Paleophyllum parvum* and a new species of *Manipora*. *Paleophyllum parvum* is also present in the Stonewall Formation (Stearn 1956, p.90) and was also reported in Upper Ordovician strata from the lower Mackenzie River area (Borden, 1956, unpublished M.Sc. thesis, University of Alberta, p.32).

As previously stated the 'arctic' fauna is long ranging

throughout the Upper Ordovician and consequently it is not known with any degree of certainty whether the Prince of Wales and Somerset Islands 'arctic' faunas are synchronous or succeed each other. Consideration of the sedimentary history of this area reveals that on both islands there was a major incursion of the 'arctic' fauna into an area otherwise devoid of marine life with preservable hard parts. If this event was approximately synchronous then the lower boundary of the Allen Bay Formation on Prince of Wales Island is slightly older than on Somerset Island. No upper Ordovician fossils are known from the Allen Bay Formation of Somerset Island; the oldest fossils encountered were always Silurian forms.

Silurian Fauna

The Allen Bay Formation contains a sparse, generally poorly preserved Silurian fauna. Most of the Silurian fossils were found in the Somerset Island sections and only a few on Prince of Wales Island. At Lang River the Allen Bay Formation contains at least one fossiliferous bed and many other, isolated fossils. The Allen Bay Formation at Creswell Bay contains a greater number of fossil-bearing beds, especially in fault blocks B and F.

Table 6 lists the Silurian fossils from each location and apparently they belong to two groups, the first characterised by the fauna from fault block B (G.S.C. locality 89515) and the second group from fault blocks F

and G, Creswell Bay (G.S.C. localities 89516 and 89517 respectively). The faunas from localities A and Z (G.S.C. localities 89510 and 89520 respectively) are similar in composition and belong to the first group. Comparison of fault blocks B and F indicates a difference that may be due either to a facies control or to a difference in age. Fault block G contains a mixture of the various faunal types but the faunal elements are considered to be related more to the fauna of fault block F. The following discussion will consider the two faunal groups and will show that the differences are due to different ages.

Halysites labyrinthicus is considered to be characteristic of the Lower Silurian and although *Halysites encrustans* was originally described from Middle Ordovician strata (Buehler 1955, p.66), Bolton (1966, p.14) reported its occurrence in the Niagaran of Manitoulin Island. The species of *Syringopora* is believed to be an early form and is similar to *S. retiformis* Billings, a Niagaran, form of this genus. The faunas from fault block B, Creswell Bay and localities A and Z are therefore considered to be Lower Silurian in age.

The second group contains two genera typical of the Middle Silurian, namely *Conchidium* and *Discosorus*. Galloway and St. John (in Galloway 1957) first described the genus *Cystostroma* from the Middle Ordovician but it is here reported in association with a Middle Silurian fauna.

TABLE 6 : Silurian fauna of the Allen Bay Formation on Somerset and Prince of Wales Islands. Location numbers refer to Geological Survey of Canada locations which are described on pages 123-125.

Horizons: 4 - lower to middle Allen Bay Formation Age: L - Lower Silurian
5 - middle to upper Allen Bay Formation M - Middle Silurian

Name	Location	Hori -zon	Age	Pl./fig.	Reference
<i>Halysites labyrinthicus</i> GOLDFUSS	89515	4	L	-	p.179
	89520	4	L	-	
	89510	5	L	-	
<i>H. encrustans</i> n. subsp. A	89515	4	L	26/3	p.180
<i>Favosites</i> sp. form 1	89516	5	M	-	p.203
<i>F.</i> sp. form 3	89515	4	L	-	p.204
	89517	5	M	-	
<i>F.</i> sp. form 4	89515	4	L	-	p.204
	89517	5	M	-	
<i>F.</i> sp. form 5	89510	5	L	-	
	89515	4	L	-	p.204
<i>F.</i> sp. indet.	89517	5	M	-	
<i>Syringopora</i> cf. <i>retiformis</i> BILLINGS	89515	4	L	-	Billings 1858
	89520	4	L	-	

TABLE 6 (cont'd)

Name	Location	Horiz- -zon	Age	Pl./fig.	Reference
<i>Syringopora</i> cf. <i>retiformis</i> BILLINGS	89510	5	L	-	
? <i>Streptelasma</i> sp. indet.	89515	4	L	-	
? <i>Dinophyllum</i> sp.	89516	5	M	23/4	
<i>Actinostroma</i> sp.1	89515	4	L	19/5,6	
	89520	4	L	-	
A. sp.2	89510	5	L	-	
A. sp.3	89515	4	L	18/5, 20/2	
<i>Cystostroma</i> ?n.sp.	89516	5	M	20/5	p.129
	89517	5	M	20/3	
<i>Clathrodictyon</i> sp.3	89517	5	M	19/3	p.202
? <i>Actinoceras</i> sp. indet.	89516	5	M	-	
	89517	5	M	-	
<i>Discosorus</i> sp.	89516	5	M	-	
<i>Proteoceratid</i> , genus unknown sp.1	89516	5	M	-	p.204.
	89517	5	M	-	
<i>Proteoceratid</i> , genus unknown sp.2	89516	5	M	-	p.204
? <i>Oonoceras</i> sp.	89516	5	M	-	
<i>Armenoceras</i> sp. indet.	89517	5	M	-	
<i>Nautiloids</i> indet.	89510	5	L	-	

TABLE 6 (cont'd)

Name	Location	Hori- -zon	Age	Pl./fig.	Reference
<i>Nautiloids</i> indet.	89516	5	M	-	
	89517	5	M	-	
<i>Liospira</i> sp.	89516	5	M	-	
<i>Hormotoma</i> sp.	89515	4	L	-	
<i>Conchidium</i> sp.	89516	5	M	-	

Age and Correlation

Lang River Formation

The only faunal evidence for dating the Lang River Formation comes from Somerset Island where Lower and Upper Ordovician faunas have been positively identified. On the Boothia Peninsula a Middle Cambrian fauna was reported by Blackadar and Christie (1963, p.9; G.S.C. locality 51205) from the basal sedimentary rocks near Kangikjuke Lake which are lithostratigraphically equivalent to the Lang River Formation. It is proposed that any future work on the Boothia Peninsula should refer these rocks to the Lang River Formation. The basal beds of the Boothia Peninsula were considered by Tuke et al. (1966, p.709) to be possibly equivalent to the top of the Aston Formation and their member 1 of the Hunting Formation. These conclusions were reiterated by Cowie (in Holland 1971, pp.357-358). The reinterpretation of the contact between the Lang River and Allen Bay Formations makes their correlations unfeasible and it now seems certain that the Hunting Formation is Proterozoic in age. Diabase dykes and sills intrude the Aston and Hunting Formations and a diabase sample from a sill within the Aston Formation gave a radiometric age of 702 ± 25 m.y. (see appendix 1 for further discussion of the Hunting Formation).

From the indigenous fauna the minimum time interval represented by the Lang River Formation is from the Lower Ordovician to the Upper Ordovician (?Richmondian). Litho-

stratigraphic correlation with the Boothia Peninsula basal Paleozoic succession, suggests that the lower part of the Lang River Formation may be as old as Middle Cambrian. Lower Cambrian fossils have been reported from the basal Paleozoic rocks of Victoria Island (North in Holland 1971, p.313) , Devon Island and Bache Peninsula (Cowie in Holland 1971, pp.325-383). This indirect evidence may possibly indicate that Paleozoic sedimentation adjacent to the Boothia Arch began in Lower Cambrian times.

On Prince of Wales Island the Lang River Formation is devoid of fossils in the sections studied. As both islands contain a similar rock succession and were both influenced by the Boothia Arch it is assumed that the minimum ages are also similar.

The Lang River Formation occupies a long time period which on other Arctic Lowland islands is represented by several formations (table 7). Similar basal detrital successions have been described from other Arctic areas adjacent to tectonic arches, as for example adjacent to the Minto Arch on Victoria Island (Thorsteinsson and Tozer 1962).

Allen Bay Formation

The scarcity of fossils precludes exact dating of the Allen Bay Formation. The oldest age was obtained for the Prince of Wales Island successions where an Upper Ordovician fauna was identified, but on Somerset Island the oldest fossils located in the Allen Bay Formation were Lower Silurian

forms. The previously noted similarity of the Upper Ordovician Allen Bay fauna to that of the Lang River Formation may indicate that the lower boundary of the Allen Bay Formation is older on Prince of Wales Island. With the limited paleontological control available this interpretation is only tentative.

The youngest age of the Allen Bay Formation is not adequately defined by the indigenous fauna. Some of the fossils present are known to be typical of the Middle Silurian suggesting that the Allen Bay Formation extends at least into the Middle Silurian. The overlying Young Bay Formation contains a fossil fish bed known to occur in three of the localities visited (localities A, B and Z) and elsewhere (S.R. Williams pers. comm. 1972). Thelodonts from a fossil fish bed at locality A were examined by S. Turner (in Turner and Dixon 1971) who suggested that they indicated a Wenlockian, possibly Upper Llandoveryan age. However, Williams (in Dixon, Williams and Turner 1972) considered that the lowest fauna of the overlying Read Bay Formation indicated that the age of the fish bed was no older than the latest Wenlockian.

The type section of the Allen Bay Formation on Cornwallis Island (Thorsteinsson 1958, pp.42-47) was given an age range of Upper Ordovician to Middle Silurian. The Silurian fauna included Llandoveryan and lowermost Wenlockian equivalents (op. cit., p.47).

Thus part of the Allen Bay Formation on Somerset Island is at least as old as Lower Silurian and may be as old as Upper Ordovician. Part of the formation is Middle Silurian in age. On Prince of Wales Island the formation ranges in age from the Upper Ordovician to the Middle Silurian. The youngest age on both islands may be lowermost Wenlockian. The Allen Bay Formation has been recognised on Cornwallis, Devon and Victoria Islands (table 7.).

VII FAUNAL DESCRIPTIONS AND COMMENTS

Introduction

Most of the fossils collected were identified, although the taxonomic level to which they could be identified varied quite considerably. During the course of the identifications numerous problems of classification and comparison arose and where possible these were resolved. However, in some groups, especially the streptelasmatid corals and the armenoceratid nautiloids, identification at the specific level proved difficult and when such uncertainties arose individual species or distinct forms were designated by numbers.

Several possible new species and subspecies were discovered but because they are based on only a few specimens, less than the minimum considered desirable for the formal establishment of new taxa, they have been designated by numerals and letters respectively. All the figured and listed specimens are deposited in the Geological Survey of Canada (G.S.C.), Ottawa. The various fossil horizons have been allocated G.S.C. locality numbers but each specimen bears the author's collecting number. The following are brief descriptions of the localities which have been allocated G.S.C. numbers:

G.S.C. locality 89509: locality A, Prince of Wales Island (fig. 10). The fossiliferous beds are 320-350ft. (97-106m.) above the base of the Allen Bay Formation (fig. 11). Upper Ordovician in age.

G.S.C. locality 89510: locality A, Prince of Wales Island (fig. 10). The fossil-bearing beds are 370-376ft. (112-114m.) below the top of the Allen Bay Formation (fig. 11). Lower Silurian in age.

G.S.C. locality 89511: locality B, Prince of Wales Island (fig. 10). The fossil-bearing beds are located between 530-1,000ft. (161-304m.) below the top of the Allen Bay Formation (fig. 12). Upper Ordovician in age.

G.S.C. locality 89512: locality X, fault block E, Somerset Island (fig. 6). The fossil-bearing beds are in the middle part of the Lang River Formation and estimated to be 800-1,000 ft. (243-304m.) above the base of the formation. Lower Ordovician in age.

G.S.C. locality 89513: locality X, fault block C, Somerset Island (fig. 6). The fossiliferous strata are in the top 200ft. (61m.) of the Lang River Formation (fig. 7). Upper Ordovician in age.

G.S.C. locality 89514: locality X, fault block H, Somerset Island (fig. 6). The fossiliferous strata are in the top 200ft. (61m.) of the Lang River Formation. Upper Ordovician in age.

G.S.C. locality 89515: locality X, fault block B, Somerset Island (fig. 6). The fossil-bearing strata are present in the lower half of the Allen Bay Formation. Lower Silurian in age.

G.S.C. locality 89516: locality X, fault block F, Somerset Island (fig. 6). The fossil-bearing beds occur through 184ft. (56m.) of strata in the middle to upper parts of the Allen Bay

Formation (fig. 7). Middle Silurian in age.

G.S.C. locality 89517: locality X, fault block G, Somerset Island (fig. 6). The fossil-bearing beds occur through 51ft. (15.6m.) of strata in the upper part of the Allen Bay Formation. Middle Silurian in age.

G.S.C. locality 89518: locality Y, Somerset Island (fig. 8). The fossiliferous beds are 2,700-2,900ft. (823-884m.) above the base of the Lang River Formation. Upper Ordovician in age.

G.S.C. locality 89519: locality Z, Somerset Island (fig. 3). The fossiliferous strata are 907-1,317ft. (277-400m.) above the base of the Lang River Formation (fig. 4). Upper Ordovician in age.

G.S.C. locality 89520: locality Z, Somerset Island (fig. 3). The fossil-bearing beds are in the middle or lower middle parts of the Allen Bay Formation (fig. 4). Lower Silurian in age.

Systematic descriptions are presented for stratigraphically important fossils or where new taxonomic or morphological data is involved. The remaining fauna is tabulated without formal descriptions (tables 3, 4 and 6). Comments on some of the tabulated fossils are also included.

Faunal Descriptions

Phylum COELENTERATA Frey and Leuckart 1844

Order STROMATOPOROIDEA Nicholson and Murie 1878

The classification of the Stromatoporoidea is still in need of extensive clarification but that of Galloway (1957) will be used as it appears to be the most simple and consistent.

Family LABECHIDAE Nicholson 1847

Genus *Cystostroma* Galloway and St. John (in Galloway 1957)

Type Species *Cystostroma vermontense* Galloway and St. John
(in Galloway 1957)

Massive coenosteum, latilaminate, consisting of convex, overlapping and unequal cyst plates. Pillars absent.

Smooth coenosteum surface or with mamelons of varying size and primitive astrorhizae.

Cystostroma ?n.sp.

Pl. 20, figs. 3,5

Occurrence: G.S.C. localities 89516, 89517.

Horizon and age: Present in the lower half of the Allen Bay Formation in fault blocks F and G, Creswell Bay, Somerset Island. Lower Silurian

Holotype: X248/2.

Paratype: X49/7.

Diagnosis: Small to mediumly large mamelons, 4-9mm. in diameter. Microstructure consists of cyst plates arranged end-to-end or overlapping, forming narrow laminae, 0.2-0.3mm. wide.

Description: The coenosteum is massive with regularly spaced, small to mediumly large mamelons, 4-9mm. in diameter. The microstructure consists of long (0.75-1.0mm.) and narrow (0.2-0.3mm.) cyst plates arranged end-to-end or overlapping such that the coenosteum is made up of laminae and areas of compact tissue.

Remarks: In the possession of mamelons, this species differs from *Cystostroma vermontense* and *C. simplex* described by Galloway and St. John. (in Galloway 1957).

Genus *Aulacera* Plummer 1843

Type Species *Aulacera plummeri* Galloway and St. John (in Galloway 1957)

Columnar coenosteum with a central axis occupied by hemispherical, upwardly curved cyst plates traversing the diameter of the central axis and which in some specimens may grade into smaller lateral cyst plates. Pillars either absent or present in the outer part of the lateral zones or sporadically developed in the outer zone. Coenosteum surface papillate, smooth, mamellated or ridged. Astorhizae rare.

Aulacera n.sp.1

Pl. 18, figs. 1a-c

Occurrence: G.S.C. locality 89519.

Horizon and age: 907-1317ft. (277-400m.) above the base of the Lang River Formation. Upper Ordovician.

Holotype: Z16/51.

Diagnosis: Angular, smooth-walled, columnar coenosteum.

Central axis apparently empty, surrounded by a wall divisible into an inner cystose zone and an outer pillared zone.

Description: The single, incomplete specimen is 10cm. long.

The basal transverse section is four-sided, with two long sides 20mm. in length and two adjacent shorter sides each about 10mm. in length. In the mature portion of the coenosteum the transverse outline is almost square with the walls 25-35mm. long and slightly concave. The external surfaces of the walls are smooth.

The central axis is 5-6mm. in diameter and does not contain large cyst plates although it is possible that silicification has destroyed them. The enclosing coenosteum has two distinct zones of differing skeletal elements. The inner zone consists of cyst plates. The area adjacent to the central axis has undergone recrystallisation but it appears that the cyst plates in this area are about twice the size of the outer cyst plates. At the wall angles the cystose zone extends far into the corners such that only a very thin outer zone, usually less than 1.0mm. wide, separates the cysts from the external surface. Radial structures are generally absent in the cystose zone but in the wall angles there are straight, tubular structures extending almost the whole width of the cystose zone which are comparable to astrorhizae.

The outer zone is 3mm. wide and consists of radial pillars of varying length but which rarely extend the full width of the outer zone. The boundary between the inner cystose zone and the outer zone is sharp even though some of the pillars originate in the outermost part of the cystose

zone. One distinct lamina is present in the outer zone, dividing this zone into approximately two halves. No other laminar structures are present.

Remarks: Nelson (1963, p.27, Pl.-4, figs. 1a-c, 2) described a new species called *Beatricea clarki* (in Galloway's 1957 classification this would become *Aulacera clarki*) which has similar skeletal elements to the above but differs in that it has a triangular transverse outline and a nodular surface. However, *Aulacera clarki* (Nelson) and the above species are probably closely related.

Aulacera ?n.sp.2

Pl. 18, fig. 2; Pl. 20, fig. 6

Occurrence: G.S.C. locality 89519.

Horizon and age: 907-1317ft. (277-400m.) above the base of the Lang River Formation. Upper Ordovician.

Holotype: Z16/68.

Paratype: Z16/52.

Diagnosis: Generic features of *Aulacera* but characterised by a maculate microstructure in the outermost zone.

Description: Both specimens are incomplete fragments of smooth-walled, columnar coenostea. They are circular in transverse outline. The holotype is 150mm. long, 30mm. in diameter and has a central axis 5-8mm. in diameter. The central axis is divided into chambers by upwardly arched cyst-plates 5mm. apart.

The skeletal elements of the coenosteum are divisible

into three concentric zones. The inner zone is 16mm. in diameter and includes the central axis. Unfortunately silicification has destroyed the microstructure of the inner zone. The median zone is 4-8mm. wide and consists of cyst plates. The outer zone is 6-10mm. wide and consists of radially and concentrically arranged maculae.

Remarks: Both specimens are encrusted by bryozoans and in the case of the holotype the bryozoan encircles the coenosteum.

Family unknown or new family

New Genus A

Diagnosis: Smooth-walled, cylindrical coenosteum of moderate diameter (3.0cm.). Basal invagination often present. Large axial canal, about $\frac{2}{3}$ of the total diameter, divided into chambers by downwardly directed tabulae. Tabulae essentially conical in shape and may be straight sided or irregular. Axial canal may also be divided longitudinally by a central partition.

Skeletal tissue apparently of closely-spaced laminae.

Type Species A n.sp.1

Pl. 19, fig. 1

Occurrence: G.S.C. locality 89519.

Horizon and age: 907-1317ft. (277-400m.) above the base of the Lang River Formation. Upper Ordovician.

Holotype: 217/3.

Paratype: Z16/53.

Diagnosis: Smooth-walled, cylindrical coenosteum 2.5cm. in diameter. Coenosteum has a basal invagination. Large axial canal, 1.5cm. in diameter, divided into chambers by downwardly directed conical tabulae. Surrounding skeletal tissue of thin laminae without pillars.

Description: The smooth-walled, cylindrical coenosteum is 2.5cm. in diameter from near its base. The basal part of the coenosteum is strongly invaginated in the holotype but only slightly dimpled in the paratype. Both specimens are incomplete. The holotype is 75mm. long and the paratype 100mm. long.

The wall surrounding the axial canal is very thin, only 5.0mm. wide whereas the axial canal is 1.5cm. in diameter. The axial canal is divided into chambers by closely-spaced, downwardly directed, steeply conical, tabulae. These tabulae are 2.0mm. thick and 1.0mm. apart. Apparently the tabulae do not close at their apices but leave an open central canal 8.0mm. in diameter.

Both specimens are extensively silicified and dolomitised such that details of the microstructure are obscure. However, remnants of the microstructure suggest that the skeletal tissue of the wall consisted of closely-spaced laminae but there were no traces of pillars or pillar-like structures.

Remarks: Superficially this genus resembles *Aulacera* but in

contrast there are no cyst plates in either the axial canal or in the surrounding skeletal tissue. Both macro- and microstructures are apparently unique and the specimens appear to belong to a new genus and probably to a new family.

New genus A n.sp.2

Pl. 18, fig. 3, Pl. 19, figs. 2a,b

Occurrence: G.S.C. locality 89519.

Horizon and age: 907-1317ft. (277-400m.) above the base of the Lang River Formation. Upper Ordovician.

Syntypes: Z16/54, Z16/55.

Diagnosis: Smooth-walled, cylindrical coenosteum 2.5-3.0cm. in diameter. Slight basal invagination. Large axial canal, 1.5-2.0cm. in diameter, divided into two parts by a central longitudinal partition and also divided into chambers by irregular and downwardly directed tabulae. Surrounding skeletal tissue of thin laminae.

Description: The smooth-walled, cylindrical coenosteum is 2.5-3.0cm. in diameter with a slightly elliptical transverse outline. The maximum diameter is attained very close to the base. Specimens Z16/54 and Z16/55 are 70mm. and 60mm. long respectively. There is a slight basal invagination.

The wall surrounding the axial canal is 1.0-2.0mm. thick. Dividing the axial canal into two halves is a longitudinal partition which is almost vertical in specimen Z16/54 but irregular in specimen Z16/55. Transverse

chambers are defined by irregular tabulae^o which are essentially conical in shape and project downwards.

Extreme silicification and dolomitisation has destroyed much of the microstructure of the wall but there are indications that closely-spaced parallel laminations were present.

Remarks: The longitudinal partition and irregular tabulae distinguish this from *A. sp.1.*

Order RUGOSA Milne-Edwards and Haime 1850 .

Suborder COLUMNARIINA Rominger 1876

Family STAURIDAE Milne-Edwards and Haime 1850

Genus *Paleophyllum* Billings 1858

Type Species *Paleophyllum rugosum* Billings 1858

Fasciculate or halysitoid corallum. Corallites usually circular, or sub-polygonal in the halysitoid forms. Major and minor septa present and vary in number and size according to the species and also to the size of the corallites. Tabulae horizontal, or arched, or downwardly deflected at their margins.

The taxonomic position of *Paleophyllum* is still uncertain. Billings (1858), Lang, Smith and Thomas (1940), Bassler (1950), Hill (in Moore 1956) and Nelson (1963) considered this genus to be a colonial streptelasmatic. Lambe (1899), Duncan (1956) and Strusz (1961) believed that *Columnaria* and *Favistella* were closer relatives. Hill

(1961) revised her earlier opinion and concluded that *Paleophyllum* was related to *Columnaria* and should be classified in the *Columnariina*. This conclusion was supported by Flower (1961) who advocated a derivation from *Favistina* although he acknowledged that the streptelasmatids may have been derived from *Paleophyllum*.

Paleophyllum halysitoides (Wilson)

1926 *Diphyphyllum halysitoides* WILSON, p.18, Pl.2, figs. 8,9.

1928 *Columnaria halysitoides* TROEDSSON, p.113, Pl.28, figs. 8,9.

1963 *Paleophyllum halysitoides* (Wilson). NELSON, p.31, Pl.5, fig.4.

Occurrence: G.S.C. localities 89509 and 89519.

Horizon and age: Locality 89509: 320-350ft. (97-106m.)

above the base of the Allen Bay Formation. Locality 89519:

907-1317ft. (277-400m.) above the base of the Lang River

Formation. Upper Ordovician.

Plesiotypes: Z16/32, Z16/34, CBl/16.

Description: The corallites are arranged most commonly into halysitoid ranks with as many as 14 corallites. The corallites are sub-polygonal to sub-quadrate in outline, but are circular where isolated. Mature corallites are 3.5-4.0mm. in diameter.

Eighteen major septa extend to the axis and may form a simple vesicular columella. Not all the corallites have

a columella. Minor septa are present as inconspicuous ridges.

The tabulae are horizontal medially but have downwardly deflected margins. They are spaced approximately 0.5mm. apart.

Paleophyllum halysitoides n. subsp. A

Pl. 18, fig. 6

Occurrence: G.S.C. locality 89514.

Horizon and age: Top 200ft. (61m.) of the Lang River Formation. Upper Ordovician.

Type Specimen: X95.

Diagnosis: Similar to *Paleophyllum halysitoides* but with larger corallites, 4.25-5.0mm. in diameter, flatter tabulae and shorter ranks of 2-6 corallites.

Description: The corallites are 4.25-5.0mm. in diameter and are arranged in short ranks consisting of 2 to 6 corallites.

There are usually 18 straight or slightly undulose major septa. The major septa extend to the axis and form a simple small vesicular columella. Minor septa are present as short projections.

The tabulae are only slightly arched and are about 0.4mm. apart.

Paleophyllum halysitoides n. subsp. B

Pl. 24, fig. 1

Occurrence: G.S.C. locality 89513.

Horizon and age: Top 200ft. (61m.) of the Lang River

Formation. Upper Ordovician.

Type Specimens: X204/17.

Diagnosis: Corallites 3.75-5.0mm. in diameter, usually isolated but may be in short ranks with as many as 4 corallites. 16 to 18 major septa.

Description: The corallites occur isolated as commonly as they occur in halysitoid ranks. Halysitoid ranks rarely exceed 4 corallites in length and they also tend to split into isolated corallites at a higher point of growth. The corallite diameters range from 3.75 to 5.0mm.

The major septa vary from 16 to 18 in number, although 18 is the most common. The major septa extend to the axis and interdigitate to form a simple vesicular columella.

The minor septa are present as short projections.

The tabulae are arched.

Paleophyllum cf. *halysitoides* (Wilson).

Occurrence: G.S.C. locality 89514.

Horizon and age: Top 200ft. (61m.) of the Lang River Formation. Upper Ordovician.

Hypotype: X54.

Description: The corallites are arranged in halysitoid ranks or are isolated and are 4.0-5.5mm. in diameter.

There are usually 16 major septa but corallites with 15 or 17 are also present. The major septa extend to the axis where adjacent or opposite septa may unite to form a simple columella. The minor septa are prominent and are

about 1/4 the length of the major septa.

Tabulae are either horizontal or gently arched in the centre with downwardly deflected margins. They are spaced 0.7mm. apart.

Remarks: The halysitoid growth of this specimen is comparable to that of *P. halysitoides*, but the former differs in having larger corallites, fewer major septa, more prominent minor septa and a different columellar structure. It is possible that this specimen is a separate species or a subspecies.

Paleophyllum radugini Nelson has a similar growth form and similar numbers of major septa but is smaller, has shorter minor septa and has a differently constructed columella than specimen X54.

Paleophyllum parvum Stearn

1956 *Paleophyllum pasense parvum* STEARN, p.90, Pl.7, fig.5.

Occurrence: G.S.C. locality 89509.

Horizon and age: 320-350ft. (97-106m.) above the base of the Allen Bay Formation. Upper Ordovician.

Plesiotype: CBI/10.

Description: The corallites are small and circular, 1.4-2.25mm. in diameter, but most are 1.9mm. in diameter.

Corallites are usually isolated but may occur in short halysitoid ranks which are rarely more than three corallites in length. Halysitoid ranks are not usually persistent vertically.

Major septa are invariably 10 in number and they extend to the axis where their extremities touch and form a simple columella. Minor septa are very short.

The tabulae are either horizontal or curved upwards and are spaced 0.25-0.35mm. apart.

Remarks: The differences between Stearn's (1956) subspecies and *P. pasense* are considered sufficiently distinct to merit full species status. This was also informally recognised by Borden (unpublished M.Sc. thesis, University of Alberta, 1956).

Paleophyllum raduguini Nelson

Pl. 23, fig. 2, Pl. 24, fig. 5

1936 *Columnaria halysitoides* RADUGUIN, p.100, Pl.2, fig.12,
(teste Nelson 1963).

1963 *Paleophyllum raduguini* NELSON, p.32, Pl.6, fig.7.

Occurrence: G.S.C. localities 89509, 89514 and 89519.

Horizon and age: Locality 89509: 320-350ft. (97-106m.)

above the base of the Allen Bay Formation. Locality 89519:

907-1317ft. 277-400m.) above the base of the Lang River

Formation. Locality 89514: top 200ft. (61m.) of the Lang

River Formation. Upper Ordovician.

Hypotypes: X55, Z16/36, CB2/11, CB2/18.

Description: The corallites are isolated or halysitoid with ranks up to 7 corallites in length. In specimens CB2/11, CB2/18 and Z16/36 corallite diameters are 2.25-3.25mm.

whereas in specimen X55 they are 3.5-4.0mm.

Specimens CB2/11, CB2/18 and Z16/36 have 14 major septa and occasionally 16, but specimen X55 usually has 16, sometimes 15. The major septa extend to the axis and by interdigitating, twisting and the fusion of adjacent or opposite septa form a columella. Minor septa are inconspicuous.

The tabulae are either horizontal or undulating axially but are downwardly deflected at their margins.

Remarks: Nelson (1963) renamed Raduguin's (1936) species as the specific name was preoccupied (Wilson 1926 - *Diphyphyllum halysitoides*). However, Nelson's (op. cit.) hypotypes differ slightly from Raduguin's (op. cit.) specimens in size and the number of major septa. Nelson (op. cit.) reported in his hypotypes 16 to 18 major septa but an examination of his illustrations reveal that the number varies from 14 to 18, although most have 16. Specimens CB2/11, CB2/18 and Z16/36 have diameters similar to those stated by Nelson (op. cit.) but the number of major septa compares with Raduguin's (op. cit.) description. Without further information on variation within this species it is not considered necessary to distinguish two species.

Paleophyllum aff. *raduguini*

Pl. 24, fig. 4

Occurrence: G.S.C. locality 89511.

Horizon and age: 530-1,000ft. below the top of the Allen Bay Formation. Upper Ordovician.

Hypotypes: B29/6, B29/10, B29/14.

Description: The corallites are circular and usually isolated but may occur in short halysitoid ranks no greater than four corallites in length. Corallite diameters range from 2.5 to 3.25mm.

There are 14 to 16 major septa although 16 is more common. They extend to the axis and interfinger to form a simple columella. Minor septa are prominent and are approximately $1/3$ to $1/2$ the length of the major septa.

The tabulae are arched upwards and spaced 0.5mm. apart.

Remarks: The specimens differ from *Paleophyllum radugini* in the more isolated corallites and prominent minor septa.

Paleophyllum vaurealensis (Twenhofel)

Pl. 24, figs. 2,3

1928 *Columnaria* (*Paleophyllum*) *vaurealensis* TWENHOFEL, p. 122, Pl.4, fig.1.

?1961 *Paleophyllum gracile* FLOWER, p.89, Pls.46, 47, figs. 1-8.

Occurrence: G.S.C. locality 89513.

Horizon and age: Top 200ft. (61m.) of the Lang River Formation.

Plesiotypes: X178, X184, X204/16

Description: The corallites are either isolated or in halysitoid ranks, some up to 8 corallites in length. Small clusters of corallites 2 to 4 in number are also present. Corallite diameters range from 2.5 to 3.5mm.

There are usually 14 major septa but some corallites

have 15 or 16. Some of the major septa extend to the axis and by interfingering form a very simple columella. The minor septa are only short ridges.

The tabulae are horizontal axially and downwardly deflected at the margins and are spaced 0.75-1.0mm. apart. Remarks: Twenhofel's (1928) illustrations are considered inadequate but fortunately his description is quite extensive. *Paleophyllum gracile* Flower compares very closely and may be conspecific..

Paleophyllum aff. *thomi* (Hall) teste Flower (1961)

Pl. 25, fig. 1

1857 *Columnaria thomi* HALL, in Emory 1857, Pl.20, figs. 1a-d.

1961 *Paleophyllum thomi* (Hall). FLOWER, p.91, Pl.47, fig.9, Pl.51, Pl.52.

Occurrence: G.S.C. locality 89519.

Horizon and age: 907-1317ft. (277-400m.) above the base of the Lang River Formation.

Hypotypes: Z16/33, Z16/35.

Description: The corallites are either isolated or in short halysitoid ranks up to 5 corallites in length. Corallite diameters range from 4.75 to 5.25mm.

There are generally 20 major septa but as many as 22 may be present. They extend to the axis, interfinger and form a simple columella. The minor septa are short projections.

The tabulae have downwardly deflected margins, slightly arched central areas and are spaced 0.4mm. apart.

Remarks: *Paleophyllum thomi* differs from these specimens only in having sinuate tabulae.

Paleophyllum n.sp.1

Pl. 17, figs. 1,2

Occurrence: G.S.C. Locality 89509.

Horizon and age: 320-350ft. (97-106m.) above the base of the Allen Bay Formation. Upper Ordovician.

Holotype: CBl/32.

Diagnosis: Isolated corallites with mature diameters of 3.25-4.25mm. Number of major septa varies according to corallite size but most mature corallites have 16 to 18. Only two or three major septa form the columella.

Description: Corallites are usually isolated with mature diameters ranging from 3.25 to 4.25mm.

The number of major septa varies according to the size of the corallite and ranges from 10 to 18. Mature corallites usually have 16 to 18 major septa. Most of the major septa do not extend to the axis but at least two reach the centre where they may touch or overlap to form a very simple columella. Minor septa are inconspicuous and are usually not visible.

The tabulae are arched upwards with greater curvature at their margins and are spaced 0.8mm. apart.

Remarks: This specimen is intimately associated with a

Manipora colony in which the corallites of the *Palaephyllum* occupy the lacunae between the ranks of the *Manipora*. Such a relationship may be either symbiotic or tolerant (Ager 1963, p.245). If the association was symbiotic the unrestricted growth of both colonies would suggest mutualism rather than commensalism. A similar association was noted in a colony of *Manipora amicarum* although in this case *Palaephyllum* sp. was restricted to a small portion of the *Manipora* colony and was apparently short-lived.

Order TABULATA Milne-Edwards and Haime 1850

Family SYRINGOPHYLLIDAE Pošta 1902

Genus *Sarcinula* Lamarck 1816

Type Species *Madrepora organum* Linné 1758 (partim.)

Fasciculate coenenchymal coral; wide coenenchymal platforms interrupt the fasciculate form. Radial costae on the platforms.

Sarcinula sp.

Pl. 25, figs. 2,3

Occurrence: G.S.C. localities 89513 and 89519.

Horizon and age: Locality 89513: top 200ft. (61m.) of the Lang River Formation and at locality 89519, 907-1317ft.

(277-400m.) above the base of the formation. Upper Ordovician.

Specimens: X171, Z16/37.

Description: The larger corallum (X171) is elongate and

domed, 15cm. long, 10cm. wide and 8cm. high, and the smaller one is 7cm. in diameter and 1.8cm. high. Corallites are circular in transverse outline, 1.8-2.1mm. in diameter in specimen X171 and 1.4-1.6mm. in specimen Z16/37.

Coenenchymal platforms are irregularly distributed and have 20 radial costae projecting into the corallite lumen.

Recrystallisation has destroyed much of the internal structure but in specimen Z16/37 some sinuate tabulae have been preserved.

Remarks: Without a larger collection or information concerning variation the two specimens are considered together, as specimen Z16/37 may be only a smaller individual of the same species. Troedsson (1928, pp.120-124, figs.3-8) described *Syringophyllum organum* from Greenland which is in fact a species of *Sarcinula*. This is the only reported *Sarcinula* from the Arctic archipelago but it does not appear to be conspecific with the specimens from Somerset Island. Borden (unpublished M.Sc. thesis, University of Alberta, 1956) cited an occurrence of *Sarcinula* in the lower McKenzie River area which is within the 'arctic' Ordovician faunal province and is one of the few occurrences of this genus in North America.

Family HALYSITIDAE Milne-Edwards and Haime 1850

A large proportion of the corals from Prince of Wales

and Somerset Islands, especially from the 'arctic' Ordovician fauna, belong to the Halysitidae. Their abundance permitted a morphological study more detailed and comprehensive than was possible with most of the other coral groups. Particular attention was given to corallite morphology, corallite increase and lacuna patterns. The following discussion of the family deals particularly with the Ordovician halysitids and includes a taxonomic review.

Previous work on the Ordovician Halysitidae

Prior to the study by Buehler (1955) halysitid species were assigned to one genus, *Halysites* Fischer von Waldheim, even though *Catenipora* Lamarck had been established as a genus. Buehler (op. cit.) recognised two genera, *Catenipora*, characterised by monomorphic corallites, and *Halysites*, with dimorphic corallites. Until 1955 the following Ordovician halysitid species had been described from North America (original names):

Halysites gracilis HALL 1851 (in Foster and Whitney 1851)

?*H. catenularia* var. *harti* ETHERIDGE 1878

H. catenularia var. *fieldeni* ETHERIDGE 1878

H. catenularia var. *quebecensis* LAMBE 1899

H. agglomeratiformis WHITFIELD 1900

H. cylindricus WILSON 1926

H. delicatulus WILSON 1926

H. pulchellus WILSON 1926

H. robustus WILSON 1926.

H. gracilis var. *borealis* WILSON 1931

H. aequabilis TEICHERT 1937

H. irregularis TEICHERT 1937

H. rasmusseni TEICHERT 1937.

Buehler reclassified most of these as *Catenipora* but he mistook Etheridge's (1878) and Teichert's (1937) species as Silurian and he only recognised the following as true Ordovician halysitids: *Catenipora delicatula*, *C. gracilis*, *C. pulchella*, *C. quebecensis* and *C. robusta*. He also questioned whether Wilson's (1926) *C. cylindrica* was an halysitid.

Sinclair (1955) reviewed Leith's (1944) description of *Halysites gracilis* and noted that in fact there were two quite distinct species, a monoserial form which he named *C. rubra* and a multiserial form which was the basis of a new genus, *Manipora*, with *M. amicarum* as the type species. Sinclair (op. cit.) also pointed out that *C. rubra* was not intended to be synonymous with *H. gracilis* (s.s.) but the latter name has lapsed from usage in North America.

Sinclair (1955) described *Manipora* as, "A *Saffordophyllum*-like coral of halysitoid habit, the subquadrate corallites forming single or multiple ranks, tabulae complete, the inner walls of the corallites sporadically wrinkled into discontinuous 'septa'." Although likened to *Saffordophyllum*, *Manipora* is considered by many to be a halysitid. Flower

(1961) preferred closer affinities to *Saffordophyllum*, basing his conclusions on detailed studies of corallite wall structures in which he noted that *Manipora* has a single wall layer whereas *Catenipora* has a double layer. Nelson (1963), independantly and apparently without knowledge of Flower's (1961) work, confirmed the single wall layer of *Manipora* while still retaining this genus in the Haly-sitidae. The absence of an outer wall or holotheca seems to be typical of many cerioid corals and may not necessarily be an accurate indication of taxonomic relationships.

Sinclair (1955) added a third halysitid genus, *Quepora*, based on Lambe's (1899) *H. catenularia* var. *quebecensis*. *Quepora* is monomorphic and distinguished by its polygonal lacuna pattern and the absence of septal spines. The absence of septal spines seems to have been the only criterion for establishing a new genus. Nelson (1963) rejected the genus and believed that *Q. quebecensis* was synonymous with *C. aequabilis* (Teichert). *Catenipora aequabilis* is very similar in its lacuna pattern and corallite morphology. Nelson (op. cit.) described some specimens as *C. aequabilis* which had septal spines; septal spines are apparently absent in *C. aequabilis* (s.s.) and *Q. quebecensis*. This difference Nelson (op. cit.) attributed to preservation. Teichert (1937) mistakenly identified his material as Silurian in age whereas the associated fauna is typical of the 'arctic' Ordovician. Nelson's (op. cit.) specimens are also from an

'arctic' Ordovician assemblage and consequently Nelson and Teichert may have been describing the same species. *Quepora quebecensis* was originally described from Middle Ordovician strata but the halysitids are generally long ranging and there is no reason for this species not to be conspecific with a similar halysitid from the Upper Ordovician.

Some doubt must remain concerning the synonymy of *Q. quebecensis* and *C. aequabilis* (sensu Nelson 1963). If it is held that the absence of septal spines is sufficient to differentiate the two, then Nelson's species must be renamed.

Further confusion regarding the status of *C. aequabilis* was added by Hamada (1957) who first classified it as a species of *Quepora*. Later he revised his classification (Hamada 1958) referring *C. aequabilis* to the genus *Falsicatenipora*, a move totally unfounded and in part based on the mistaken belief that *C. aequabilis* was Silurian.

The retention of the generic name *Quepora* is also open to doubt. Sinclair (1955), Hamada (1957), Flower (1961), Strusz (1961) and Webby and Semeniuk (1969) have accepted the use of the generic name. Nelson (1963) would prefer to maintain the use of *Catenipora* for all monomorphic halysitids. The latter view is also supported in this report.

Hamada (1957) added a new Ordovician genus, *Eocatenipora*, with *C. cylindricus* (Wilson) as the type species. Although adequately described by Wilson (1926) the

illustrations are not clear and there are some doubts as to the true affinities of this species (see Buehler 1955, p.59). Flower (1961, p.45) noted that the wall structure of *C. cylindrica* appears to be similar to *Manipora*, a similarity also expressed in this report.

In review it is considered that *Catenipora* is a valid halysitid genus, that the genus *Ouepora* should be suppressed and that the validity of *Manipora* as a halysitid is still open to doubt but for this report will be considered as a halysitid.

North American Ordovician Halysitid Species

The following list contains all the known published North American Ordovician species of *Catenipora* and *Manipora* in use since Buehler's (1955) revision:

- Catenipora aequabilis* (TEICHERT) 1937
- C. agglomeratiformis* (WHITFIELD) 1900
- C. cylindrica* (WILSON) 1926
- C. delicatula* (WILSON) 1926
- C. foersti* NELSON 1963
- C. pulchella* (WILSON) 1926
- C. rasmusseni* (TEICHERT) 1937
- C. rubra* SINCLAIR and BOLTON 1956
- C. quebecensis* (LAMBE) 1899
- C. robusta* (WILSON) 1926
- C. stearni* NELSON 1963

C. workmanae FLOWER 1961

Manipora amicarum SINCLAIR 1955

M. fieldeni (ETHERIDGE) 1878

M. irregularis (TEICHERT) 1937

M. magna FLOWER 1961

M. trapezoidalis FLOWER 1961

Catenipora aequabilis has already been discussed. *Catenipora delicatula* and *C. rasmusseni* are considered to be conspecific. Both species have similar corallite dimensions and circular to elongate lacunae of the same order of magnitude. Nelson (1963, p.58) thought that *C. rasmusseni* and *C. agglomeratiformis* were conspecific. Although corallite dimensions are similar, lacuna patterns are markedly different. They are meandrine to irregular in *C. agglomeratiformis* and circular to elongate in *C. rasmusseni*.

Catenipora pulchella was adequately described by Wilson (1926, p.15) but the illustrations are poor. Until the type material is restudied this species will be considered valid. Nelson (1963, p.59) described a new species, *C. foersti*, characterised by the presence of incomplete ranks. Other than the incomplete ranks there is a close similarity to *C. robusta* and if an environmental control is considered to be the cause of the incomplete ranks then the two species could be considered as conspecific.

Catenipora cylindrica is a very distinct cateniform coral but Buehler (1955) and Flower (1961) both expressed

doubts as to its status as a *Catenipora*. In Wilson's (1926, Pl. 2, fig. 6) illustrations of this species one of the corallites shows a distinct type of peripheral increase similar to a newly noted type to be discussed in subsequent pages. This type of corallite increase is a common feature of *Manipora* spp. although it has been noted in three species of *Catenipora*. Without knowledge of its wall structure it is difficult to assign *C. cylindrica* to its correct genus.

The species *C. rubra*, *C. robusta* and *C. agglomeratiformis* show a gross similarity in their meandrine lacuna pattern. Although there is a tendency for their various parameters to overlap, studies of these species indicate lacuna dimensions to be distinct for each species. *Catenipora rubra* has also been defined as having subquadrate corallites but it has been seen that specimens referable to this species may also have subelliptical corallites.

From the foregoing discussion the following species of *Catenipora* are considered to be valid:

Catenipora agglomeratiformis

C. aequabilis

C. delicatula

C. robusta

C. rubra

C. stearni

C. workmanae

The specific status of *C. foersti* is questionable. The status of *C. quebecensis* has already been discussed.

Catenipora cylindrica and *C. pulchella* may not belong to the genus *Catenipora* but for the present are retained until the type material is studied.

Sinclair's (1955) definition of *Manipora* was based, in part, on Leith's (1944) description of *Halysites gracilis*. Some of Leith's (op. cit.) material was used as the type specimens for *Manipora amicarum* and Sinclair (op. cit.) illustrated additional specimens. If the two authors' illustrations are compared (Leith 1944, Pl. 42, figs. 1, 2; Pl. 43, figs. 1, 3, 4; Sinclair 1955, Pl. 17, figs. 1, 4, 10) two variations are obvious. Sinclair's (op. cit.) illustrations are of an essentially monoserial form whereas Leith (op. cit.) illustrated a dominantly biserial form. At first it would seem two species are represented but study of these corals from the Upper Ordovician rocks of Somerset Island indicates that there is probably a gradation between the monoserial and the multiserial forms. These specimens of *M. amicarum* have three main forms with the following characters:

- i) essentially monoserial ranks with small corallite clusters at rank junctions (Pl. 29, fig. 1),
- ii) monoserial and biserial ranks, occasionally triserial, with clusters of 2 to 4 corallites at rank junctions (Pl. 27, fig. 4),
- iii) biserial and triserial ranks, corallite clusters enclose small circular lacunae (Pl. 29, figs. 2, 3).

Intermediate forms are present but few in number. Studies of the asexual methods of increase in *Manipora* have shown how multiserial ranks could be derived from monoserial ones (fig. 23). Perhaps the environment may control to some extent the growth of ranks, as for instance an abundant food supply may encourage rank growth.

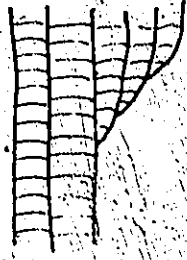
Flower (1961) described two new species of *Manipora*, *M. magna* and *M. trapezoidalis*, both of which are considered to be variants of *M. amicarum*. Flower's (op. cit.) new species have the growth form of *M. amicarum* and differ only in the corallite size or shape.

Catenipora irregularis, reclassified to *Manipora* by Nelson (1963), is very similar to *M. fieldeni*. Nelson (op. cit.) also noted the similarity but preferred to retain the species. The original description and illustrations (Teichert 1937, p.132) are poor and could easily be interpreted as *M. fieldeni*. In this report the two species are considered to be conspecific.

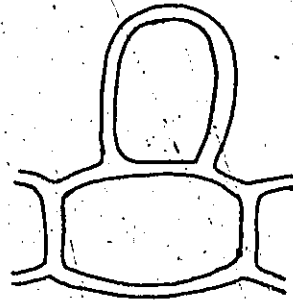
From this brief review of the past literature only *M. amicarum* and *M. fieldeni* are considered to be valid species. The other named species should be restudied and reviewed in the light of modern species concepts and new information.

Corallite Increase in *Catenipora* and *Manipora*

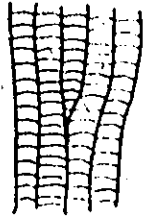
Three main methods of corallite increase have been



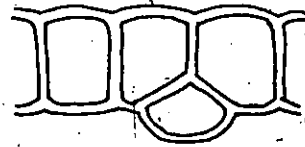
Peripheral increase



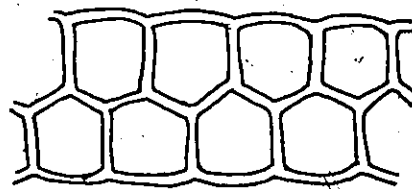
Lateral peripheral increase



Intermural increase



Lateral intermural increase



Biserial rank formation by lateral intermural increase

FIGURE 23. ASEQUAL CORALLITE INCREASE IN THE HALYSITIDAE.

identified in *Catenipora* and *Manipora* (Buehler 1955, Hamada 1959) and these are peripheral budding, intermural or interstitial increase and lateral budding. These methods will be briefly outlined and two variations of the first two methods will also be discussed.

Peripheral budding

Peripheral budding involves the addition of a corallite to the end of a rank (fig. 23) such that the long diameter of the new corallite is essentially continuous to or slightly oblique to the long diameter of the preceding corallite. Peripheral budding in a lateral direction has not been previously reported but examination of the species of *Manipora* and two new species of *Catenipora* show that this variation of peripheral budding is a common occurrence. A swelling on one of the lateral sides of a corallite develops and expands. Eventually the swelling is separated from the parent corallite by a wall (fig. 23). This variation of peripheral budding results in the formation of either new ranks or multiserial ranks.

Intermural increase

Intermural or interstitial increase involves the insertion of new corallites between existing corallites and these develop within the rank (fig. 23). A variation on this method was observed in *M. amicarum* and *M. fieldeni* in which the new inserted corallite develops in a lateral direction instead of within the rank (fig. 23). This

type of corallite increase gives rise to multiserial ranks (fig. 23).

Lateral budding

Hamada (1959, pp.276-277, fig. 4) defined lateral budding as ".... the springing up of a new corallite from an older corallite tube, the two being connected only at the base of the new one." Only one example was cited by Hamada (op. cit.) and he did not consider this method of increase to be important, suggesting that it was mainly a form of rejuvenation.

Megacorallite: A New Type of Corallite

Unusually large corallites are present in two new species of *Catenipora* from Somerset Island. These corallites are 2 to 2.5 times larger than the auto-corallites and will be referred to as megacorallites (the term macrocorallite has already been applied to a type of corallite).

In *Catenipora* n.sp.2 the megacorallites occur within the monoserial ranks as enlarged, subelliptical, circular or subquadrate corallites (Pl. 16, figs. 1,2; Pl. 30, fig. 4). The megacorallites of *Catenipora* n.sp.1 have a similar morphology but usually occur in the centre of tri- or quadripartite rank divergence (Pl. 21, figs. 1,2). This mode of occurrence is rare in *Catenipora* n.sp.2.

The megacorallites of *Catenipora* n.sp.2 are apparently

persistent vertically; one example extended for at least 30mm. Serial sections of a megaripple from *Catenipora* n. sp.1 showed that the megacorallites originate by expansion of an autocorallite and that after a short vertical distance (about 5mm.) they revert to an autocorallite. In *Catenipora* n.sp.2 the megacorallites are more persistent vertically and serial sections failed to reveal whether the megacorallites originate in the same way as those of *Catenipora* n.sp.1.

The significance of the megacorallites is uncertain, although the following factors may be involved:

- i) mutation or disease
- ii) variation of known species
- iii) sexual reproduction
- iv) asexual reproduction.

The first two factors are not thought to be strong possibilities when it is considered that the megacorallites occur in two distinct species. As only three specimens have megacorallites, disease could be considered a feasible explanation but the persistence of megacorallites within a corallum and their apparent 'virility' in allowing asexual increase to continue do not point to a diseased corallite. An enlarged corallite was observed in only one corallum of *Manipora fieldeni* which superficially resembles a megacorallite. Past descriptions and illustrations of this species do not include enlarged corallites. Therefore this isolated occurrence in *Manipora fieldeni* is probably not a true megacorallite.

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The possibility that megacorallites are related to corallite increase or sexual reproduction is considered to be more likely. If at least two species contain megacorallites one would assume the polyps of the megacorallites performed a similar, unique and intermittent function. This function is believed to have been sexual reproduction and the polyps may have contained both male and female gametes. In the other species of *Catenipora* it is possible that all the autocorallites were capable of gamete production. On the other hand in the two new cateniporid species if gamete production was limited to a specialised polyp then these polyps would have to produce a greater proportion of gametes and this may explain their larger size. Considering that the cateniporids already had efficient means of asexual increase and furthermore, that the two new species also exhibit the previously described variations of asexual reproduction the reproductive function of the megacorallites may be sexual rather than asexual.

No published references to or illustrations of comparable corallite structures have been found. In addition, the two new species which best show the megacorallites are quite distinct from all previously described cateniporid species.

Theoretical Development of Lacuna Patterns

Both Buehler (1955) and Hamada (1959) discussed the

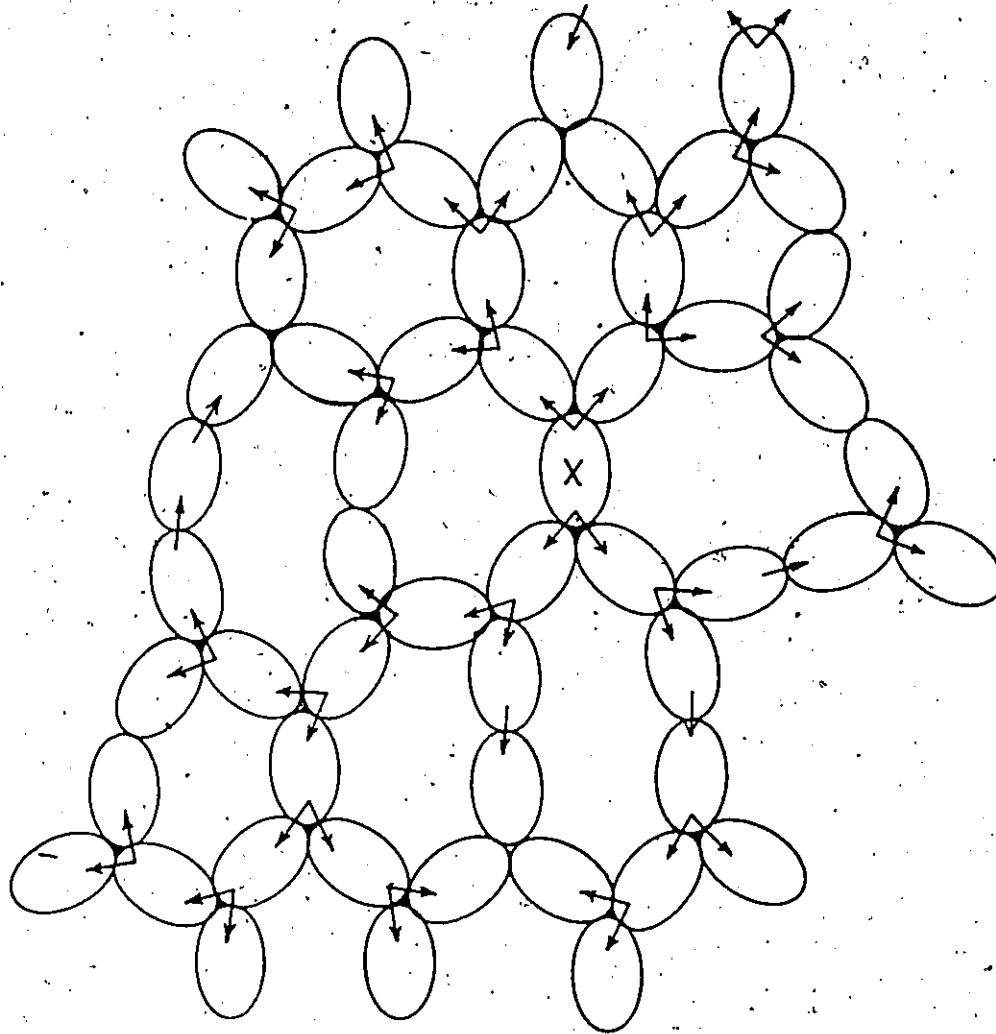


FIGURE 24 DEVELOPMENT OF A POLY-
GONAL LACUNA PATTERN IN
THE HALYSITIDAE.
X - initial polyp.

growth of cateniform corals but the present discussion will attempt to link the various patterns in the form of a theoretical evolutionary sequence. The earliest known halysitid is the Middle Ordovician *Catenipora quebecensis* which is characterised by polygonal or circular lacunae, and by ranks usually only one or two corallites in length (fig. 24).

If it is assumed that *C. quebecensis* represents the primitive stock, or a closely related form, it can be demonstrated how more complex lacuna patterns could have been derived from this simple polygonal pattern.

As previously discussed peripheral buds usually arose at the ends of the long diameter of the corallites. Therefore the initial polyp of *C. quebecensis* would have had two 'ends' capable of peripheral budding but all subsequent polyps would only have had one 'end' capable of corallite increase. In *C. quebecensis* the ranks are usually one or two corallites in length resulting in a closed polygonal pattern (fig. 24). Initial growth of halysitoid colonies involved rapid lateral expansion followed by vertical growth. The polygonal lacuna pattern was maintained by occasional intermural increase and cross-linking between the enlarged ranks.

From this simple pattern it is very easy to derive all subsequent lacuna patterns. By generating new corallites through intermural increase to form ranks greater than one corallite in length the corals would have developed a larger

circular lacuna pattern, as in *Catenipora delicatula*. Further rank increase by intermural increase would have produced elongate and meandrine lacuna patterns typical of *Catenipora rubra*, *C. robusta* and *C. agglomeratiformis*.

Thus from theoretical considerations *C. quebecensis*, or a species very similar, is considered to have been the parent stock from which arose the Ordovician species, *C. delicatula*, *C. rubra*, *C. robusta* and *C. agglomeratiformis*. *Catenipora delicatula* has a lacuna pattern intermediate between *C. quebecensis* and the remaining three cateniporid species named above. The species of *Manipora* may also show similar trends, *M. fieldeni* has polygonal lacunae whereas *M. amicarum* has an irregular lacuna pattern.

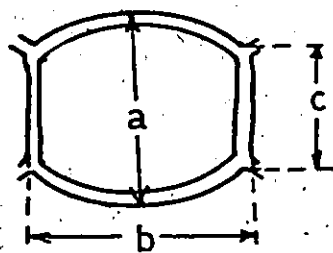
One of the features noted in the review of the cateniporid corals is that lacuna patterns are apparently specific characteristics. Consequently the effect of environment upon lacuna patterns is difficult to assess. Further work using very large collections is needed for a comprehensive understanding of this problem but this is not possible in this discussion. Qualitative observations indicate that each species has a consistent lacuna pattern. *Catenipora rubra* and *C. robusta* both have elongate to meandrine lacunae but in the latter species the lacunae are generally smaller. These two species are further distinguished by corallite size and shape.

Genus *Catenipora* Lamarck 1816

Type Species *Catenipora escharoides* Lamarck 1816

Cateniform coralla consisting of monomorphic corallites (autocorallites) generally arranged in monoserial ranks.

The method of measurement of individual corallites differed from some authors. It was found simpler to measure the long diameter, that is the axis parallel to the rank, and include both shared walls rather than to measure the distance between the mid-points in each shared wall (fig. 25). Other dimensions correspond to those used by previous authors.



- a - short diameter
- b - long diameter
- c - appressed end

FIGURE 25 SIZE PARAMETERS OF A HALYSITID AUTOCORALLITE

Catenipora aequabilis (Teichert)

Pl. 26, fig. 1

- 1931 *Halysites* cf. *fieldeni* (Etheridge). WILSON, p.297, Pl.3, figs.6,7.
- 1937 *Halysites aequabilis* TEICHERT, p.57, Pl.8, fig.2; Pl.9, fig.4.
- 1957 *Quepōra aequabilis* (Teichert). HAMADA, pp.408, 423.
- 1958 *Falsicatenipora aequabilis* (Teichert). HAMADA, p.98.
- 1963 *Catenipora aequabilis* (Teichert). NELSON, p.57, Pl.14, figs.8,9.

?1969 *Quepōra calamus* WEBBY and SEMENIUK, p.346, figs.1a,b.

Occurrence: G.S.C. localities 89509, 89511 and 89514.

Horizon and age: Locality 89513: in the top 200ft. (61m.)

of the Lang River Formation. Locality 89509: 320-350ft.

(97-106m.) above the base of the Allen Bay Formation.

Locality 89511: 530-1,000ft. (161-304m.) below the top of the Allen Bay Formation. Upper Ordovician.

Plesiotypes: X58, X71, CBl/1 to CBl/9, B29/1, B29/2.

Description: The coralla are large and hemispherical, and the largest is 230mm. in diameter and 180mm. high.

The corallites are subelliptical to elliptical in shape, occasionally subquadrate or subcircular. The corallite dimensions are as follows (100 measurements):

Long diameter(mm.)			Short diameter(mm.)			Av. ratio (long/short)
Max.	Min.	Av.	Max.	Min.	Av.	
1.9	1.3	1.5	1.2	0.7	0.9	1.7

Twelve septal spines are usually present and are well preserved.

The coralla have short monoserial ranks one to four corallites in length, but usually with only one or two corallites. The lacunae are characteristically polygonal, subcircular or elliptical. Lacuna dimensions are as follows (50 measurements):

Transverse length (mm.)			Transverse width (mm.)		
Max.	Min.	Av.	Max.	Min.	Av.
4.0	2.2	2.9	2.5	1.5	1.6

The tabulae are flat and there are 7-9 per 5mm.

Remarks: The status of this species has been discussed in the introduction to the Halysitidae.

Catenipora agglomeratiformis (Whitfield)

Pl. 26, fig. 2

- 1900 *Halysites agglomeratiformis* WHITFIELD, p.20, Pl.2, figs.1,2.
- 1915 *Halysites agglomeratiformis* Whitfield. BASSLER, p.584.
- 1928 *Halysites agglomeratiformis* Whitfield. TROEDSSON, p.133, Pl.46, figs.1a-d.
- 1941 *Halysites agglomeratiformis* Whitfield. ROY. p.77, figs.39a-c.
- 1954 *Halysites agglomeratiformis* Whitfield. MILLER et al., Pl.8, fig.1.
- 1955 *Catenipora agglomeratiformis* (Whitfield). BUEHLER, p.49.
- 1957 *Quepora agglomeratiformis* (Whitfield). HAMADA, p.408.

1963 *Catenipora agglomeratiformis* (Whitfield). NELSON,
p.58, Pl.14, figs.10,11.

1969 *Quepora agglomeratiformis* (Whitfield). WEBBY and
SEMENIUK, p.356.

Occurrence: G.S.C. localities 89513 and 89519.

Horizon and age: Locality 89519: 907-1317ft. (277-400m.)
above the base of the Lang River Formation and in the top
200ft. (61m.) of the formation at locality 89513.

Plesiotypes: X204/7, Z16/11.

Description: The coralla are small and bun-shaped, 50mm.
high, 90mm. long and 65mm. wide.

The corallites are consistently elliptical in cross
section with strongly curved walls and pinched appressed
ends. This gives the ranks a beaded appearance. The
corallite dimensions are as follows (20 measurements):

Long diameter (mm.)			Short diameter (mm.)			Av. ratio
Max.	Min.	Av.	Max.	Min.	Av.	(long/short)
1.6	1.0	1.3	1.0	0.75	0.9	1.5

The appressed ends of the corallites are 0.6-0.7mm. wide in
cross section. Septal spines are present in specimen Z16/11.

The coralla have monoserial ranks up to 18 corallites
in length but most contain between 5 and 8 corallites. The
lacunae are circular to meandrine and have the following
dimensions (10 measurements):

Transverse length (mm.)			Transverse width (mm.)		
Max.	Min.	Av.	Max.	Min.	Av.
50	1.5	10-20	4.0	1.0	2.0

The tabulae are flat and there are 10 per 5mm.

Catenipora delicatula (Wilson)

Pl. 27, fig. 1; Pl. 28, fig. 3

- 1926 *Halysites delicatulus* WILSON, p.14, Pl.2, figs.3-5.
?1928 *Halysites gracilis* (Hall). HUSSEY, p.71, Pl.1, fig.4.
1937 *Halysites rasmusseni* TEICHERT, p.134, Pl.9, figs.5,
6; Pl.10, fig.2.
1955 *Halysites delicatulus* Wilson. BUEHLER, p.58.
1955 *Halysites rasmusseni* Teichert. BUEHLER, p.65.
1957 *Quepura delicatula* (Wilson). HAMADA, p.408.

Occurrence: G.S.C. localities 89509, 89511, 89513 and 89519.

Horizon and age: Locality 89519: 907-1317ft. (277-400m.) above the base of the Lang River Formation and in the top 200ft. (61m.) of the formation at locality 89513. Locality 89509: 320-350ft. (97-106m.) above the base of the Allen Bay Formation and 530-1,000ft. (161-304m.) below the top of the formation at locality 89511.

Plesiotypes: X157, Z16/10, CB2/10, CB2/15, B29/7.

Description: The coralla are disc-shaped and one of the complete specimens is 130mm. long, 95mm. wide and 38mm. high.

Corallites are generally elliptical and have the following dimensions (50 measurements):

Long diameter (mm.)			Short diameter (mm.)			Av. ratio
Max.	Min.	Av.	Max.	Min.	Av.	(long/short)
1.75	1.2	1.4	1.0	0.7	0.8	1.8

Specimen B29/7 has unusually wide corallites (average 1.25mm.) and slightly greater than average long diameters (average 1.7mm.) and is not included in the above measurements.

Septal spines are not apparent.

The corallum has monoserial ranks with as many as 6 corallites but most ranks have 2 to 4 corallites. The ranks form a net-like pattern enclosing circular, polygonal or elongate lacunae. The lacunae diameters rarely exceed 10mm. although one example was 30mm. across. Most lacunae are between 1 and 6mm. in diameter.

The tabulae are flat or slightly arched and there are 10 per 5mm.

Remarks: Teichert's (1937) *Halysites rasmusseni* was mistakenly identified as Silurian when in fact the associated fauna is typically Upper Ordovician. *Halysites rasmusseni* and *C. delicatula* are almost identical in their descriptions.

Catenipora cf. delicatula (Wilson)

Pl. 27, figs. 2,3.

Occurrence: G.S.C. localities 89509, 89513 and 89519.

Horizon and age: Locality 89519: 907-1317ft. (277-400m.) above the base of the Lang River Formation and in the top 200ft. (61m.) of the formation at locality 89513. Locality 89509: 320-350ft. (97-106m.) above the base of the Allen Bay Formation. Upper Ordovician.

Hypotypes: XI65, Z16/4, CB2/12, CB2/13.

Description: The coralla are disc-shaped and the only complete corallum is 150mm. in diameter and 40mm. high.

The corallites are elliptical and have the following dimensions (40 measurements):

Long diameter (mm.)			Short diameter (mm.)			Av. ratio
Max.	Min.	Av.	Max.	Min.	Av.	(long/short)
2.75	1.9	2.3	1.5	1.1	1.4	1.7

Traces of septal spines occur in one specimen but spines are otherwise absent.

The corallites occur in monoserial ranks up to 8 corallites in length but usually there are between 4 and 6.

The lacunae are circular, polygonal or slightly elongate and they rarely exceed 30mm. in diameter.

The tabulae are generally flat and there are 5-8 per

5mm.

Remarks: The corallite dimensions approach those of *C. rubra* and *C. robusta*, whereas the lacunae are comparable to *C. delicatula*.

Catenipora robusta (Wilson)

Pl. 28, fig. 4

1926 *Halysites robustus* WILSON, Pl.1, figs.8-10.

1955 *Catenipora robusta* (Wilson). BUEHLER, p.58.

1963 *Catenipora robusta* (Wilson). NELSON, p.56, pl.14, figs. 3-5.

Occurrence: G.S.C. localities 89509, 89513, 89514 and 89518.

Horizon and age: Locality 89518: 2,700-2,900ft. (823-884m.) above the base of the Lang River Formation and in the top 200ft. (61m.) of the formation at localities 89513 and 89514. Locality 89509: 320-350ft. (97-106m.) above the base of the Allen Bay Formation. Upper Ordovician. Plesiotypes: X51, X65, X204/30, Y5/2, CB2/14, CB2/16, CB2/17, CB2/19.

Description: The coralla are hemispherical and the largest attains a height of 120mm.

The corallites are monomorphic, mostly subelliptical in cross section and have the following dimensions (60 measurements):

Long diameter (mm.)			Short diameter (mm.)			Av. ratio (long/short)
Max.	Min.	Av.	Max.	Min.	Av.	
2.1	1.6	1.8	1.6	1.2	1.3	1.4

The cross-sectional width of the appressed ends is about 1.2mm. but may be as little as 0.9mm. Septal spines are present in some of the corallites and their occurrence is apparently controlled by preservation. There are no more than 12 vertical series of septal spines per corallite.

The monoserial ranks of corallites enclose meandrine lacunae. The lacunae have a maximum transverse length of 20mm. but most are 8-10mm. long with corresponding widths of 2-4mm. The lacunae may also be circular, polygonal or elongate. Ranks may contain from 4 to 9 corallites but most only contain between 4 and 6 corallites.

The tabulae are flat and there are 5-10 per 5mm.

Remarks: Although the corallite dimensions approach those of *C. rubra* the dimensions of the lacunae are considerably smaller and distinct.

Catenipora rubra Sinclair and Bolton

Pl. 28, figs. 1, 2

- 1899 *Halysites catenularia* var. *gracilis* (Hall). (partim.)
LAMBE, p.69, Pl.3, fig.5.
- ?1937 *Halysites gracilis* (Hall). TEICHERT, p.55, Pl.7, figs.
3,6.
- 1941 *Halysites* cf. *gracilis* (Hall). ROY, p.79, figs.40a,b.
- 1944 *Halysites gracilis* (Hall). (partim.), LEITH, Pl.43,
figs.3,5.
- 1955 *Catenipora gracilis* (Hall). BUPHLER, p.36, Pl.4, fig.
7; Pl.5, fig:1.
- 1955 *Catenipora rubra* Sinclair and Bolton. SINCLAIR, p.99,
Pl.1, figs.2,6,7; fig.2.
- 1956 *Catenipora rubra* SINCLAIR and BOLTON, p.204.
- 1963 *Catenipora rubra* Sinclair and Bolton. NELSON, p.55,
Pl.14, figs.1,2.

Occurrence: G.S.C. localities 89511, 89513, 89518 and 89519.

Horizon and age: Locality 89513: in the top 200ft. (61m.)
of the Lang River Formation and at localities 89518 and
89519, 2,700-2,900ft. (823-884m.) and 907-1317ft. (277-
400m.) above the base of the Lang River Formation respect-
ively. Locality 89511: 530-1,000ft. (161-304m.) below the
top of the Allen Bay Formation. Upper Ordovician.

Plesiotypes: X204/5, Z16/12, Y5/1, Y5/3, B29/11.

Description: The five specimens identified as *C. rubra* exhibit a wide range of corallite dimensions as shown by the following (a minimum of 10 measurements per specimen):

Specimen.	Long			Short			Av. ratio (long/short)
	diameter (mm.)			diameter (mm.)			
	Max.	Min.	Av.	Max.	Min.	Av.	
B29/11	2.25	1.25	1.7	1.5	1.2	1.3	1.3
Y5/1	2.75	2.0	2.4	1.3	1.25	1.3	1.9
Y5/3	2.5	1.75	2.1	1.5	1.1	1.3	1.6
Z16/12	2.25	1.6	1.9	1.6	1.25	1.4	1.4
X204/5	2.5	1.75	2.2	1.7	1.2	1.4	1.6

The corallite cross-sectional shape varies from subelliptical to subquadrate. The corallites occur in monoserial ranks. Most specimens do not have septal spines although spines occur sporadically in two specimens of the collection.

The lacunae are characteristically meandrine with transverse lengths up to 40mm. and corresponding widths of 3-4mm. Most lacunae are 20-25mm. long in cross section.

The tabulae are flat and there are 6-9 per 5mm.

Remarks: The corallites are more elongate than is typical of *C. rubra* but the lacunae are typical of this species.

Catenipora n.sp.1

Pl. 21, figs, 1,2

Occurrence: G.S.C. locality 89513.

Horizon and age: Top 200ft. (61m.) of the Lang River

Formation. Upper Ordovician.

Holotype: X204/8.

Diagnosis: Dimorphic corallites: autocorallites and a few megacorallites. Monoserial ranks often incomplete. Adjacent corallites often offset. Circular, elongate, labyrinthine or irregular lacunae.

Description: The corallum is disc-shaped, 170mm. long, 110mm. wide and 60mm. high.

Two types of corallites are present, the typical autocorallites, which are by far the most abundant, and a new type of large circular or polygonal corallite, to be called megacorallites. The autocorallites are elliptical to sub-elliptical and have the following dimensions (30 measurements):

Long diameter(mm.)			Short diameter(mm.)			Av. ratio (long/short)
Max.	Min.	Av.	Max.	Min.	Av.	
2.1	1.6	1.9	1.4	1.2	1.3	1.5

The appressed ends are 0.8mm. wide in cross section. Autocorallite walls are relatively thick and consist of two layers, an outer holotheca which is one-half to one-third of the total wall thickness and an inner fibrous layer. The free walls are 0.15-0.25mm. thick and the shared walls are 0.25-0.5mm, thick. Septal spines are present and do not exceed 12 in number.

The megacorallites are about 2.25mm. in diameter and usually are situated at the junction of three or four radiating ranks. In serial cuts of the corallum the

frequency of occurrence decreases towards the base of the corallum. There is one per 6.25sq. cm. at the top of the corallum and one per 20.6sq. cm. near the base.

The autocorallites form monoserial ranks of as many as 12 corallites but most ranks have between 3 and 9 corallites. The ranks are often incomplete. Lacunae are circular, elongate, labyrinthine or irregular. The circular and elongate lacunae are 2-4mm. in diameter. Labyrinthine lacunae result from the incompleteness of ranks across the lacunae and in cross section may exceed 40mm. in length. In some ranks the alternate free walls of the autocorallites have a greater curvature and make adjacent corallites appear offset.

The tabulae in the autocorallites are generally flat but may be gently arched or depressed. Megacorallites have more pronounced arched tabulae. In both types of corallite tabular spacing is irregular and their number varies from 6 to 12 per 5mm.

The corallites display peripheral and intermural increase and the variation of peripheral increase which has been discussed in the introduction to the Halysitidae.

Remarks: Although *Catenipora* is partly defined as monomorphic the characteristics of this new species, apart from the megacorallites, are cateniporid in nature and it is not necessary to establish a new genus. Instead it is preferable to expand the definition of *Catenipora* to include

those specimens which are essentially cateniporid in character but which have megacorallites.

Catenipora n.sp.2.

Pl. 16, figs. 1,2: Pl.30, fig. 4

Occurrence: G.S.C. locality 89519.

Horizon and age: 907-1317ft. (277-400m.) above the base of the Lang River Formation. Upper Ordovician.

Holotype: Z16/3.

Paratype: Z16/5.

Diagnosis: General appearance similar to *Catenipora rubra* but also has megacorallites. Megacorallites occur within normal monoserial ranks and only rarely form the nucleus of rank generation.

Description: The corallum of the holotype is 150mm. long, 90mm. wide and 150mm. high, but is incomplete.

The corallites are characteristically subrectangular to subquadrate in cross section but have a subelliptical lumen. The dimensions of the autocorallites show little variation and are as follows (20 measurements):

Long diameter (mm.)			Short diameter (mm.)			Av. ratio
Max.	Min.	Av.	Max.	Min.	Av.	(long/short)
2.1	1.9	2.0	1.25	1.1	1.2	1.7

The appressed ends of the autocorallites are 0.9-1.0mm. wide in cross section. Autocorallite free walls are 0.2mm. thick and consist of two layers, a very thin holotheca, about one-fifth of the total wall thickness, and a thicker

inner fibrous layer. Common walls are between 0.25 and 0.5mm. thick.

The megacorallites are circular or subelliptical and 2.5mm. in diameter. They occur mostly within the monoserial ranks and only rarely form the nucleus of three radiating ranks.

Septal spines are not apparent in either type of corallite.

The lacunae are mostly meandrine and in cross section they attain 60mm. in length and range from 2 to 10mm. in width. There are also circular and elongate lacunae rarely exceeding 10mm. in diameter.

The tabulae are similar in both corallite types. They are generally flat but may be gently arched or depressed. There are 8-10 per 5mm.

Corallite increase is by peripheral budding and intermural increase and also the two newly described variations of these methods. The two additional variations of corallite increase are not common.

Remarks: In general appearance this species resembles *Catenipora rubra*, especially in its lacuna pattern. However, the new species differs in the following ways:

- i) the presence of megacorallites,
- ii) the presence of the variations in peripheral budding and intermural increase,
- iii) the possession of subrectangular corallites as opposed

to the subquadrate corallites of *C. rubra*,
iv) the presence of thicker autocorallite walls.

Catenipora n.sp.3

Pl. 30, figs. 3a,b

Occurrence: G.S.C. locality 89513.

Horizon and age: The top 200ft. (61m.) of the Lang River Formation. Upper Ordovician.

Holotype: X170.

Diagnosis: Monomorphic corallites, elliptical in cross section with strongly appressed ends imparting a beaded appearance to the ranks. Short monoserial ranks enclosing circular or elongate lacunae.

Description: The holotype is an incomplete corallum 130mm. long, 40mm. wide and 75mm. high.

Corallites are elliptical with strongly appressed ends and the latter are 0.75-0.9mm. wide in cross section. Corallite dimensions are as follows (10 measurements):

Long diameter (mm.)			Short diameter (mm.)			Av. ratio (long/short)
Max.	Min.	Av.	Max.	Min.	Av.	
2.25	2.0	2.1	1.5	1.25	1.4	1.5

The free wall consists of two layers, an extremely thin holotheca and an inner fibrous layer which together are 0.2mm. thick. Septal spines are not apparent. Corallite increase involves peripheral and intermural increase plus the newly described variation of peripheral increase.

The short monoserial ranks contain 1 to 4 corallites.

The lacunae are circular or elongate and range from 1 to 15mm. in diameter.

The tabulae are gently arched.

Genus *Halysites* Fischer von Waldheim 1813

Type Species *Tubipora catenularia* Linnaeus 1767

Cateniform corallum, dimorphic corallites. Autocorallites separated by smaller mesocorallites.

Halysites labyrinthicus (Goldfuss)

1826 *Catenipora labyrinthica* GOLDFUSS, p.75, tab.25, figs. 5a,b.

1937 *Halysites labyrinthicus* (Goldfuss). TEICHERT, p.135, Pl.9, figs.1-3.

1955 *Halysites labyrinthicus* (Goldfuss). BUEHLER, p.29, Pl.3, figs.1-5.

Occurrence: G.S.C. localities 89510, 89515, and 89520.

Horizon and age: In the lower half of the Allen Bay Formation at all localities. Lower Silurian.

Plesiotypes: X130 to X132, Z34/1, Z34/2, A40/1.

Description: The specimens are fragments of a large corallum. The plesiotypes have the following autocorallite dimensions (a minimum of 10 measurements per specimen):

Specimen	Long			Short			Av. ratio (long/short)
	diameter (mm.)			diameter (mm.)			
	Max.	Min.	Av.	Max.	Min.	Av.	
Z34/1	2.5	1.9	2.3	2.0	1.75	1.9	1.2

Z34/2	3.0	2.0	2.4	2.4	1.5	2.0	1.2
X130-132	2.75	2.0	2.4	2.25	1.8	2.1	1.2
A40/1	3.25	2.25	2.8	3.0	2.25	2.7	1.0

In transverse section the autocorallites are elliptical to subcircular. In transverse section the mesocorallites are rectangular with their longest axis perpendicular to the length of the rank. The long diameter is between 1.0 and 1.5mm. and the short diameter between 0.5 and 1.25mm. No septal spines are apparent in the autocorallites.

The lacunae are highly irregular in shape where the long ranks are incomplete. Some ranks may have as many as 14 corallites. The lacunae are often open ended and 4 to 6 mm. wide in cross section.

The tabulae in the autocorallites may be arched, depressed or flat and there are 5-10 per 5mm.

Halysites encrustans n.subsp.A

Pl. 26, fig. 3

1955 *Halysites encrustans* BUEHLER, p.66, Pl.10, figs.1-5.

Occurrence: G.S.C. locality 89515.

Horizon and age: Lower half of the Allen Bay Formation.

Lower Silurian.

Type Specimen: X36/1.

Diagnosis: Similar in form to *Halysites encrustans* but the corallites are 1.5 to 2 times larger, and lacunae are larger.

Description: The specimen is an incomplete corallum 60mm. in diameter and 55mm. high.

The corallites are dimorphic. The larger autocorallites are subcircular to oval and have the following dimensions (10 measurements):

Long diameter (mm.)			Short diameter (mm.)			Av. ratio
Max.	Min.	Av.	Max.	Min.	Av.	(long/short)
2.75	2.25	2.6	2.5	1.75	2.1	1.2

Septal spines are not apparent. Mesocorallites are very small with their longest axis (perpendicular to the rank) about 1.0mm. and their shortest axis about 0.4mm. The smallness of the mesocorallites accentuates the beaded appearance of the ranks in cross section.

The monoserial ranks contain from 1 to 3 corallites and enclose polygonal or slightly elongate lacunae which generally measure 4 by 6mm. The largest lacuna is 10 by 3mm.

The tabulae are usually flat or locally slightly depressed. There are 8 per 5mm.

Remarks: Because the corallites and lacunae are much larger than *Halysites encrustans* this subspecies may merit full species status. However, the remarkable similarity of form between the two suggests that they are closely related and probably conspecific.

Genus *Manipora* Sinclair 1955

Type Species *Manipora amicarum* Sinclair 1955

Monomorphic corallites arranged in monoserial or multi-serial ranks. Wall structure one layer thick and the inner

surface often wrinkled into ridges.

Manipora amicarum Sinclair

Pl. 27, fig. 4; Pl.29, figs. 1-3

- 1928 *Halysites gracilis* (Hall). TRÖEDSSON, p.131, Pl.40, figs.2,3a,b.
- 1944 *Halysites gracilis* (Hall). (partim). LEITH, p.268, Pl.42, figs.1,2: Pl.43, fig.4.
- 1955 *Manipora amicarum* SINCLAIR, p.97, Pl.1, figs.1,4,10.
- 1961 *Manipora amicarum* Sinclair. FLOWER, p.46, Pl.2, figs. 1-5,8,9: Pl.3.
- 1961 *Manipora magna* FLOWER, p.45, Pl.2, figs.6,7.
- 1961 *Manipora trapezoidalis* FLOWER, p.47, Pl.4
- 1963 *Manipora amicarum* Sinclair. NELSON, p.60, Pl.15, figs.1-3.

Occurrence: G.S.C. localities 89513, 89514 and 89519.

Horizon and age: Locality 89519: 907-1317ft. (277-400m.) above the base of the Lang River Formation and in the top 200ft. (61m.) of the formation at localities 89513 and 89514. Upper Ordovician.

Plesiotypes: X204/1, X204/3, X204/4, X53, X175, X176, X190, Z16/6, Z16/7, Z16/9, X174.

Description: No complete coralla were collected. The largest specimen was 120mm. long, 90mm. wide and 70mm. high.

The corallites are arranged in monoserial, biserial and locally triserial ranks. Clusters of corallites, with an appearance similar to favositid corallites, may be

present, especially at rank junctions. The corallites are polygonal and their shape varies according to the type of rank in which they occur. Subquadrate to quadrate corallites are common in monoserial ranks; pentagonal corallites in biserial ranks or in the centre row of triserial ranks; and hexagonal corallites are present in the centre of corallite clusters. The corallites are approximately equidimensional and have long diameters of 2.25 to 2.5mm. and short diameters of 1.5 to 2.25mm.

The corallite free walls are usually strongly convex and in monoserial ranks a more strongly convex free wall may occur alternately in adjacent corallites and impart an offset appearance to the corallites. The inner surface of the corallite wall is wrinkled into longitudinal ridges in most corallites.

The lacuna patterns are varied, from labyrinthine to circular. The ranks are often incomplete.

The tabulae are usually flat or may be slightly arched or depressed. There are 8-10 per 5mm.

Remarks: *Manipora magna* and *M. trapezoidalis* show the basic growth form of *M. amicarum* and apparently differ only in size and cross sectional shape of the corallites. These differences are not considered sufficient to merit species status.

Manipora amicarum n.subsp.A

Occurrence: G.S.C. locality 89511.

Horizon and age: 530-1,000ft. (161-304m.) below the top of the Allen Bay Formation. Upper Ordovician.

Type specimens: B29/3, B29/9, B29/12, B29/16, B29/5.

Diagnosis: Corallites commonly occur in favositid-like clusters.

Description: The coralla are incomplete and the largest specimen is 150mm. long. They occur in dolomite and are poorly preserved. The radiating growth pattern suggests that the coralla were hemispherical.

The corallites commonly occur in favositid-like clusters, more than is usual for *M. amicarum*. Monoserial and multiseriate ranks are also present. The corallites are commonly pentagonal or hexagonal, equidimensional and 2.0mm. in diameter. The inner surfaces of the walls are wrinkled into longitudinal ridges.

The ranks are mostly incomplete and therefore the lacunae are very irregular in shape and often open ended.

The tabulae are flat and there are 8-10 per 5mm.

Manipora fieldeni (Etheridge)

Pl. 25, fig. 4

1878 *Halysites catenularia* var. *fieldeni* ETHERIDGE, p.582,

Pl.28, fig.1.

?1899 *Halysites catenularia* var. *gracilis* (Hall). (partim.)

LAMBE, pp.69, 74, Pl.3, fig.7.

1915 *Halysites catenularia fieldeni* (Etheridge). BASSLER, p.586.

- (non) 1925 *Halysites catenularia fieldeni* (Etheridge). HUME, p.38, Pl.8, fig.3.
- 1928 *Halysites fieldeni* (Etheridge). TROEDSSON, p.132, Pl.41, Pl.42, Pl.43, figs.1a,b.
- 1937 *Halysites irregularis* TEICHERT, p.132, Pl.7, figs.4, 5; Pl.8, fig.3.
- 1944 *Halysites gracilis* (Hall). (partim.), LEITH, Pl.43, figs.1,2.
- 1947 *Halysites* spp. (partim.), MILLER and YOUNGQUIST, p.5, Pl.1, fig.3.
- 1955 *Halysites fieldeni* (Etheridge). BUEHLER, p.43.
- 1955 *Halysites irregularis* Teichert. BUEHLER, p.64.
- 1961 *Manipora fieldeni* (Etheridge). FLOWER, p.44.
- 1963 *Manipora fieldeni* (Etheridge). NELSON, p.61, Pl.14, figs.14,15.
- 1963 *Manipora irregularis* (Teichert). NELSON, p.60, Pl.14, figs.12,13.

Occurrence: G.S.C. localities 89513 and 89519.

Horizon and age: Locality 89519: 907-1317ft. (277-400m.) above the base of the Lang River Formation and in the top 200ft. (61m.) of the formation at locality 89513. Upper Ordovician.

Plesiotypes: X204/2, X204/6, X204/9, X149, X152, Z16/1, Z16/2, Z16/8, X146, X159, X203.

Description: The coralla have a depressed hemispherical form and the largest is 240mm. in diameter and 100m. high.

The corallites are mostly subquadrate or polygonal but some are elliptical. The corallite dimensions are as follows (100 measurements):

Long diameter (mm.)			Short diameter (mm.)			Av. ratio (long/short)
Max.	Min.	Av.	Max.	Min.	Av.	
1.6	0.75	1.2	1.25	0.5	0.9	1.3

The strongly appressed ends of the corallites are one-third to one-half of the short diameter. The corallite sizes differ between coralla but are less variable within a corallum. Specimen X204/9 contains a few circular or quadrate corallites which are 2.0mm. in diameter. These corallites may be comparable to the megacorallites of the two new species of *Catenipora* or they may be deformed.

The ranks are usually monoserial but some are biserial and corallite clusters may be present. The ranks generally contain between 1 and 5 corallites, and rarely more than 8. The lacunae are small, circular, polygonal or elongate and they rarely exceed 15mm. in diameter. Most of the lacunae are only 2-3mm. in diameter. Meandrine lacunae occur where the ranks are incomplete, but this condition is not persistent.

The tabulae are generally flat but may be arched or depressed. There are 10-15 per 5mm.

Remarks: Buehler (1955) considered Etheridge's (1878) original description inadequate and Flower (1961) also suggested that the type material should be restudied. By

present standards. the original description is insufficient but it is felt there is enough information from the description and illustration to recognise the distinctive polygonal lacuna pattern. The specimens which Troedsson (1928) described as *H. fieldeni* from a similar Upper Ordovician horizon within the Arctic region are, apparently conspecific with Etheridge's (1878) type specimen and possibly Troedsson's work should be the basis for future recognition of this species.

Teichert (1937) described *H. irregularis* from Silurian strata when in fact it was associated with a typical 'arctic' Ordovician fauna. Buehler (1955) reassigned this species to *Catenipora* and Nelson (1963) placed it in the genus *Manipora*. Both Teichert's (op. cit.) and Nelson's (op. cit.) descriptions and illustrations compare very closely to *M. fieldeni* and consequently the two species are considered to be conspecific.

?Manipora n.sp.1

Pl. 30, figs. 1,2; Pl. 31, figs. 1-3

Occurrence: G.S.C. locality 89509.

Horizon and age: 320-350ft. (97-106m.) above the base of the Allen Bay Formation. Upper Ordovician.

Syntypes: CB1/11, CB1/13 to CB1/15.

Diagnosis: Small polygonal corallites, 1.0-1.25mm. in diameter, arranged in multiserial ranks and cerioid corallite clusters. The cerioid corallite clusters may be isolated.

Description: All of the specimens are fragments of large coralla. The largest specimen is 120mm. long; 100mm. wide and 60mm. high.

The corallites are small, polygonal and 1.0-1.25mm. in diameter. Although extensively dolomitised the corallite walls appear to be single layered. Neither septal spines nor wall crenulations are visible.

The corallite ranks are monoserial or multiserial and there are also cerioid corallite clusters. The four specimens show different habits between extremes of a dominantly monoserial habit and a multiserial and cerioid habit.

Consequently the lacuna patterns differ with different types of rank in the individual, and range from circular and elongate to meandrine and irregular. In the cerioid end member the corallite clusters tend to be isolated and contain from 2 to 50 corallites. Occasionally the cerioid clusters are interconnected by short ranks.

The tabulae are generally flat but may be gently arched. There are 6 or 7 per 5mm.

The corallites increase by peripheral budding and inter-mural increase and the two variations of these methods. Also specimen CBl/15 apparently has a type of quadripartite division in at least one corallite.

Remarks: The continuous range of variations in the growth habit of these corals suggests that they belong to one species. The growth habit is typical of the genus *Manipora*

but dolomitisation has destroyed details of the wall structure and there remains some doubt as to their generic identification.

Phylum MOLLUSCA .

Class CEPHALOPODA Cuvier 1797

Subclass NAUTILOIDEA Agassiz 1847

A large proportion of the Lower and Upper Ordovician fossil assemblages consists of nautiloids. They are also present in the Silurian assemblages. Preservation is very variable and many specimens are not suitable for specific identification. In many cases only the siphuncle is preserved and although this structure is important in the classification and identification of nautiloids, especially the Actinocerida, it is considered good practice to use the siphuncle only if it is of unique form and dimensions. Many previous specific identifications rely greatly upon the siphuncle, and in some cases species have been identified from siphuncular remains alone. There are few, if any, studies on the variation within species of Ordovician and Silurian nautiloids and consequently many past descriptions should be used with discretion. Where possible the nautiloids are identified to species level but most are either given numeric identifications or compared to previously described species.

Family ARMENOCERATIDAE Troedsson 1926

Genus *Armenoceras* Foerste 1924

Type Species *Actinoceras heartsi* Parks 1913

Medium to large orthoconic phragmocones. Siphuncle excentric, large. Septal necks short, wide brims, often recumbent, adnation areas broad. Well developed canal system.

Most of the nautiloids from the Upper Ordovician assemblage belong to this genus. In the majority of specimens only the siphuncle was preserved which made specific identifications uncertain. The collection of armenoceratids has been divided into eight numbered species and several identified specimens of which only the former are described.

Armenoceras sp.1

Pl. 33, figs. 1,2

Occurrence: G.S.C. localities 89513 and 89519.

Horizon and age: Locality 89519: 907-1317ft. (277-400m.) above the base of the Lang River Formation and in the top 200ft. (61m.) of the formation at locality 89513. Upper Ordovician.

Type specimens: Z16/65, Z16/74, X204/32.

Description: The specimens are incomplete siphuncles some with portions of the phragmocone attached. Specimen Z16/ is 150mm. long, specimen Z16/74 80mm. long and specimen X204/32 95mm. long.

The siphuncle is as close as 1mm. to the venter. The

shell wall is 0.75mm. thick and the phragmocone diameter is estimated to be 60-70mm. The gradually expanding siphuncle has the following dimensions:

Expanded segment diameter	40mm.
Septal foramen diameter	27-30mm.
Segment length	8-12mm.
Rate of segment diameter expansion	1mm. every 11mm. to 1mm. every 17mm. of length
Central canal diameter	2-4mm.

Radial canals are strongly curved and originate 1.5 to 2 segments anterior to their termination. The radial canals slope apically from the central canal and turn sharply at the expanded portion of the segments.

Episeptal and mural deposits are present. Septal necks are recumbent but appear pseudoloxochoanitic.

Remarks: The cameral deposits and pseudoloxochoanitic septal necks make these specimens unique to the collection. No previous descriptions are comparable.

Armenoceras sp.2

Occurrence: G.S.C. localities 89513, 89514 and 89518.

Horizon and age: Locality 89518: 2,700-2,900ft. (823-884m.)

above the base of the Lang River Formation and in the top 200ft. of the formation at localities 89513 and 89514.

Upper Ordovician.

Type specimens: X148, X149, X75, X204/25, Y5/9.

Description: The specimens are incomplete siphuncles with

attached septa. Specimen Y5/9 is the longest and is 365mm. long.

The phragmocone is estimated to have been 45-50mm. in diameter and apparently had an extremely low rate of expansion. The siphuncle is close to the venter and maintains a constant diameter in each specimen, although the actual dimensions vary with the individual. The expanded segment diameter ranges from 18mm. in the smallest to as large as 26mm. with corresponding septal foramen diameters of 15mm. to 20mm. The segments vary in length from 3 to 6mm.

The diameter of the central canal also varies with the individual but attains a maximum of 4mm. Radial canals originate in the same segment as their termination and they are very gently curved.

The septa are moderately curved with an approximate curvature of 1.5 segments. Septal necks appear blunt-ended but they are probably recumbent. Adnation areas are greatest on the adoral surface. The camerae are 6mm. long. Remarks: *Armenoceras vesperale* Flower (1961), although smaller, shows some similarities. *Armenoceras iowense* Foerste (1935) also has similar dimensions but the available description of this species is not sufficient for comparison.

Armenoceras sp. 3.

Pl. 33, fig. 3

Occurrence: G.S.C. localities 89513 and 89519.

Horizon and age: Locality 89519: 907-1317ft. (277-400m.)

above the base of the Lang River Formation and in the top 200ft. (61m.) of the formation at locality 89513. Upper Ordovician.

Type specimens: X204/31, Z16/63, Z16/66, Z16/61, X180/2.

Description: The specimens are incomplete siphuncles, the longest of which reaches 151mm. Septa are attached to some of the siphuncles.

The siphuncle maintains a constant expanded segment diameter of 45-50mm. and a septal foramen diameter of 26-30mm. The segments are 10-12mm. long. The position of the siphuncle within the phragmocone is unknown.

The central canal is 1-3mm. in diameter. Radial canals originate at the septal foramen or slightly adorally from the foramen. They slope obliquely apically, turn towards the perispatium and become either straight or gently curved.

The septa are apparently strongly curved. Septal necks may be turned apically very slightly at their tips imparting a pseudoloxochoanitic appearance,

Remarks: The septal necks are similar to those of *Armenoceras* sp.1 but the latter also has cameral deposits which are apparently absent in *Armenoceras* sp.3.

Armenoceras sp.4

Occurrence: G.S.C. localities 89514 and 89519.

Horizon and age: Locality 89519: 907-1317ft. (277-400m.) above the base of the Lang River Formation and in the top 200ft. (61m.) of the formation at locality 89514. Upper

Ordovician.

Type specimens: X82, Z16/75.

Description: The specimens are incomplete siphuncles, some with attached septa. Specimen X82 is 121mm. long and specimen Z16/75 210mm. long.

The siphuncle is circular or slightly depressed and the diameter expands 1mm. every 12mm. of length. The siphuncle dimensions are as follows:

	Specimens	
	X82	Z16/75
adoral expanded segment diameter (mm.)	35	34
apical expanded segment diameter (mm.)	25	34
adoral septal foramen diameter (mm.)	21	24
apical septal foramen diameter (mm.)	17	17
adoral segment length (mm.)	12	12
apical segment length (mm.)	8	8
central canal diameter (mm.)	1-2	1-2

The radial canals are gently curved.

The septa are strongly curved on the ventral side. Septal necks appear blunt-ended but they are probably recumbent. The adnation areas are equal in specimen Z16/75 but greater on the adoral surface in specimen X82.

Remarks: Miller and Youngquist (1947) illustrated an unidentified *Armenoceras* species (op. cit., Pl. 4, figs. 1,2; Pl. 56, fig. 3) which is similar to the above species.

Armenoceras sp.5

Pl. 33, fig. 7

Occurrence: G.S.C. locality 89519.

Horizon and age: 907-1317ft. (277-400m.) above the base of the Lang River Formation. Upper Ordovician.

Type specimen: Z16/60.

Description: The specimen is an incomplete, partially sili-cified siphuncle, 165mm. long.

The siphuncle is depressed in shape and is probably ventral in position. The siphuncle dimensions are as follows:

adoral expanded segment diameter	60mm.
apical expanded segment diameter	55mm.
adoral septal foramen diameter	40mm.
apical septal foramen diameter	36mm.
adoral segment length	15mm.
apical segment length	14mm.
rate of segment expansion	1mm. every 20mm. of length.

The central canal is small compared to the size of the siphuncle and is only 3mm. in diameter. Radial canals are curved and they originate in the central part of the segment adoral to their termination.

The septa are apparently strongly curved. Septal necks appear blunt-ended but they are probably recumbent. The adnation area is greatest on the adoral surface of the

septal neck.

Remarks: The large dimensions are similar to those of *Armenoceras saxosum* Foerste (1929) but there is not a large expanding central canal and the siphuncle is depressed. The specimen may be the apical portion of a long siphuncle and would not necessarily have a large central canal.

Armenoceras sp.6

Pl. 33, fig. 4

Occurrence: G.S.C. locality 89519.

Horizon and age: 907-1317ft. (277-400m.) above the base of the Lang River Formation. Upper Ordovician.

Type specimen: Z16/64.

Description: The specimen is an incomplete, partially silicified siphuncle, 62mm. long.

The siphuncle is circular in transverse outline and has the following dimensions:

expanded segment diameter	45mm.
septal foramen diameter	27mm.
segment length	12mm.
central canal diameter	4mm.

The radial canals are straight or slightly curved, originating and terminating in the same segment.

The septa appear to be moderately to strongly curved. The septal necks are recumbent. The adnation area is greatest on the adoral surface of the septal neck. Episeptal deposits are present.

Armenoceras sp.7

Pl. 33, fig. 5

Occurrence: G.S.C. locality 89513.

Horizon and age: Top 200ft. (61m.) of the Lang River Formation. Upper Ordovician.

Type specimens: X204/36, X204/39.

Description: The specimens are incomplete siphuncles with parts of the septa attached. Specimen X204/36 is 150mm. long and specimen X204/39 110mm. long.

The siphuncle is circular or depressed and probably ventral in position. Specimen X204/36 has the following siphuncle dimensions:

adoral expanded segment diameter	45mm.
apical expanded segment diameter	40mm.
adoral septal foramen diameter	38mm.
apical septal foramen diameter	35mm.
adoral segment length	12mm
apical segment length	9mm.

The central canal has a slightly depressed transverse outline expanding from 13mm. to 15mm. but in the four adoral segments the diameter decreases to 9mm. The radial canals are straight or gently curved.

The siphuncle segments of specimen X204/36 slope very gently adorally.

The septal necks appear blunt-ended but are probably recumbent. Adnation areas are greatest on the adoral surface.

Armenoceras ?sp.7

Pl. 33, fig. 7

Occurrence: G.S.C. locality 89513.

Horizon and age: Top 200ft. (61m.) of the Lang River Formation. Upper Ordovician.

Type specimen: X221.

Remarks: Although the siphuncle dimensions are similar to those of *Armenoceras* sp.7 the radial canals are more strongly curved and the adoral adnation areas more pronounced.

Armenoceras sp.8

Occurrence: G.S.C. locality 89513.

Horizon and age: Top 200ft. (61m.) of the Lang River Formation. Upper Ordovician.

Type specimen: X156.

Description: The specimen is an incomplete siphuncle 33mm. long with attached portions of the septa.

The phragmocone diameter is estimated to be 40-50mm.

The ventrally positioned siphuncle has the following dimensions:

expanded segment diameter	15-18mm.
septal foramen diameter	12mm.
segment length	6mm.

The central canal diameter rapidly expands from 3 to 7mm. in the length of the specimen. The radial canals are straight or very gently curved.

The septa are moderately curved. The septal necks appear blunt-ended but are probably recumbent.

Family ONCOCERATIDAE Hyatt 1884

Genus *Oonoceras* Hyatt 1884

Type Species *Cyrtoceras acinaces* Barrande 1866

Gradually expanding, slender, compressed cyrtococone of slight curvature. Lateral lobes. Short camerae and body chamber. Hyponomic sinus on aperture. Ventral siphuncle, cyrtocoanitic.

Oonoceras ?n.sp.1

Pl. 34, figs. 1a,b

Occurrence: G.S.C. locality 89519.

Horizon and age: 907-1317ft. (277-400m.) above the base of the Lang River Formation. Upper Ordovician.

Holotype: Z16/70.

Diagnosis; Small cyrtococonic phragmocone 60mm. long. Slight expansion of the phragmocone.

Description: The cyrtococonic phragmocone has a mid-lateral length of 60mm. and expands adorally only very slightly. The radius of dorsal curvature is 70mm. and that of the venter 100mm. The apical transverse outline is oval with a dorso-ventral diameter of 23mm. and a transverse diameter of 14mm.

The camerae are short with a mid-lateral length of 4mm. The sutures have shallow lateral lobes and short, sharp ventral saddles.

The siphuncle is 1mm. from the venter and has an expanded segment diameter of 3mm.

Remarks: This possible new species is smaller than previously described Ordovician species. *Oonoceras wyomingense* Miller and Carrier (1942) has a similar general shape but is much larger.

Subclass ENDOCERATOIDEA Teichert 1933

Family ENDOCERATIDAE Hyatt 1883

Genus *Cyclendoceras* Grabau and Shimer 1910

Type species *Endoceras annulatum* Hall 1847

Annulated orthoceraconic conch. Annulations well defined, subrectangular to rounded, transverse or oblique to the conch axis. Teichert (in Moore 1964, p.173) reclassified this genus as *Endoceras*. The annulated conch is distinctive and it may be worthwhile retaining the generic name. Most descriptions of these types of nautiloid use the name *Cyclendoceras* and for the sake of clarity and comparison this name is used in this report.

Cyclendoceras ?n.sp.1

Pl. 34, fig. 5

Occurrence: G.S.C. 89519.

Horizon and age: 907-1317ft. (277-400m.) above the base of the Lang River Formation. Upper Ordovician.

Holotype: Z16/73.

Diagnosis: Annulated orthocone. Annulations 15mm. apart, lateral amplitude of 2mm. or less and oblique to the phragmocone axis. Distinct rounded lateral saddles.

Description: The holotype consists of an internal mold 125mm. The incomplete phragmocone is straight, very gradually expanding and annulated. The venter is slightly flatter than the dorsum at the apical end. The phragmocone has the following dimensions:

adoral dorso-ventral diameter	24mm.
apical dors-ventral diameter	26mm.
adoral lateral diameter	46mm.
apical lateral diameter	36mm.
rate of lateral expansion	1mm. every 12.5mm. of length.

The annulations are 15mm. apart, are more pronounced on the lateral surfaces of the phragmocone and have an amplitude of 2mm. or less. They are very slightly oblique to the length of the phragmocone and slope apically from the right to the left side. There are 2.5 to 3 camerae per annulation. The camerae are 4-5mm. long.

The sutures have very shallow dorsal lobes and short rounded saddles on the left side. The ventral sutures are also lobed but are shallower than those of the dorsum.

The siphuncle is not preserved.

Remarks: This species is distinguished from other Arctic species (see Foerste 1929, Teichert 1937, Miller et al. 1954) by the larger camerae and the prominent right lateral saddles.

Comments on some of the Undescribed Fossils

Cryptophragmus antiquatus Raymond (1914) (table 4): The solitary specimen has the outer sheaths preserved but due to recrystallisation the microstructure (if any) could not be observed.

Clathrodictyon sp.3 (table 6): This species is similar to *Clathrodictyon miniapse* Petryk (1967) described from the Middle Silurian of Baffin Island. *Clathrodictyon miniapse* has straighter laminae and mamelons; the latter are apparently absent in the species from Somerset Island.

Streptelasma spp. (tables 4 and 6): Insufficient specimens and poor preservation, and the confused nature of the earlier taxonomy (Cox 1937, Nelson 1963) prevented a major revision of this genus and its species. Seven forms have been distinguished in the collection and these have been given numerical designations. The seven forms were identified on the basis of size, number of septa and the structure of the columella. There may be several species represented by these seven forms but until a more comprehensive collection is available and the taxonomy has been clarified they cannot be given species status.

The solitary coral designated ?*Streptelasma* form 7 (Pl. 22, fig. 7) is unique in that it has the only patellate corallum in the collection and the specimen may belong to

another genus. No other comparable Ordovician genus could be found.

Lobocorallium trilobatum Nelson (table 4): Nelson (1963) pointed out that the original specimens of *L. trilobatum* (s.s.) were small and did not have a complex columella whereas the specimens Nelson (1963) described from Hudson Bay were large and had a well developed columella in the later growth stages. Nelson (op. cit.) gave his specimens a variety name, *L. trilobatum* var. *major*. The Somerset Island specimens correspond to this variety but until further work on variation and ontogeny in this species is forthcoming it is preferred to suppress the variety name. It is likely that the smaller specimens are younger forms of the larger.

Favosites spp. (table 4 and 6.): The poor preservation of the specimens, an inadequate collection and a lack of information concerning growth variation within the species of *Favosites* hindered specific identification. The specimens are placed in five morphological groups based on corallite size and the range of corallite dimensions within a corallum. These forms are not illustrated. The characteristics of each form are as follows:

Form 1: large corallites 4-5mm. in diameter,

Form 2: uniform corallite diameters, 1.5-2.0mm.,

Form 3: wide range of corallite diameters, 0.5-4mm.,

Form 4: uniform corallite diameters within a corallum,
generally 2-3mm., but in different coralla diameters
range from 1-3.5mm.,

Form 5: corallite diameters 0.5-1.5mm., but most are 1.0mm.

Armenoceras australe Flower (1957) and *A. arcticum* Troedsson (1926) (table 4): These two species have similar morphology and may be conspecific.

Family Proteoceratidae, Genus unknown (table 6): Two species of this unknown genus were identified from a total of sixteen specimens of which fifteen belong to one species. Although there are some similarities to *Ephippiorthoceras* the Somerset Island specimens have a more compressed phragmocone and a ventrally positioned siphuncle.

Geisonoceras sp. (table 4): This genus is an uncommon component of the 'arctic' Ordovician fauna but it has been reported from the Shamattawa Limestone of southwest Hudson Bay (Foerste 1928) and the Maquoketa Shale of Iowa (Foerste 1935).

Calymene meeki Foerste (1910) (Pl. 18, fig. 4; table 4): Troedsson's (1928) variety of this species, *C. meeki* var. *tenuisulcata*, differs from the holotype only in size and other minor details and it is probable that the variety name

is unnecessary. *Calymene croneisi* Roy (1941) also appears to differ only in minor details and is considered to be conspecific.

Receptaculites sp. (table 4): The 'arctic' Ordovician species of *Receptaculites* have been discussed extensively by Troedsson (1928, pp.140-145), Teichert (1937, p.49) and Roy (1941, pp. 59-66). Three species have been reported from the 'arctic' Ordovician, namely, *R. arcticus* Etheridge, *R. occidentalis* Salter and *R. oweni* Hall. Both Roy (op. cit.) and Troedsson (op. cit.) concluded that all three are conspecific and that *R. arcticus* has precedence. Teichert (op. cit.) however, reserved judgement as to the synonymy of *R. arcticus* and *R. occidentalis*. The Somerset Island specimens are left unidentified until the confusion is resolved.

VIII CONCLUSIONS

Stratigraphy

The early Paleozoic strata of Prince of Wales and Somerset Islands are divided into two formations, the lower, newly named, Lang River Formation and the upper Allen Bay Formation. The new formation derives its name from the Lang River area, Somerset Island, where an almost continuous section of the formation is exposed.

The Lang River Formation rests unconformably upon Precambrian metamorphic and sedimentary rocks on Somerset Island but at the two sections visited on Prince of Wales Island the formation is faulted against Precambrian rocks. A varied sequence of dolostone rock types is characteristic of this formation and in the lower part of the succession, sandstone and other detrital material are also present. On Prince of Wales Island sandstone-dolostone cyclothem are present in the Lang River Formation of locality A and stromatolitic dolostone-fissile dolostone cyclothem are present at locality B. Upper Ordovician fossiliferous calcareous dolostone and dolomitic limestone beds are present in the Lang River Formation on Somerset Island.

The conformably overlying Allen Bay Formation is almost entirely dolomitic and in the field is superficially more uniform in appearance and more resistant to weathering than the Lang River Formation. In detail, a variety of rock types are present and especially common are laminated,

stromatolitic and structureless dolostone. Overlying the Allen Bay Formation is the recessively weathering, thinly bedded dolostone and limestone of the informally named Young Bay Formation (S.R. Williams, personal communication 1972).

The Lang River and Allen Bay Formations contain few fossil horizons and accurate dating of the formations was not always possible. The two sections of the Lang River Formation studied on Prince of Wales Island contained no fossils but the sections on Somerset Island contained two faunal assemblages. A Lower Ordovician assemblage is present at Creswell Bay and an Upper Ordovician fauna is present at all three widely separated localities on Somerset Island. Lithologically equivalent strata on the Boothia Peninsula (to the south of Somerset Island) contain Middle Cambrian fossils (Blackadar and Christie 1963, p.9). These fossils possibly indicate that part of the Lang River Formation may be at least as old as Middle Cambrian.

Lower and Middle Silurian fossils are present in the Allen Bay Formation and on Prince of Wales Island an Upper Ordovician fauna is present in the lower part of the formation. The latter fauna is comparable to the Upper Ordovician fauna in the Lang River Formation on Somerset Island and consequently the boundary between the Lang River and Allen Bay Formations may be diachronous across the two islands.

The Lang River Formation represents a considerable time period which on other islands in the Arctic Lowlands is represented by several formations. The Allen Bay Formation is correlated with the type section on Cornwallis Island

(Thorsteinsson 1967) and is also present on several other Arctic islands.

Depositional Environments

Planar- and cross-laminated dolostone, intraformational breccia and conglomerate, pelletal dolostone, oolitic dolostone (?oncolitic), stromatolitic dolostone, biogenic dolostone, biomicrite and grain mosaic dolostone were the principal rock types identified in the two formations. These rock types represent deposits ranging from the supratidal to the subtidal zones, and are dominantly intertidal sediments. For much of the time represented by the two formations, sedimentation appears to have been on a tidal flat complex. A widespread marine subtidal phase containing an abundant and diverse biota developed in Upper Ordovician times. No other regionally extensive marine deposits were recognised at other stratigraphic levels although fossiliferous subtidal deposits are present locally in the formations.

The primary cause of cyclical sedimentation on the western margin of the Boothia Arch may have been basin subsidence. However, local factors, such as the supply of terrigenous material and local submarine topography (e.g. the presence of barriers and/or lagoons), may account for the two different types of cyclothem.

Paleontology

The Lang River and Allen Bay Formations are generally unfossiliferous but there is a rich and diverse Upper Ordovician fauna on Somerset Island and a similar, but less

abundant, fauna on Prince of Wales Island. The Upper Ordovician fauna consisted of abundant corals, stromatoporoids and nautiloids. Species of *Armenoceras* are the dominant nautiloids; *Paleophyllum* and *Catenipora* are the dominant corals and *Aulacera* is the dominant stromatoporoid.

The halysitid corals were studied in detail with the recognition of new morphologic and taxonomic data. A review of the Ordovician Halysitidae indicated that two genera are valid members of this family, namely *Catenipora* and *Manipora*. A third commonly used genus, *Quepora*, is considered to be a synonym of *Catenipora* and should be suppressed. A review of the North American halysitid species suggested that the following cateniporid species are valid:

Catenipora agglomeratiformis

C. aequabilis

C. delicatula

C. robusta

C. rubra

C. stearni

C. workmanae

Catenipora foersti NELSON (1963), *C. cylindrica* (WILSON) (1926) and *C. pulchella* (WILSON) (1926) need to be restudied to determine their true taxonomic position.

The species of *Manipora* considered to be valid are *M. amicarum* and *M. fieldeni*. *Manipora magna* and *M. trapezoidalis*, both described by Flower (1961), are considered to be variants of *M. amicarum*. *Catenipora irregularis* (TEICHERT)

(1937) is believed to be conspecific with *M. fieldeni*.

A new large corallite type was discovered in two species of *Catenipora* and was given the name megacorallite. These megacorallites are believed to have performed a unique and intermittent function, probably gamete production.

The Lower Ordovician, and Lower and Middle Silurian fossils were generally poorly preserved and were inadequate for detailed study. Nautiloids and gastropods are the only constituents of the Lower Ordovician assemblage. Corals, stromatoporoids and nautiloids are the dominant fossil types in the Silurian assemblages although *Conchidium* was quite common in the strata of fault block F at Creswell Bay on Somerset Island.

Economic Geology

The economic potential of the Lang River and Allen Bay Formations is limited to the possible petroleum and base metal content. Folded and faulted strata which might be favourable for petroleum accumulation are present adjacent to the Boothia Arch on Somerset Island. Dolostones are the dominant rock types in both formations but most of these are fine grained and generally have low visible porosity. Some porous dolostone is present in the Allen Bay Formation, and its porosity is due to the presence of fossil molds. However, these rock types comprise less than 25% of the total formation thickness and individual beds are usually less than 30ft. (9.1m.) thick. Pyrobitumenous material in the fault zone at Creswell Bay (see chapter V) may be evidence of seepage

of hydrocarbons and this area may be worth further investigation. However, in general it would appear that the Lang River and Allen Bay Formations in the area studied have a low potential as reservoir rocks.

Small grains of pyrite are common in the dolostone of the two formations but larger aggregates were not observed. A single cluster of galena crystals, about 14cm. in diameter, was collected from the Aston Formation on Savage Point, Prince of Wales Island, but no other occurrence of galena was noted. From these brief observations no valid assessment of the base metal content is possible.

APPENDIX 1 STRATIGRAPHY OF THE HUNTING FORMATION,
SOMERSET ISLAND

Introduction

During the investigation of the Paleozoic rocks at Hunting River (locality Y) in early July 1970 the recognition of an unconformity between the Hunting Formation and the overlying strata induced the author to reassess the stratigraphy of the Hunting Formation in the vicinity of the lower reaches of the Hunting River. A qualitative restudy of the Hunting Formation involved mapping, re-examining the localities visited by Tuke et al. (1966 - who probably failed to recognise the unconformity because of a heavy snow cover during their field work) and examining additional exposures. This study presents the evidence to support a revision of the stratigraphy, provides additional sedimentological information and shows important changes in the distribution of the Hunting Formation (fig. 8).

Previous Research

Rocks of the Aston and Hunting Formations were first recorded at Aston Bay by Blackadar (in Gill 1957) but remained unnamed until Fortier et al. (1959) produced a preliminary map. Blackadar and Fraser (1960) gave approximate thicknesses for the two formations which were later described by Blackadar (in Fortier et al. 1963). Blackadar and Christie (1963) added details of lithology and map

distribution and reported the presence of basic intrusions which they compared to the 'Diabase Series' of the Arctic described by Fortier (1957) and to diabase intrusions on Baffin Island. Furthermore, Blackadar and Christie (1963) divided the Hunting Formation into two units, the lower unit having a banded appearance.

Further work on Somerset Island by University of Ottawa expeditions (Dineley 1965a,b, 1966a,b) included stratigraphic and sedimentological descriptions of both the Aston and Hunting Formations based on field work by M.F. Tuke (Tuke, Dineley and Rust 1966). Brown, Dalziel and Rust (1969) reviewed the geological development of the Boothia Arch and briefly discussed the Aston and Hunting Formations.

Stratigraphic Succession

From the restudy of the area three distinct members are now recognised and these have a total thickness of 3,800-4,500ft. (1159-1373m.). They are (in descending order) as follows:

member	lithology	calculated thickness
3	variable dolostone	1,600ft. (488m.)
2	dolostone-chert alternations	1,700-2,250ft. (519-686m.)
1	sandy and dolomitic rocks	500-600ft. (153-183m.)

The Aston/Hunting contact was examined at localities 1

and 2 (fig. 8) of which locality 1 is locality D of Tuke et al. (1966, fig. 3). At locality 1 a 20ft. (6.1m.) thick conglomerate rests upon a massive, pink quartz sandstone of the Aston Formation and grades upwards into a sandy dolostone. Although the contact between the conglomerate and sandstone was not visible at locality 2 (fig. 8) the conglomerate was present. The conglomerate may lie disconformably upon the Aston Formation but no definite evidence of a stratigraphic gap was recognised. It is proposed that the base of the conglomerate be the lower boundary of the Hunting Formation.

Member 1

The basal beds at both localities 1 and 2 (fig. 8) show the following sequence (in descending order):

- iv) interbedded grey dolostone and fissile-dolostone,
- iii) interbedded grey dolostone and laminated silty dolostone,
(iii and iv have an estimated combined thickness of 460ft., 140m.),
- ii) interbedded purple siltstone and thinly bedded sandstone with sandy dolostone (20-25ft., 6.1-7.6m.),
- i) quartz pebble conglomerate (20ft., 6.1m.).

The quartz pebble conglomerate is thinly to mediumly bedded (Ingram's classification of stratigraphic units 1954) with planar, essentially horizontal beds usually separated by very thin shaly partings. The quartz pebbles range in

diameter of the longest axes from 2mm. to 10mm. and are sub-rounded to rounded with moderate sphericity. Weathered fragments of orthoclase felspar, which rarely exceed 6mm. in length, make up approximately 10% of the rock. The pebbles are set in a matrix of silt-sized to coarse sand-sized quartz grains and are cemented by secondary dolomite. A greenish colour is imparted to the rock by the presence of a micaeous mineral, probably chlorite.

The conglomerate grades upwards into interbedded purple sandy siltstone, sandstone and sandy dolostone (Pl. 15, fig. 1). The purple colour of the siltstone is a weathering feature, the rock is green when fresh. Both the siltstone and sandstone have either very low-angle, planar cross beds or ripple cross-laminations. The dolostone includes alternating silty dolostone, laminated dolostone and thin beds of intraformational breccia. All the rock types commonly show contorted and convolute bedding. The quartz grains in these rocks are generally angular to subrounded and show undulatory extinction. Fragments of biotite are present in the sandstone and siltstone and are primary in origin.

The above beds are gradationally succeeded by interbedded dolostone and silty dolostone which are only locally purple in colour. Higher in the sequence the content of detrital sediment decreases considerably and dolostone and fissile dolostone predominate. Planar-laminations and ripple cross-laminations are typical sedimentary structures in the

silty beds and cryptogalaminated stromatolites (Aitken 1967) are common in some of the dolostone. Convolute and contorted bedding is present but is less intense than in the lower beds.

Member 2

Member 2 consists of alternating beds of blue-grey to grey laminated dolostone and darker beds of laminated chert and cherty dolostone. This alternation of rock types is often reflected in the topography, as a banding recognisable on the aerial photographs. Sedimentary structures are consistent in both rock types and include subparallel to parallel sedimentary laminations which are commonly convoluted and contorted.

Rocks of member 2 occur mainly west of the Hunting River except for one small exposure by a river meander to the east at locality 3 (fig. 8). In this exposure alternating cherty beds and dolostone considered to be near the top of member 2 are overlain by rocks of member 3.

Member 3

Member 3 contains a variety of dolostone types and a few sandstone and shale beds. The succession characteristically shows irregularly alternating beds of bright red to purple-red dolostone and steel-grey to blue-grey dolostone.

The shale is bright red to buff coloured and is exposed on the western slopes of the Hunting River valley opposite the camp-site (locality c, fig. 8). A similar and probably

equivalent red shale is exposed in the succession on the eastern valley slopes adjacent to and just to the south of the camp-site. Black shales mentioned by Tuke et al. (1966, p.704) were found only above the upper boundary of the Hunting Formation.

Stromatolitic dolostone, intraformational dolostone breccia, massive dolostone and planar- and cross-laminated dolostone are the dominant rock types of member 3. Detrital components include silt-sized to sand-sized quartz grains and some argillaceous material. The detrital material occurs locally as sandstone bodies but more commonly is disseminated throughout intraformational breccia and cross-laminated sandy dolostone. Chert nodules and irregular bodies of replacement chert are present but not as extensively as the chert found in member 2.

Member 3, as defined here, includes members 3 and 4 (in part) of Tuke et al. (1966, pp.703-704). The rock types, the succession and the distinct red and grey coloration east and west of the Hunting River suggest that the successions are stratigraphically equivalent and that member 3 is repeated east of the north-south fault along the Hunting River.

Unconformably overlying and blanketing several different sedimentary facies of member 3 (see above rock descriptions) is a mature, weakly cemented grey to white sandstone (Pl. 15, fig. 2). Trough and festoon cross bedding are

common in this sandstone which is probably the ".... rare white sandstone...." of Tuke et al. (op. cit., p.709), North of locality 4 (fig.8) the overlying rocks are apparently conformable, as similar dips and strikes occur on either side of the white sandstone. However, south of locality 4 the overlying beds are seen to truncate the Hunting Formation (Pl. 15, fig. 2). A very approximate calculation from aerial photographs indicates that 200-300ft. (61-92m.) of strata are truncated in a horizontal distance of 4,000ft. (1,220m.) south of locality 4. Also at locality 4, sections on either side of the river are different and a minor east-west dip-slip fault is suspected but no trace of such a fault can be seen in the well exposed overlying rocks. In addition, a dyke at locality 4 (fig, 8) could not be traced into the overlying rocks, although of course it may die out before reaching the unconformity.

An attempt to extend the revised geology of the Hunting Formation northwestwards by means of aerial photographic interpretation proved difficult. The results of this attempt are shown in figure 26. Although the distribution of the Hunting Formation is generally similar to that illustrated by Tuke et al. (op. cit.) there are several differences which need to be checked by a ground survey. Furthermore, faulting and diabase intrusions are much more extensive than recognised by Tuke et al. (op. cit.).

Depositional Environments

The interpretation of the sedimentary environments differs very little from that of Tuke et al. (1966). The sediments apparently accumulated on a tidal flat complex similar to those present in the Persian Gulf (Illing, Wells and Taylor 1965, Wood and Wolfe 1969) or the Bahamas (Shinn, Lloyd and Ginsburg 1969). The deposits represent environments ranging from supratidal to shallow subtidal and differ from their modern counterparts in having a greater proportion of terrestrially-derived material.

The basal conglomerate overlying the sandstone of the Aston Formation may indicate a phase of activity of the Boothia Arch if the conglomerate proves to be of more than local distribution. It is considered that the conglomerate was deposited at or near a beach. The sandstone, siltstone and sandy dolostone of the basal beds are commonly rippled and were probably deposited in the intertidal or shallow subtidal zones. The provenance of these detrital sediments was the metamorphic terrain of the Boothia Arch although the Aston Formation may have provided some of the material.

As deposition continued detrital sedimentation diminished and carbonate sedimentation became dominant during the deposition of the upper part of member 1 and prevailed throughout the deposition of member 2 and 3. Thus the Boothia Arch had a very brief and minor period of activity during the deposition of the early part of the Hunting

Formation.

The detrital material found in member 3 is significantly different from that of the basal beds. It is mostly rounded silt-sized to medium sand-sized quartz grains probably intrabasinal in character or possibly reworked from the Aston Formation.

In summary the sedimentary history of the Hunting Formation possibly began with a minor transgression which introduced principally terrestrially-derived sediments. Subsequently, detrital sedimentation diminished and carbonate deposition became dominant in a shallow subtidal environment (upper part of member 1 and all of member 2). During the deposition of member 3 an extensive tidal flat complex developed with deposition in supratidal to shallow subtidal environments. The presence of stromatolites, especially in member 3, would tend to confirm this interpretation (Logan et al. 1964).

The end of Hunting sedimentation was marked by slight uplift, regression and minor erosion before the overlying sedimentary rocks were deposited unconformably on top.

Age and Correlation

The early reports of the Hunting Formation all gave its age as Proterozoic but Tuke et al. (1966) suggested that on the evidence then available it might equally well correlate with Middle Cambrian strata on the Boothia Peninsula. In the light of new information, in particular the presence of an

unconformity at the top of the Hunting Formation, the age of this formation needs reassessing.

Throughout the Arctic Lowlands Paleozoic strata rest unconformably upon Proterozoic sedimentary or metamorphic rocks. This is true of the sedimentary rocks adjacent to the Minto and Wellington Arches (Thorsteinsson and Tozer 1962), the Coppermine Arch (Yorath, Balkwill and Klassen 1969), the Melville-Southampton Belt, Baffin Island (Lemon and Blackadar 1963, Dineley 1971, p.421) and the Bache Peninsula (Kerr 1967). Lower Cambrian fossils have been identified in the rocks above the unconformity at some of these localities. It seems unlikely that such a widespread event should have by-passed the Boothia Arch and the unconformity at the top of the Hunting Formation is therefore equated with the regional unconformity at the base of the Paleozoic strata.

The Hunting Formation contains diabase dykes and sills, more abundantly than was previously suspected, and these almost certainly belong to the group of intrusions that are widespread and abundant in the Proterozoic rocks of the Churchill Province. McGlynn (in Douglas 1970, p.89) recognised two periods of intrusion, one at 1100 to 1200m.y. and a second at 600 to 750m.y. A diabase sample collected from a sill within the Aston Formation and stratigraphically close to the Aston-Hunting Formations boundary (locality I, fig. 8) was dated by Dr. W. Fahrig (Geological Survey of Canada, pers. comm. 1972) using the K-Ar method on a mixture of biotite with

5% hornblende and a trace of chlorite. The age, 702 ± 25 m.y. is well within the age range of the younger intrusions. Additional samples from a dyke and sill within the Hunting Formation (locality 4, fig. 8) have been submitted for dating. On nearby Baffin Island north-easterly trending dykes have been dated at 1100 to 1200 m.y. (McGlynn op. cit.).

The Hunting Formation is devoid of useful stratigraphic fossils although Hoffman (1971, p.42, Pl. 14) described and illustrated a trace fossil collected by Tuke et al. (op. cit., locality G, fig. 3). Hoffman considered the trace fossil to be Phanerozoic. In view of the new position of the boundary between the Hunting and Lang River Formations, locality G of Tuke et al. is thought to be in strata of the Lang River Formation. The lithology of the trace fossil specimen is very similar to the basal sandy dolostone beds of the Lang River Formation and not at all comparable to the Hunting Formation rocks near to the collecting site which are well indurated blue-grey dolostones apparently devoid of sandy material.

From the foregoing discussion it seems likely that the age of the Hunting Formation is Proterozoic and the formation may be correlated with other Proterozoic sedimentary rocks throughout the Arctic Lowlands.

APPENDIX 2 CRETACEOUS OUTLIER AT CRESWELL BAY

Location

Figure 6 indicates the position of a faulted outlier of Cretaceous beds in the Creswell Bay area. These beds are exposed in a 30-50ft. (10-17m.) high cliff on the southern, undercut bank of a river meander. Access to the outcrop is relatively easy after the snow melts.

The beds dip 15° to the west and consist of about 50ft. (17m.) of black calcareous shale. Both the top and bottom of the sequence are hidden either by drift or river gravel. Adjacent to the shale beds are dolostones of the Silurian Allen Bay Formation, also dipping 15° west and consequently their stratigraphic separation is not immediately apparent. However, field relations and the included fauna indicate that the shale is a wedge or lens within a major east-west fault zone.

Rock Types and Environment of Deposition

Most of the exposure is of a fissile, black shale. Within the top 10ft. (3.4m.) there are also very thin beds of black limestone. These limestone beds contain abundant fragments of bony fish scales, large contorted *Inoceramus* shell fragments and abundant microfossils. The shale contains a few shell impressions of inarticulate brachiopods

or possibly bivalves.

Planar-laminations with low-angle truncations and local ripple laminations are the main sedimentary structures in the limestone beds. The fragmented nature of most of the fish scales indicates mechanical damage during transportation.

The microfossils were kindly identified by W.S. Hopkins (unpublished Geological Survey of Canada report K-02-WSH-1972) who commented: "The sample is composed almost completely of algal and fungal remains, as well as a fair number of phytoplankton. Pollen and spores of higher plants are very rare and not particularly diagnostic..... This rather odd assemblage suggests a marine depositional environment, possibly anaerobic." The black colour of the shale and limestone can be attributed to a high content of organic carbon which could also possibly indicate anaerobic conditions.

Any environmental interpretation of these sedimentary rocks is limited by the local nature of the exposure. However, these beds appear to have been deposited in a near-shore environment. The high organic content and the low energy sedimentary structures could possibly indicate a lagoonal environment.

Fossils

The following microflora was identified by W.S. Hopkins:

Deflandrea cf. *dakotaensis* Stanley

Deflandrea spp.

Pterospermopsis sp.

Micrhystridium sp.

Myxomycota spores

Fungal spores

Algal spores

?Sclaginellales

Lycopodium sp.

Leptolepidites sp.

Gleicheniidites sp.

Laevigatosporites sp.

Sphagnum antiquasporites Wilson and Webster

Utrisporites sp.

Cicatricosisporites sp.

Pinus sp.

Podocarpus sp.

Tsugaepollenites mesozoicus Couper

cf. *Laricoidites* sp.

Taxodiaceae-Cupressaceae

?*Tricolpites* sp.

The following animal fossils are present:

Inoceramus sp.

?inarticulate brachiopods

bony fish scales.

Age and Correlation

The microfossils of the Creswell Bay outlier are

Senonian (Upper Cretaceous) in age. Time equivalent strata are found in the Kanguk Formation of Axel Heiberg, Ellef Rignes and Graham Islands (Fortier et al. 1963, pp.91, 411, 442, 568). The Kanguk Formation consists of marine shale and subordinate sandstone and siltstone but without limestone, other than some calcareous concretions.

On Somerset Island Cretaceous-Tertiary rocks are present at Stanwell-Fletcher Lake (the Idlorak Formation, Dineley and Rust 1968) and Cunningham Inlet (Hopkins 1971). Both of these outcrops are of detrital rocks and the Idlorak Formation was interpreted as a prograding delta sequence. These beds are probably equivalent to the widespread continental deposits of the Eureka Sound Formation (Thorsteinsson, in Douglas 1970, p.584, Fortier et al. 1963, pp.92-93).

It appears that the beds at Creswell Bay are the first reported Senonian marine strata in the Arctic islands south of Lancaster Sound.

Discussion

The several outcrops now considered to be of Cretaceous and Tertiary age indicate the extent to which these rocks may have once covered Somerset Island. At Creswell Bay the fault zone in which the shale is incorporated has not been subjected to much lateral movement and the shale was probably deposited in the area of present occurrence.

It seems probable that other Cretaceous and Tertiary

sedimentary rocks may be present on Somerset Island, especially in the faulted areas of northern Somerset Island. The map produced by Blackadar and Christie (1963, map 37-1963) misidentified the Stanwell-Fletcher Lake Cretaceous-Tertiary rocks as Paleozoic in age. Two faulted outliers to the south of Stanwell-Fletcher Lake which were also identified as Paleozoic may, with further investigation, prove to be part of the Idlorak Formation.

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PLATE I.

Figure

Page

1 Contact between members 1 and 2 of the Lang River Formation at locality Z, Somerset Island. Also shown is one of the discontinuity surfaces within member 2.

20

2 Polished surface intersecting one of the discontinuity surfaces in member 2, Lang River Formation, locality Z. Scale=1cm.

57

Rock type: finely crystalline dolostone.

Explanation of overlay:





-  Laminae of organic material
-  Pyrite crystals
-  30-40% fossil debris
-  10-15% fossil debris

PLATE 1



2

PLATE 1



discontinuity
surface



2

PLATE 2

Figure		Page
1	The Lang River Formation at locality B, Prince of Wales Island. The figure at the base of the cliff is standing against a thrombolite bed which is visible higher up the slope as a distinct dark bed.	34
2	Ripple-laminated sandy dolostone near the base of the Lang River Formation at locality X, Somerset Island.	40



1

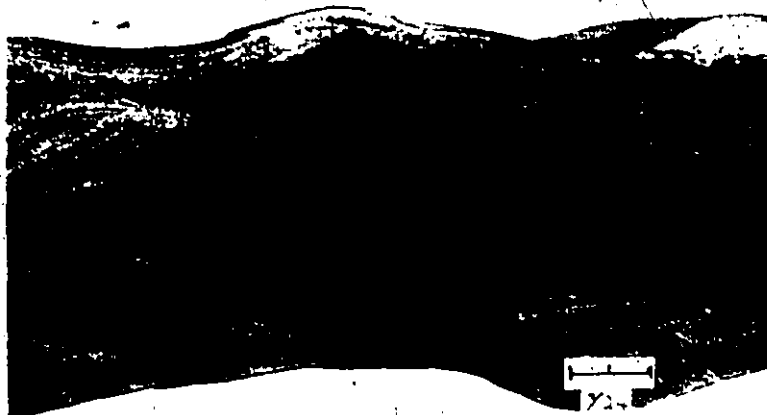


2

PLATE 3

Figure		Page
1	Ripple-laminated sandy dolostone from the Lang River Formation of locality Y, Somerset Island. Scale=1cm.	40
2	Polished surface of a red-stained intraformational conglomerate from the Lang River Formation of locality Z, Somerset Island. Scale=1cm.	46
3	Thin section of an intraclastic dolostone from the Allen Bay Formation of locality A, Prince of Wales Island. Dolomitisation and recrystallisation has destroyed much of the original texture but the central dark object may be a remnant of an original grapestone clast. x6. Specimen A29	60

PLATE 3



1



2



3

PLATE 4

- | Figure | Page |
|--|------|
| 1 Thin section of a laminated dolostone from the Allen Bay Formation of locality A, Prince of Wales Island. The laminae in the upper part of the section are disrupted.
x6. Specimen A30. | 60 |
| 2 Polished surface of a thickly laminated to very thinly bedded dolostone from the Lang River Formation of locality Z, Somerset Island.
Scale=1cm. | 40 |
| 3 Thin section of a laminated sandy dolostone from the Lang River Formation of locality A, Prince of Wales Island. Disrupted laminae and cross laminae are present in the central part of the section. The irregular structures in the thick lamina of the section may be shrinkage cracks.
x3. Specimen A15. | 40 |

PLATE 4

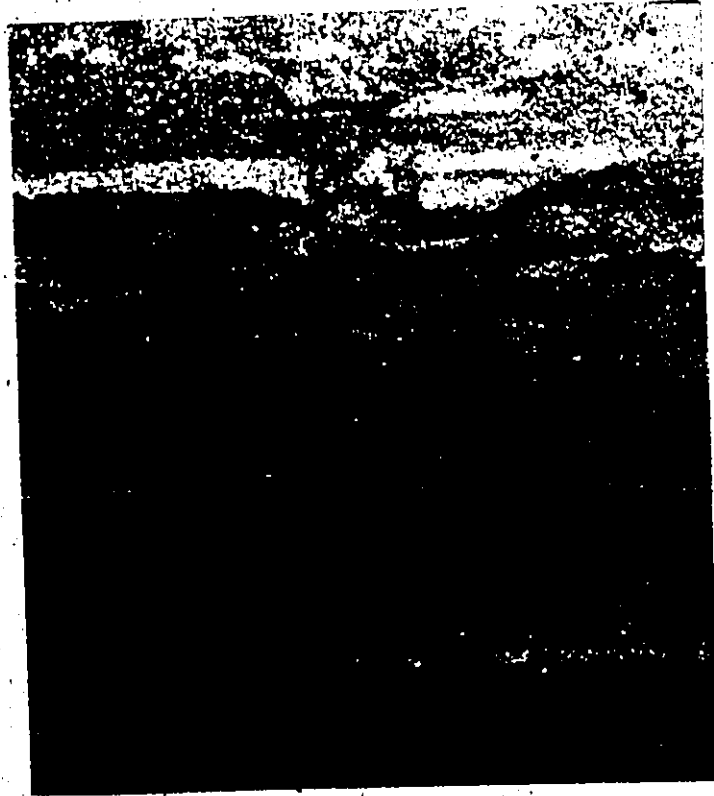
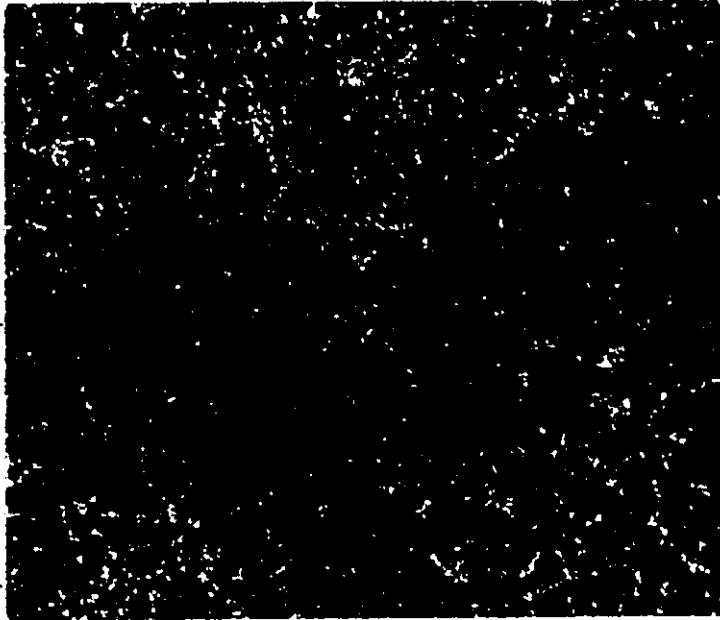


PLATE 5

Figure		Page
1	Thin section of a pellet dolostone from the Lang River Formation of locality X, Somerset Island. x4. Specimen X26.	43
2	Thin section of a thrombolite from the Lang River Formation of locality B, Prince of Wales Island. The darker areas are irregularly laminated, the laminae are defined by black organic material. The lighter clots are composed of dolomite and grains of quartz. Quartz grains are diffused throughout the whole rock but are more concentrated and coarser in the darker clots. x3. Specimen B16.	53
3	Thin section of a sandstone from the cyclothem at locality A, Prince of Wales Island. Lang River Formation. x2.75. Specimen A3.	56

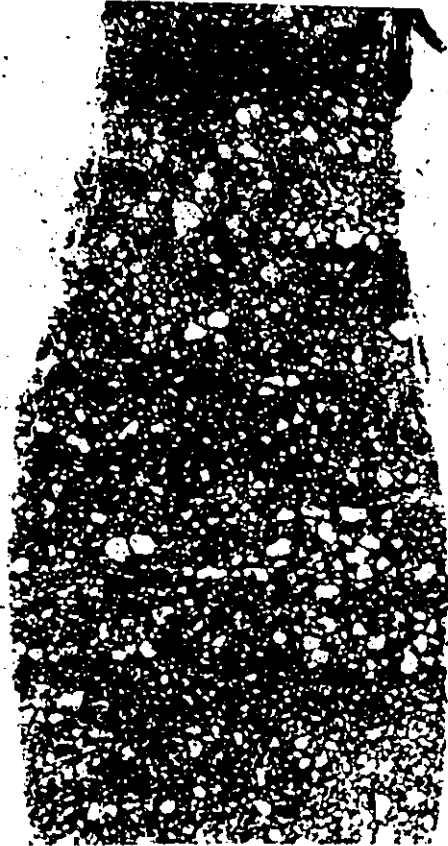
PLATE 5



1



2



3

PLATE 6

Figure

Page

1 Thin section of well-defined dolomitic oolites (?oncolites) from the Lang River Formation of locality A, Prince of Wales Island. The white particles are quartz grains.

44.

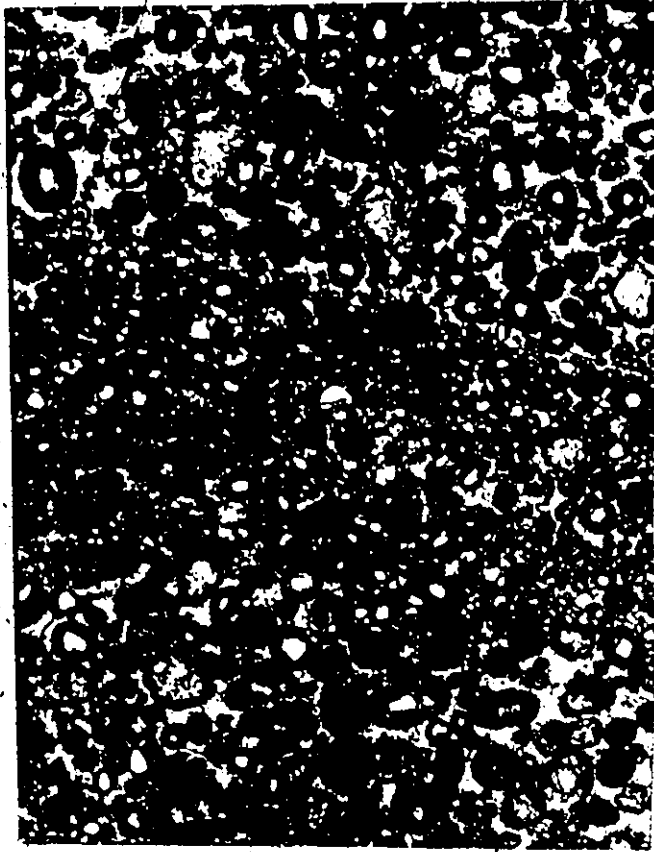
x3. Specimen A35.

2 Thin section of poorly preserved dolomitic oolites from the Lang River Formation of locality X, Somerset Island. The white particles are quartz grains.

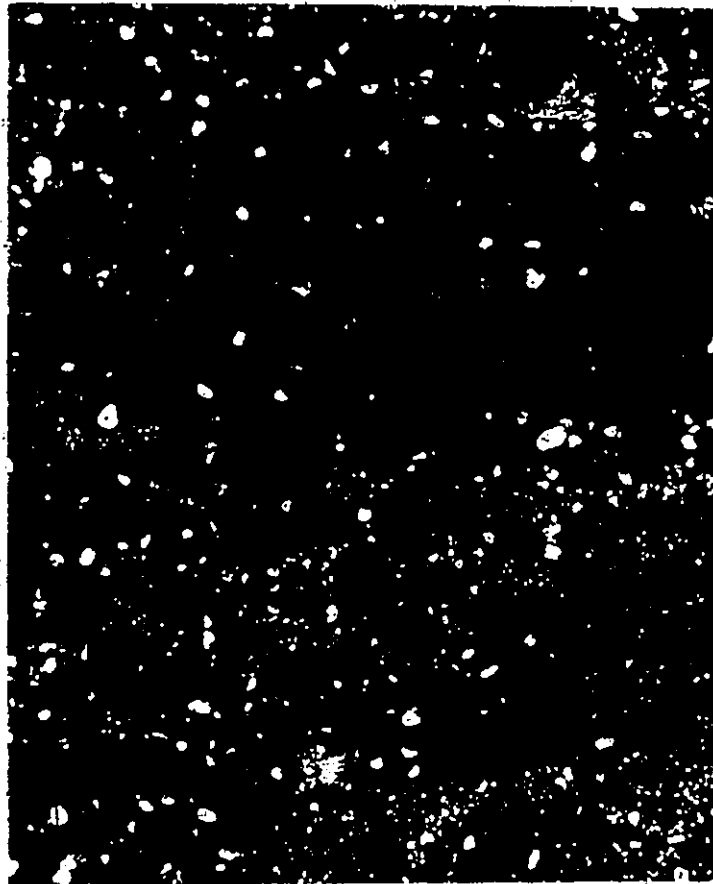
44

x4. Specimen X126.

PLATE 6



1



2

PLATE 7

- | Figure | Page |
|---|------|
| 1 Intraformational breccia bed between thinly laminated dolostone beds from the Lang River Formation of locality B, Prince of Wales Island. Top to the right. | 47 |
| 2 Polished surface of an intraformational breccia from the Lang River Formation of locality B, Prince of Wales Island.
Scale=1cm. | 47 |
| 3 Thin section of an intraformational breccia from the Lang River Formation of locality A, Prince of Wales Island. The top one-third of the section contains dolomitic pellet intraclasts.
x2.5. Specimen A20. | 47 |

PLATE 7



1

2

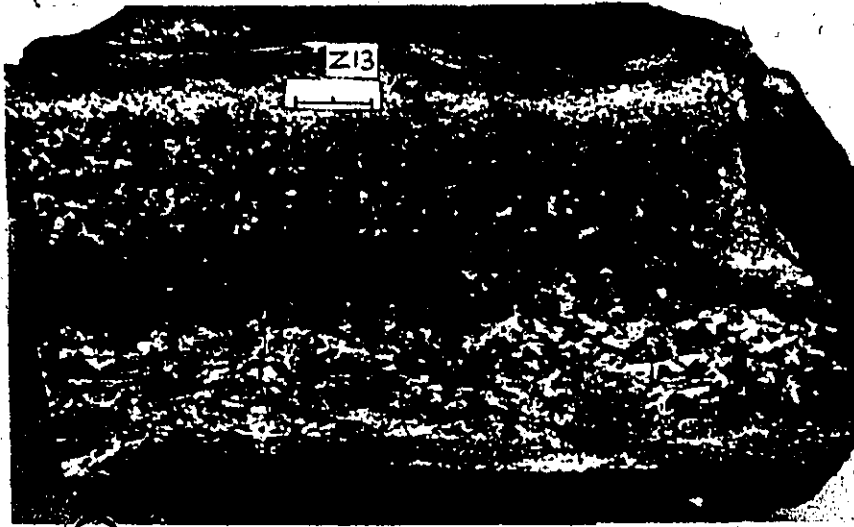


3



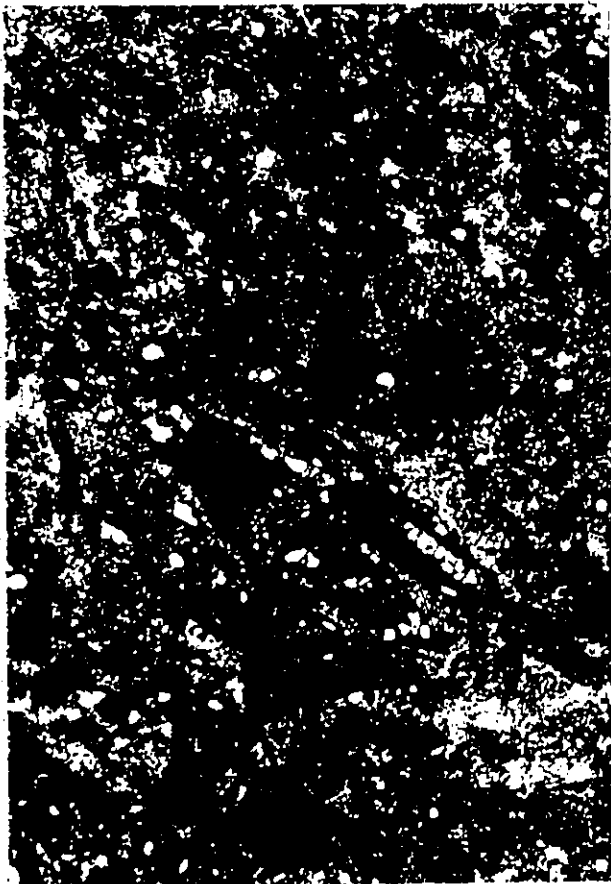
PLATE 8

- | Figure | Page |
|--|------|
| 1 Polished surface of a sandy biogenic intra-clastic dolostone bed from the Lang River Formation of locality Z, Somerset Island. The black spots are quartz grains. Scale=1cm. | 49 |
| 2 Thin section of part of the specimen illustrated in figure 1. The components of the rock include rounded grapestone intraclasts, pellets, quartz grains and unidentifiable shelly material. x3.5 | 49 |
| 3 Thin section of a sandy biogenic intraclastic biogenic dolostone with poorly defined intraclasts and shelly debris. Locality Z, Somerset Island. Lang River Formation. x3. Specimen Z14. | 49 |



1

2



3



PLATE 9

Figure		Page
1	SH-C/LLH stromatolites from the Lang River Formation of locality B, Prince of Wales Island.	51
2	Polished surface of SH-C - SH-V stromatolites from the Lang River Formation of locality X, Somerset Island.	51

Scale=1cm.

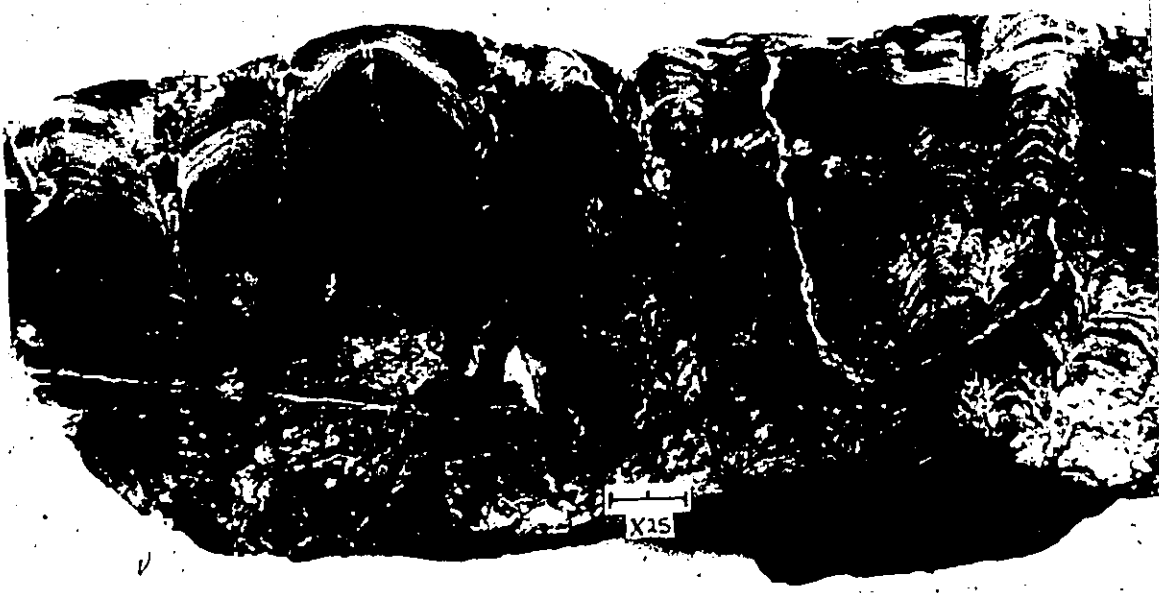
PLATE 9



5

1

2



X25

PLATE 10

Figure

Page

- 1 Gypsum/anhydrite mineral casts in thinly laminated dolostone from the Allen Bay Formation of locality A, Prince of Wales Island.
Scale=1cm. 60
- 2 LLH type stromatolites from the Allen Bay Formation of locality 2, Somerset Island. Rucksack in the right hand corner provides a scale. 61

PLATE 10



1



2

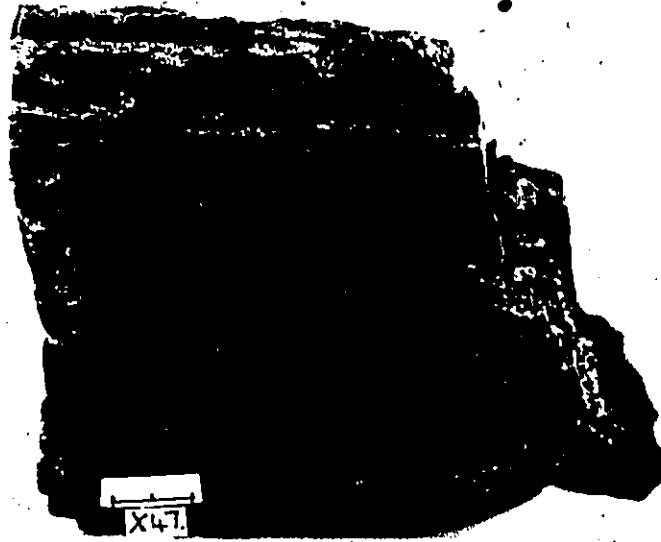
PLATE 11

Figure

Page

- 1 Possible leached birdseye structures in a laminated dolostone from the Allen Bay Formation of locality X, Somerset Island.
Scale=1cm. 61
- 2 Vermicular and branching chert nodules on a bedding plane in the Lang River Formation of locality X, Somerset Island. 86

PLATE 11



1



2

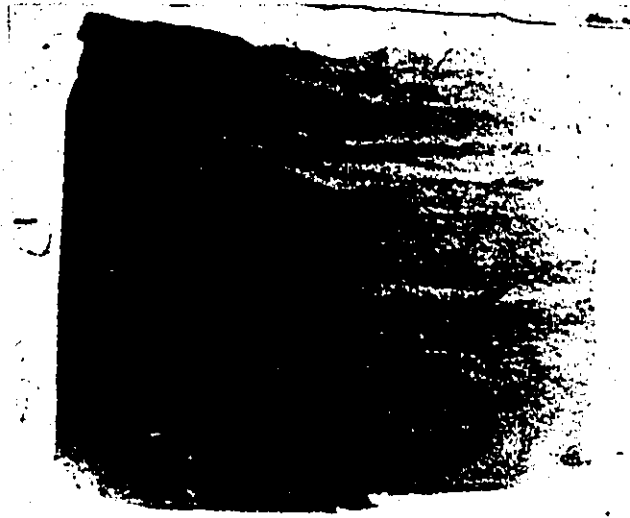
PLATE 12

Figure		Page
1	Polished surface of patterned dolostone perpendicular to the bedding from the Young Bay Formation of locality A, Prince of Wales Island. Specimen TB-9. Scale=1cm.	88
2	Patterned dolostone. Thin section of specimen TB-9 in both transmitted and partially reflected light. x3	88
3	Polished surface of patterned dolostone from the Lang River Formation of locality Z, Somerset Island. Specimen Z27. Scale=1cm.	88

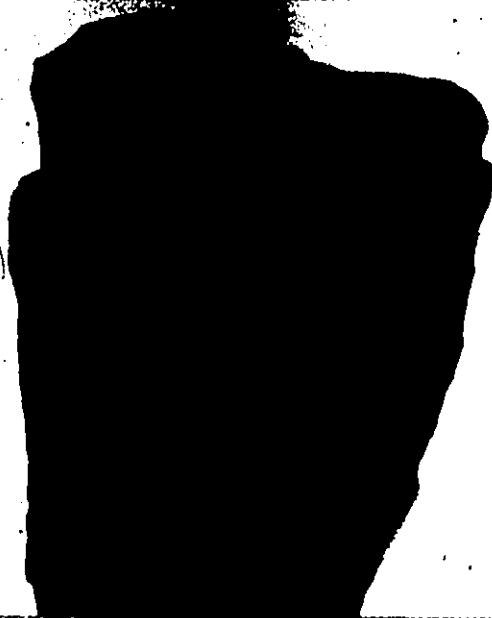
PLATE 12



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PLATE 13

Figure

Page

1 Polished surface of patterned dolostone perpendicular to the bedding from the Young Bay Formation of locality A, Prince of Wales Island. Specimen TB-10.

88

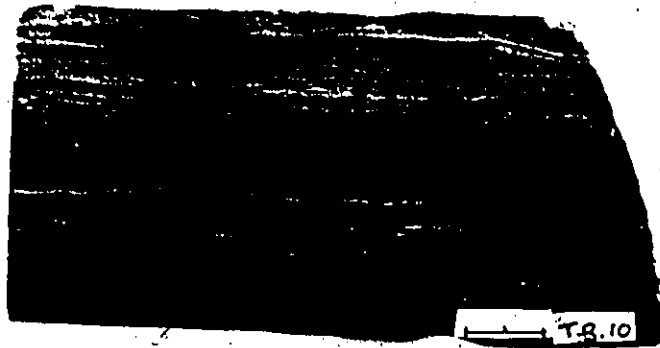
Scale=1cm.

2 Patterned dolostone. Thin section of specimen TB-10 in transmitted light. Vague 'ghosts' of the pattern may be seen.

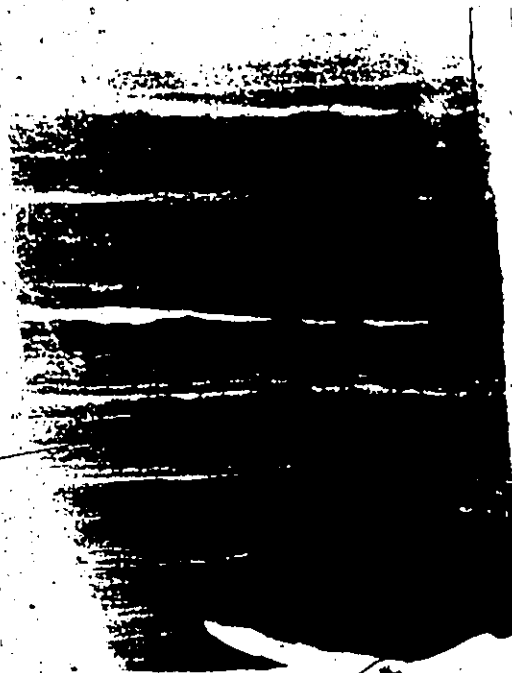
88

x3

PLATE 13



1



2

PLATE 14



2

3



PLATE 14



2



3



PLATE 15

Figure

Page

- 1 Member 1 of the Hunting Formation (locality 1 of text-fig. 6). Somerset Island.

214

Alternating beds of dark-coloured dolomitic siltstone or fine-grained sandstone and lighter sandy dolostone.

- 2 Unconformable contact between the Hunting and Lang River Formations, locality Y,

29
217

Somerset Island. The dark terrain in the background is the outcrop of the Aston Formation and further towards the horizon, the Precambrian basement. Oblique aerial photograph facing southwest. The Hunting River is situated in the lower right corner.

PLATE 15

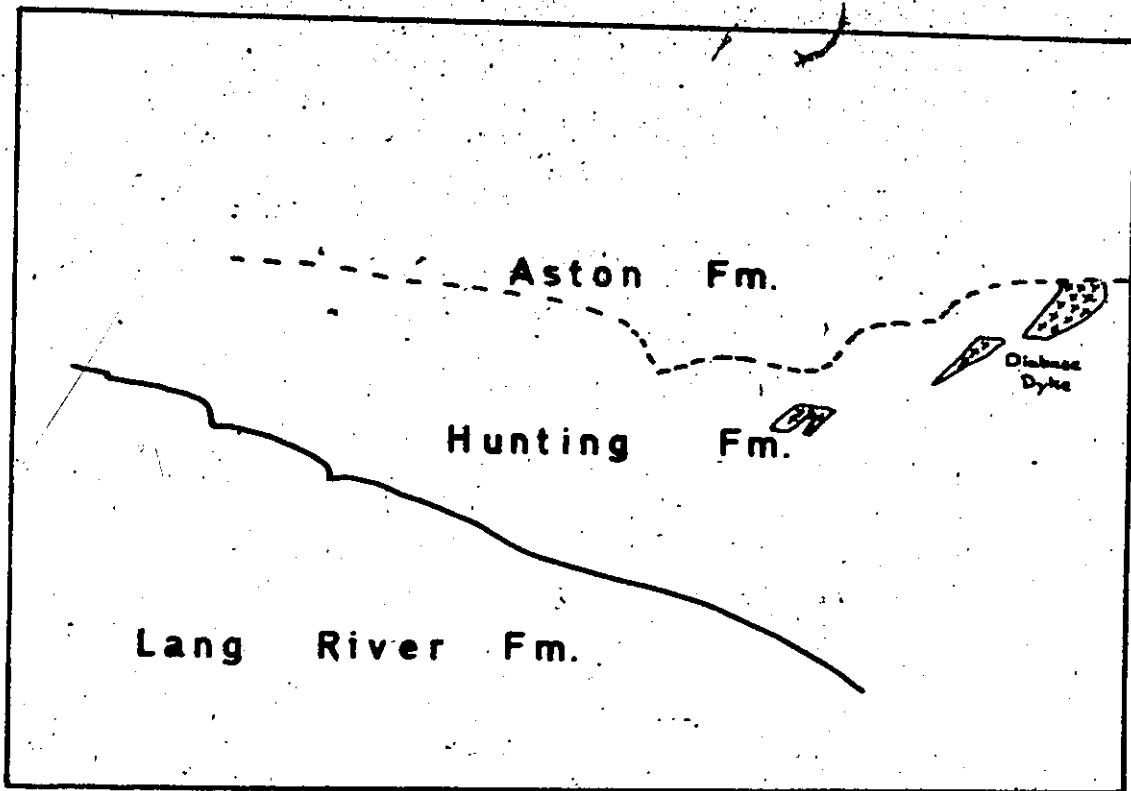


PLATE 15

1



2



PLATE 15

1



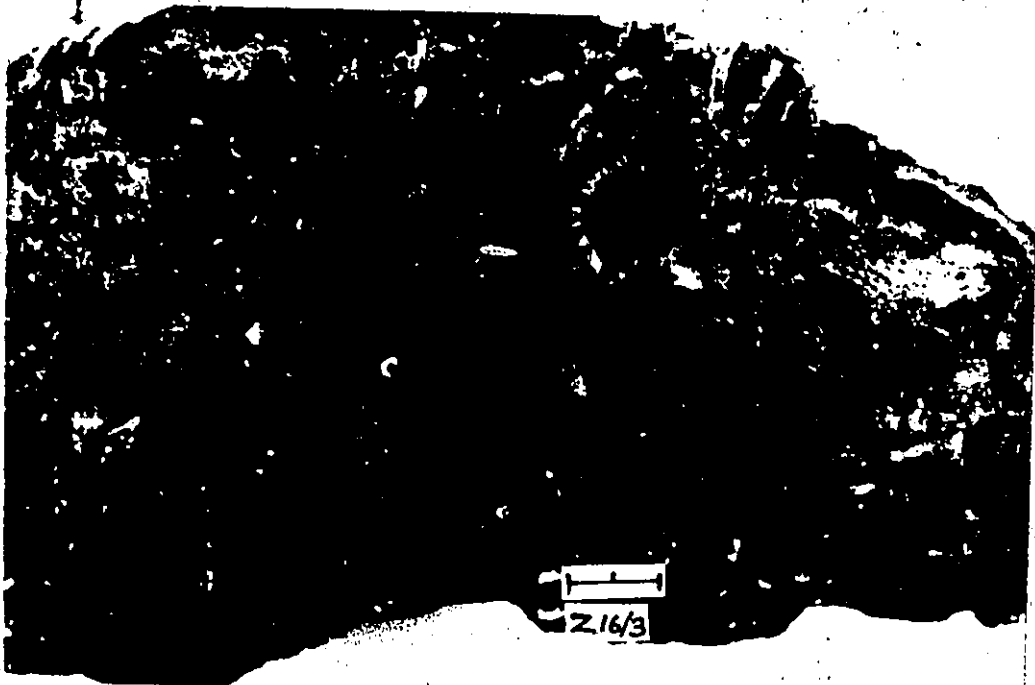
2



9

PLATE 16

Figure		Page
1	<i>Catenipora</i> n.sp.2. Polished surface showing transverse sections of corallite ranks. Holotype Z16/3. Scale=1cm.	176
2	<i>Catenipora</i> n.sp.2. Enlargement of part of figure 1 showing autocorallites and three megacorallites in transverse section. x4.5	176



1

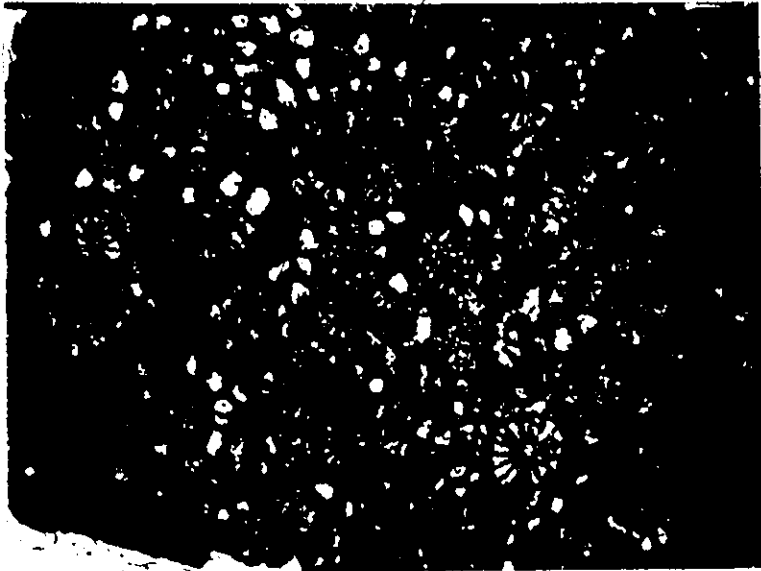


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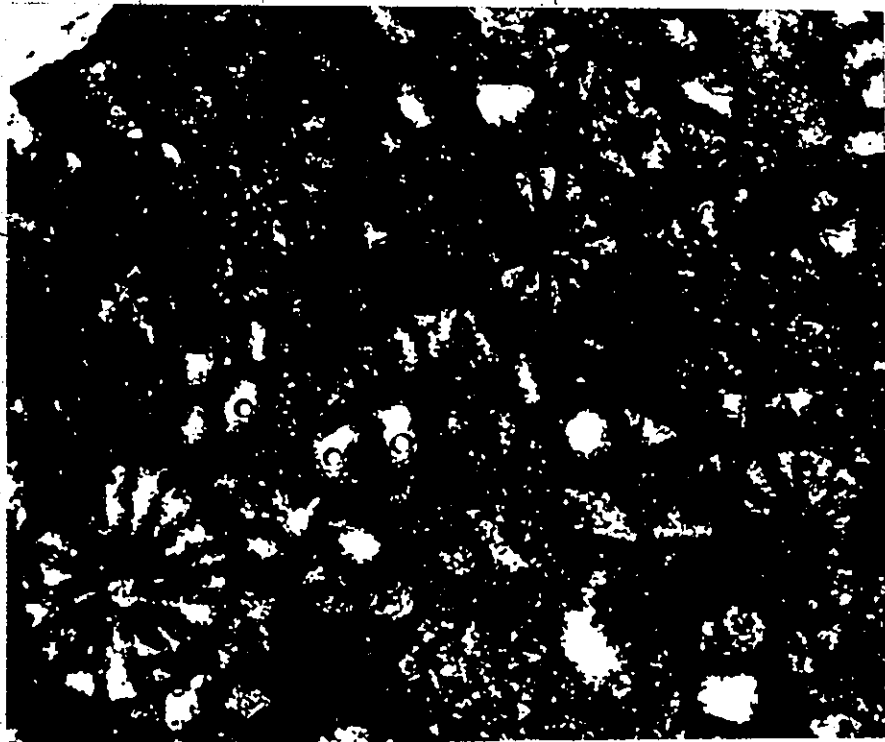
PLATE 17

- | Figure | Page |
|--|------|
| 1 <i>Paleophyllum</i> n.sp.l. Transverse thin section.
Intergrowing with <i>Manipora</i> sp.
Holotype CB2/32.
x3.25 | 145 |
| 2 <i>Paleophyllum</i> n.sp.l. Enlargement of figure 1.
Holotype CB2/32 .
x11 | 145 |

PLATE 17



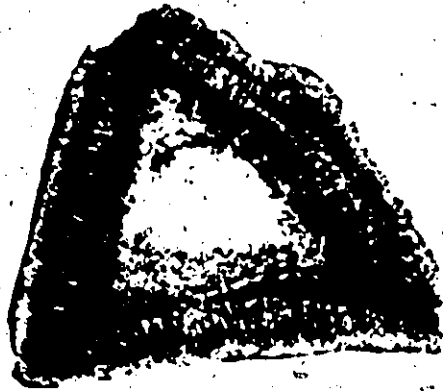
1



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PLATE 18

Figure		Page
1	a. <i>Aulacera</i> n.sp.1. , Transverse thin section. Holotype Z16/51. x 2.4	130
	b. <i>Aulacera</i> n.sp.1. Detail of one of the corners. Holotype Z16/51. x 3.7	
	c. <i>Aulacera</i> n.sp.1. External surface view. Holotype Z16/51. x 0.65	
2	<i>Aulacera</i> ?n.sp.2. Longitudinal section. Holo- type Z16/68. x 0.5	132
3	New genus A n.sp.2. External view with a broken surface showing the internal structure. Syntype Z16/55. x 0.67	135
4	<i>Calymene meeki</i> . Cephalon. Plesiotype Z16/19. x 2.2	204
5	<i>Actinostroma</i> sp.3. Transverse thin section. Specimen X144. x 2.5	119
6	<i>Paleophyllum halysitoides</i> n.subsp.A. Transverse thin section. Type specimen X95. 2.4	138



a



b



c



2



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4



6

PLATE 19

Figure		Page
1	New genus A n.sp.1. External surface view. Holotype Z17/3. x0.6	133
2	a. New genus A n.sp.2. External surface view. Syntype Z16/54. x0.6	135
	b. New genus A n.sp.2. Polished transverse surface. Syntype Z16/54. x0.9	
3	<i>Clathrodictyon</i> sp.3. Vertical thin section. Specimen X49/9. x2.5	119
4	<i>Clathrodictyon</i> sp.1. Vertical thin section. Specimen Z16/58. x3.0	105
5	<i>Actinostroma</i> sp.1. Oblique thin section. Specimen X36/5. x2.65	119
6	<i>Actinostroma</i> sp.1. Oblique thin section. Spec- imen X33/2. x3.67	119
7	<i>Clathrodictyon</i> sp. indet. Vertical thin section. Specimen X63. x4.0	105



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b



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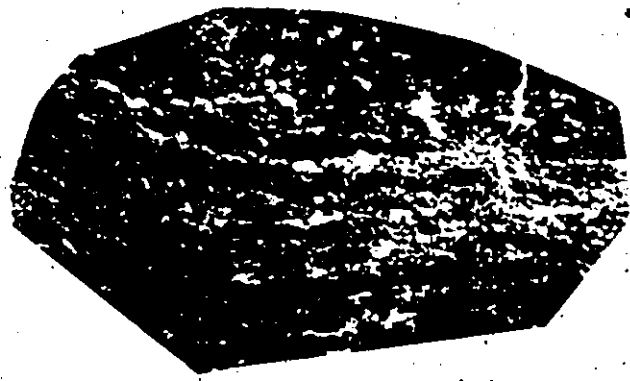
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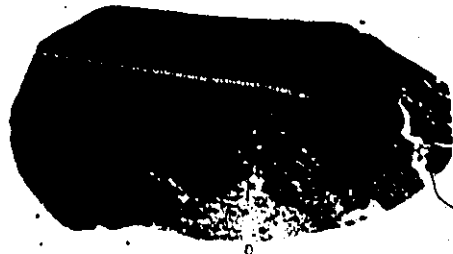
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PLATE 20

Figure		Page
1	<i>Clathrodictyon</i> sp.2. Vertical thin section. Specimen X204/29. x 2.7	119
2	<i>Actinostroma</i> sp.3. Vertical thin section. Specimen X173. x 2.3	119
3	<i>Cystostroma</i> ?n.sp. Vertical thin section. Paratype X49/7. x 2.7	129
4	<i>Clathrodictyon</i> sp. indet. Vertical thin section. Specimen Z17/14. x 2.25	105
5	<i>Cystostroma</i> ?n.sp. Vertical thin section. Holotype X248/2. x 2.8	129
6	<i>Aulacera</i> ?n.sp.2. Transverse thin section. Holotype Z16/68. x 2.7	132



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PLATE 21

Figure

Page



- | | | |
|---|---|-----|
| 1 | <i>Catenipora</i> n.sp.1. Polished transverse surface. Holotype X204/8. x 1.2 | 173 |
| 2 | <i>Catenipora</i> n.sp.1. Polished transverse surface illustrating the autocorallites and two megacorallites. X204/8. x 2.8 | 173 |
| 3 | <i>Actinostroma</i> sp.2. Oblique thin section. Specimen A40/5. x 3.0 | 119 |

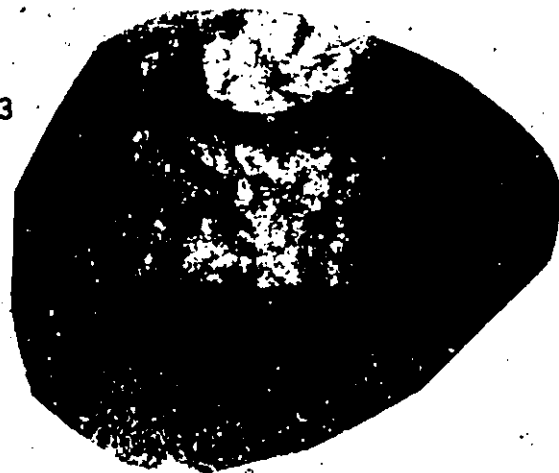
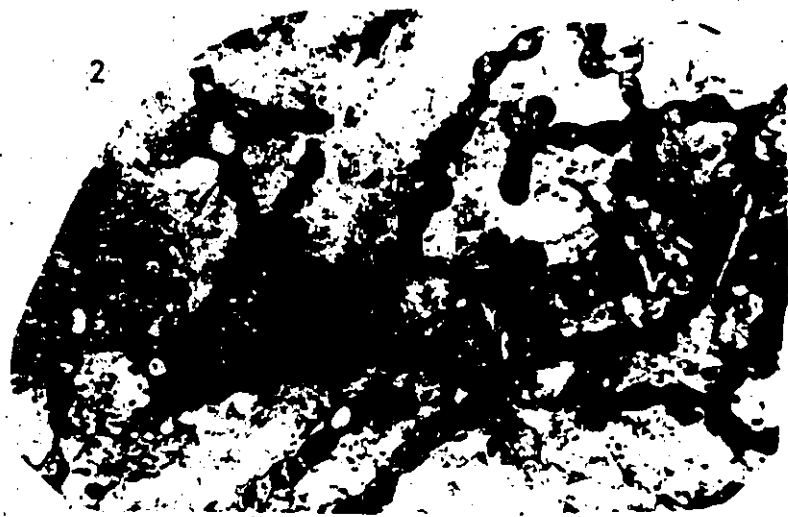


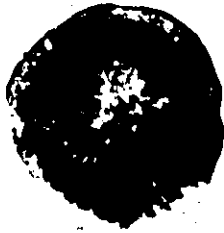
PLATE 22

Figure		Page
1	<i>Streptelasma</i> sp. form 3. Polished transverse surface of the ephelic portion of the corallum. Specimen Z16/45. x 1.0	202
2	<i>Streptelasma</i> sp. form 3. Polished transverse surface of the ephelic portion of the corallum. Specimen Z16/43. x 1.4	202
3	<i>Streptelasma</i> sp. form 5. Polished transverse surface of the ephelic portion of the corallum. Specimen Z16/43A. x 1.35	202
4	<i>Streptelasma</i> sp. form 4. Polished transverse surface of the ephelic portion of the corallum. Specimen X204/21. x 1.4	202
5	<i>Streptelasma</i> sp. form 6. Polished transverse surface of the ephelic portion of the corallum. Specimen X88. x 1.3	202
6	<i>Streptelasma</i> sp. form 6. Polished transverse surface of the ephelic portion of the corallum. Specimen X90. x 1.6	202
7	? <i>Streptelasma</i> sp. form 7. Calical view of the corallum. Specimen X186. x1.1	202
8	<i>Streptelasma</i> sp. form 4. Polished transverse surface of the ephelic portion of the corallum. Specimen X204/20. x1.4	202

(cont'd)

PLATE 22 (cont'd)

Figure		Page
9	<i>Streptelasma</i> sp. form 6. Polished transverse surface of the ephebic portion of the corallum. Specimen X78. x 2.0	202
10	<i>Streptelasma</i> sp. form 2. Specimen Z16/41.	202
	a. Polished transverse surface of the ephebic portion of the corallum showing the columella. x 1.1	
	b. Polished transverse surface of the ephebic portion of the corallum at a point slightly above the columella. x 0.9	



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a



b

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PLATE 23

Figure		Page
1	<i>Lobocorallium trilobatum</i> Polished transverse surface of the epebic portion of the corallum. Plesiotype X206. x 1.25	203
2	<i>Paleophyllum radugini</i> Transverse thin section. Plesiotype X55. x 2.75	141
3	<i>Grewingkia</i> sp. Specimen Z16/40.	105
	a. Polished transverse surface of the epebic portion of the corallum. x 1.4	
	b. Lateral view of the corallum. Counter septal position along the convex edge. x 1.2	
4	? <i>Dinophyllum</i> sp. Polished transverse surface of the epebic portion of the corallum. Specimen X247. x 1.4	119
5	<i>Bighornia</i> sp.1. Specimen X79.	105
	a. Polished transverse surface of the epebic portion of the corallum. x 1.5	
	b. ?Cardinal view of the corallum. x 1.4	
	c. Lateral view of the corallum. x 1.4	



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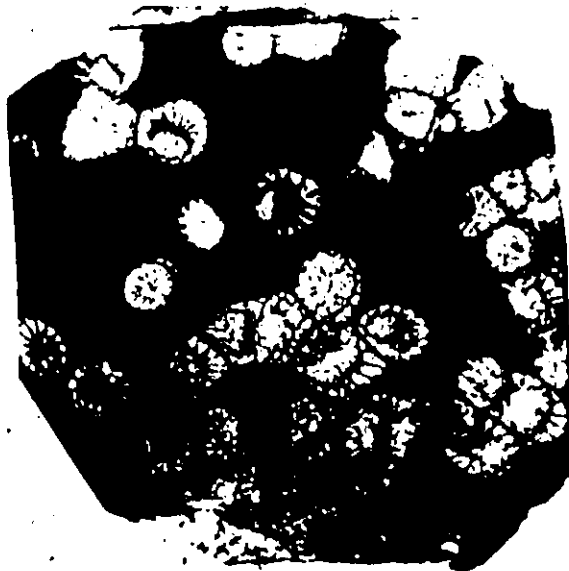


PLATE 24

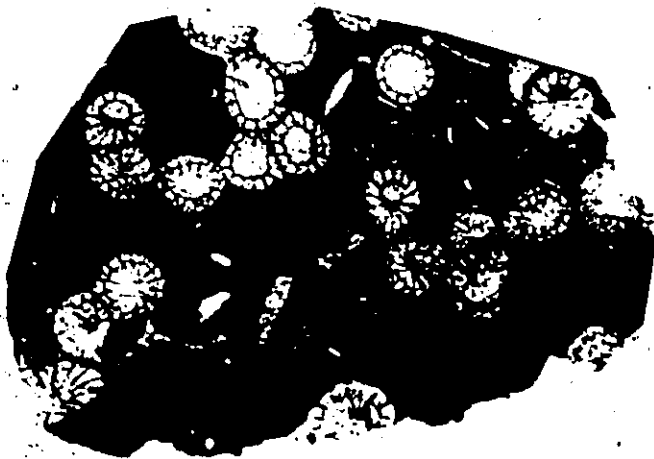
Figure		Page
1	<i>Paleophyllum halysitoides</i> n. subsp. B. Oblique thin section. Type specimen X204/17. x 2.8	138
2	<i>Paleophyllum vaurealensis</i> . Transverse thin section. Plesiotype X178. x 3.3	143
3	<i>Paleophyllum vaurealensis</i> . Transverse thin section. Plesiotype X184. x 4.0	143
4	<i>Paleophyllum</i> aff. <i>raduguini</i> . Transverse thin section. Hypotype B29/6. x 2.67	142
5	<i>Paleophyllum raduguini</i> . Transverse thin section. Plesiotype CB2/18. x 2.67	141



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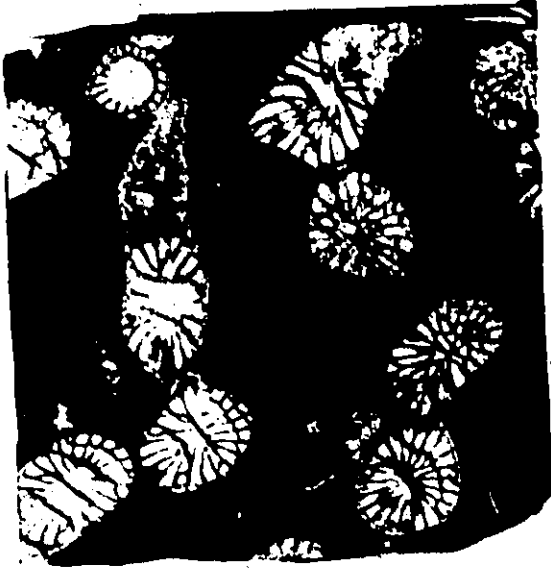
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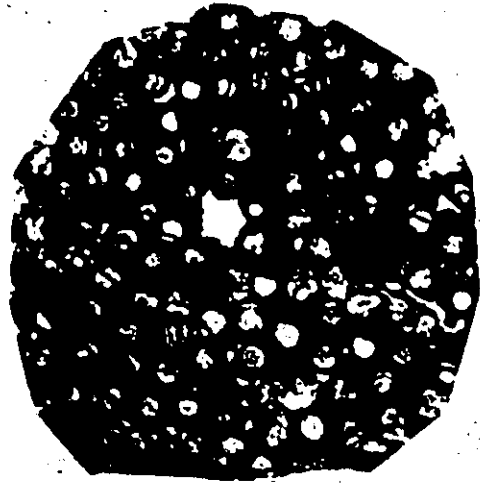
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PLATE 25

Figure		Page
1	<i>Paleophyllum</i> aff. <i>thomi</i> . Transverse thin section. Hypotype Z16/33. x 3.0	144
2	<i>Sarcinula</i> sp. Transverse thin section. Specimen Z16/37. x 2.3	146
3	<i>Sarcinula</i> sp. Polished longitudinal surface. Specimen X171. x 1.0	146
4	<i>Manipora</i> <i>fieldeni</i> . Transverse thin section. Plesiotype Z16/1. x 2.1	184
5	<i>Protrochiscolithus</i> <i>kiaeri</i> . Transverse thin section. Plesiotype X160. (x 5.3	103



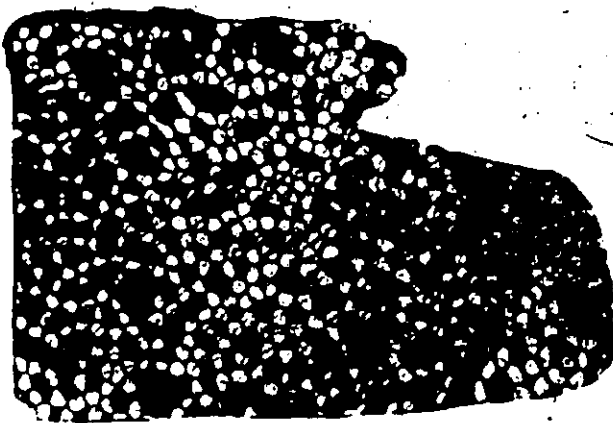
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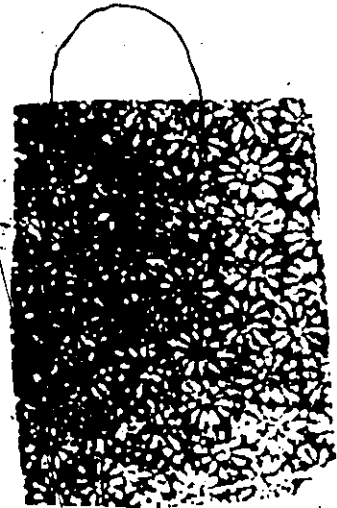
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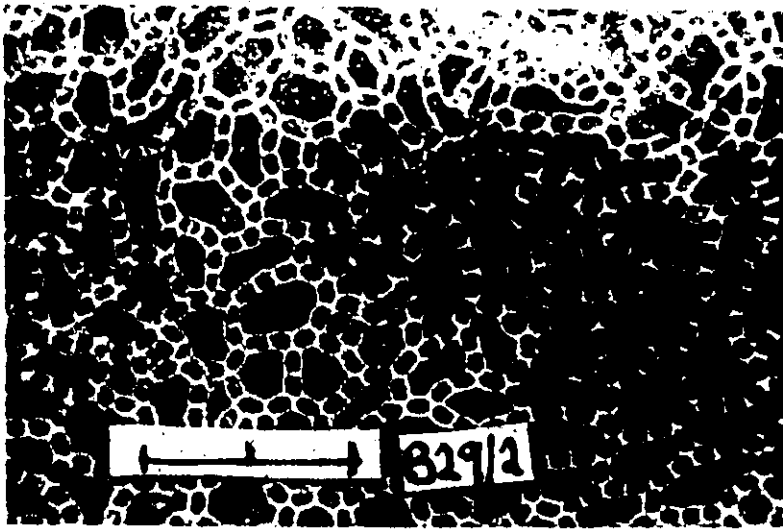
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PLATE 26

Figure		Page
1	<i>Catenipora aequabilis</i> . Polished transverse surface. Plesiotype B29/2. x 2.8	165
2	<i>Catenipora agglomeratiformis</i> . Polished transverse surface. Plesiotype Z16/11. x1.1	166
3	<i>Halysites encrustans</i> n.subsp.A. Polished transverse surface. Type specimen X36. x1.7	180



2

3

PLATE 27

Figure		Page
1	<i>Catenipora delicatula</i> . Polished transverse surface. Plesiotype X157. x1.3.	168
2	<i>Catenipora cf. delicatula</i> . Polished transverse surface. Hypotype X165. x1.3	169
3	<i>Catenipora cf. delicatula</i> . Polished transverse surface. Hypotype CB2/13. x1.3	169
4	<i>Manipora amicarum</i> . Transverse thin section. Plesiotype X204/4. x2.1	182

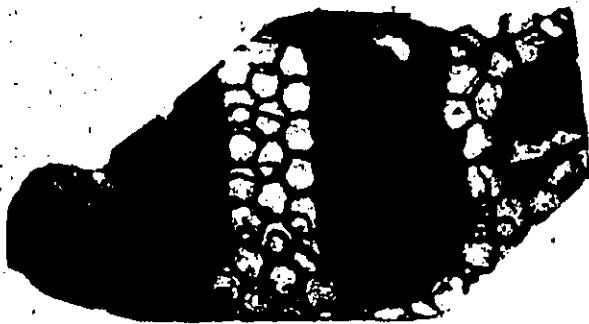
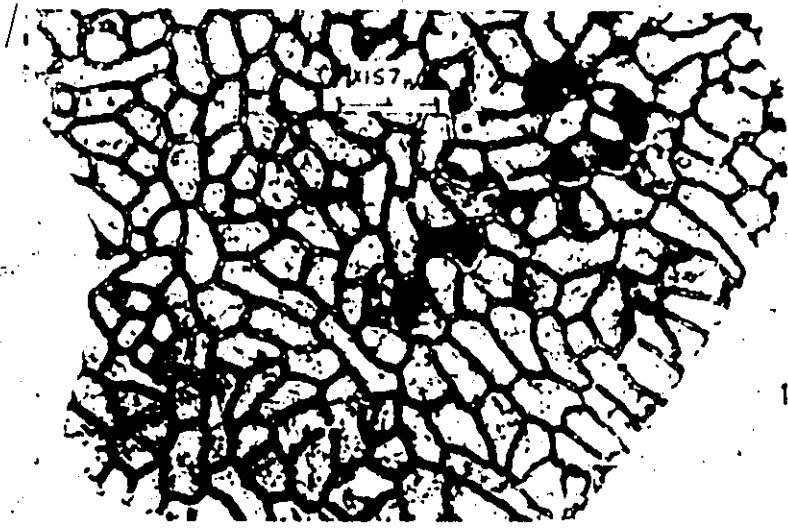
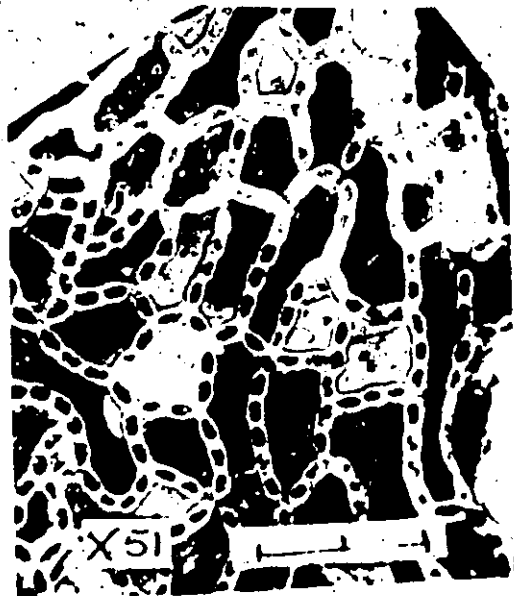


PLATE 28

Figure		Page
1	<i>Catenipora rubra</i> . Polished transverse surface. Plesiotype B29/11. x1.1	172
2	<i>Catenipora rubra</i> . Polished transverse surface. Plesiotype X204/5. x0.75	172
3	<i>Catenipora delicatula</i> . Polished transverse surface. Plesiotype B29/7. x1.3	168
4	<i>Catenipora robusta</i> . Polished transverse surface. Plesiotype X51. x2.2	170



3

2

X51

PLATE 29

Figure

Page

- | | | |
|---|--|-----|
| 1 | <i>Manipora amicarum.</i> Polished, transverse
surface. Dominantly monoserial form.
Plesiotype X204/1. x0.75
Scale=1cm. | 182 |
| 2 | <i>Manipora amicarum.</i> , Polished transverse
surface. Multiserial form. Plesiotype Z16/6.
x1.25
Scale=1cm. | 182 |
| 3 | <i>Manipora amicarum.</i> Polished transverse
surface. Multiserial form. Plesiotype Z16/7.
x1.1
Scale=1cm. | 182 |

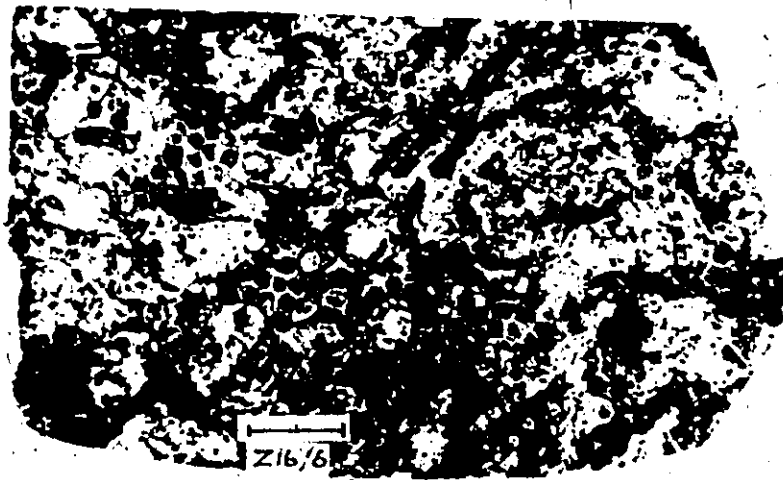
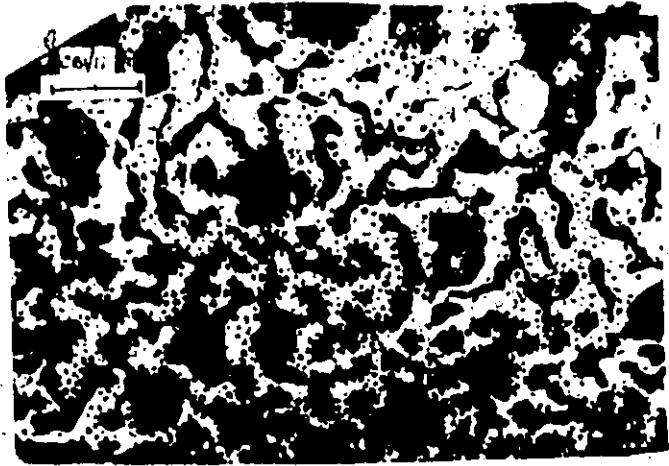


PLATE 30

Figure		Page
1	? <i>Manipora</i> n.sp.1. Transverse thin section. Syntype CB1/11. x1.9	187
2	? <i>Manipora</i> n.sp.1. Polished, transverse surface. Syntype CB1/11. x1.2	187
3	<i>Catenipora</i> n.sp.3. Holotype X170. a. Polished transverse surface. Scale=1cm. x1.8. b. Transverse thin section. x1.85	178
4	<i>Catenipora</i> n.sp.2. Transverse thin section. Holotype Z16/3. x1.8	176



a

3



b

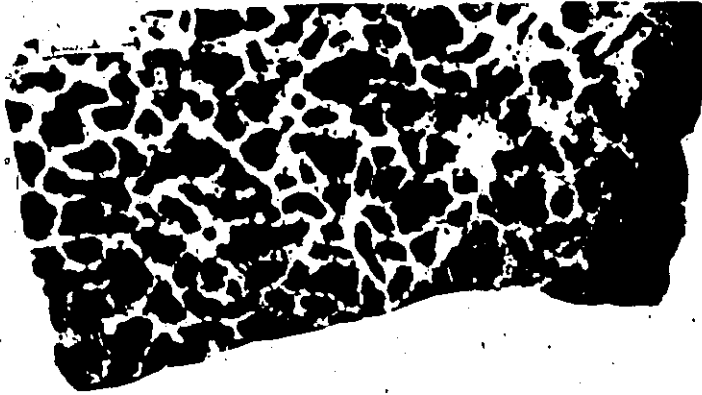


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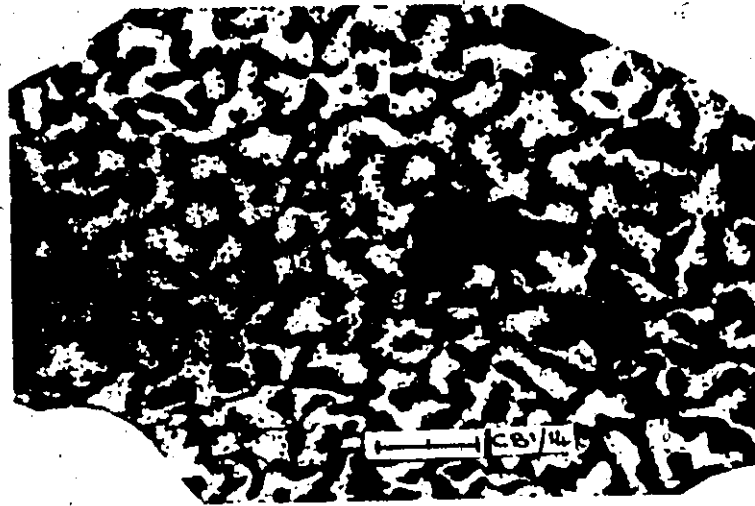


PLATE 31

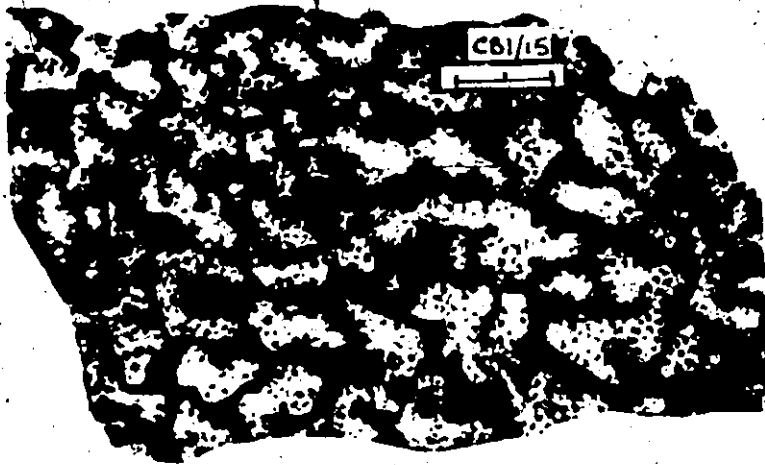
Figure		Page
1	? <i>Manipora</i> n.sp.l. Polished transverse surface. Dominantly monoserial form. Syntype CBl/13. x1.1	187
2	? <i>Manipora</i> n.sp.l. Polished transverse surface. Multiserial form. Syntype CBl/14. x1.35	187
3	? <i>Manipora</i> n.sp.l. Polished transverse surface. Cerioid form. Syntype CBl/15. x1.3	187



1



2



3

PLATE 32

Figure		Page
1	<i>Eucônia</i> sp.1. Internal mold. Specimen X222/7. x0.75	97
2	<i>Schizopea</i> sp. Internal mold. Specimen X222/48	97
	a. Apical view. x1.8	
	b. Umbilical view. x1.8	
3	<i>Sinuopea</i> sp. Internal mold. Specimen X222/49.	97
	x2.2	
4	? <i>Liospira</i> sp. Internal mold. Specimen X222/52.	97
	a. Lateral view. x1.4	
	b. Apical View. x1.4	
5	? <i>Dakeoceras</i> sp. Silicified. Specimen X223/9. x2.3	97
6	Family: <i>Ellesmeroceratidae</i> , genus unknown. Internal mold. Specimen X223/40. x3.0	97
7	? <i>Ellesmeroceras</i> sp.2. Silified. Specimen X223/65. x1.5	97
8	? <i>Caseoceras</i> sp. Silicified. Specimen X222/3. x1.3	97
9	<i>Ellesmeroceras</i> sp.1. Silicified. Specimen X222/2. x1.3	97
10	? <i>Quebecoceras</i> sp. Silicified. Specimen X223/2	97
	a. Siphuncle view. x1.3	
	b. Lateral view. x1.3	
11	<i>Ellesmeroceras</i> sp.1. Silicified. Specimen X223/41. Lateral view. x1.35	97

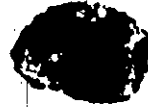


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b



11



PLATE 33

Figure		Page
1	<i>Armenoceras</i> sp.1. Polished longitudinal surface of a partially silicified siphuncle cut in a dorso-ventral direction. Ventral surface to the left. Specimen Z16/74. x0.8	190
2	<i>Armenoceras</i> sp.1. Polished longitudinal surface of the siphuncle cut in a dorso-ventral direction. Ventral surface to the left. Specimen X204/32. x0.9	190
3	<i>Armenoceras</i> sp.3. Polished longitudinal surface of the siphuncle. Direction of cut probably dorso-ventral. Specimen Z16/63. x0.7	192
4	<i>Armenoceras</i> sp.6. Polished longitudinal surface of the siphuncle. Direction of cut probably dorso-ventral. Specimen Z16/64. x0.8	196
5	<i>Armenoceras</i> sp.7. Polished longitudinal surface of a partially silicified siphuncle. Direction of cut probably dorso-ventral. Specimen X204/36. x0.6	197
6	<i>Armenoceras</i> ?sp.7. Polished longitudinal surface of the siphuncle. Direction of cut probably dorso-ventral. Specimen X221. x0.9	198
7	<i>Armenoceras</i> sp.5. Polished longitudinal surface of a partially silicified siphuncle. Direction of cut probably dorso-ventral. Specimen Z16/60. x0.67	195

PLATE 33



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PLATE 34

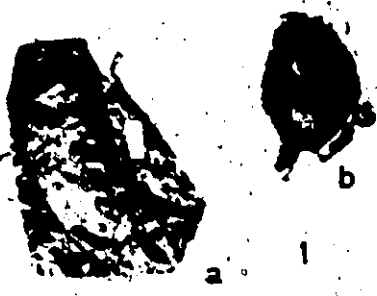
Figure		Page
1	<i>Conoceras</i> ?n.sp.1. Holotype Z16/70.	199
	a. Lateral view. x0.4	
	b. Cross sectional view. x0.7	
2	<i>Kochoceras bailliei</i> . Part of the phragmocone. Hypotype Z16/71. x0.3	107
3	<i>Geisonoceras</i> sp. Polished longitudinal surface of part of the conch. Specimen CB2/22. x0.9	204
4	<i>Lambeoceras</i> cf. <i>baffinense</i> . Polished longitudinal surface. Hypotype Z16/69. x0.5	107
5	<i>Cyclendoceras</i> ?n.sp.1. Part of the phragmocone. Z16/73. x0.6.	200
6	<i>Armenoceras</i> cf. <i>arcticum</i> . Polished longitudinal surface of the siphuncle. Hypotype X204/34. x0.5	106
7	<i>Armenoceras saxosum</i> . Polished longitudinal surface of the siphuncle. Direction of cut prob- ably dorso-ventral. Plesiotype Z16/67. x0.3	106
8	<i>Armenoceras australe</i> . Polished longitudinal surface of the siphuncle. Direction of cut prob- ably dorso-ventral. Plesiotype X158. x0.6	106

Figure

Page

9 *Armenoceras richardsoni*. Polished longitudinal surface of the siphuncle. Direction of cut probably dorso-ventral. Plesiotype Z16/62. x0.5

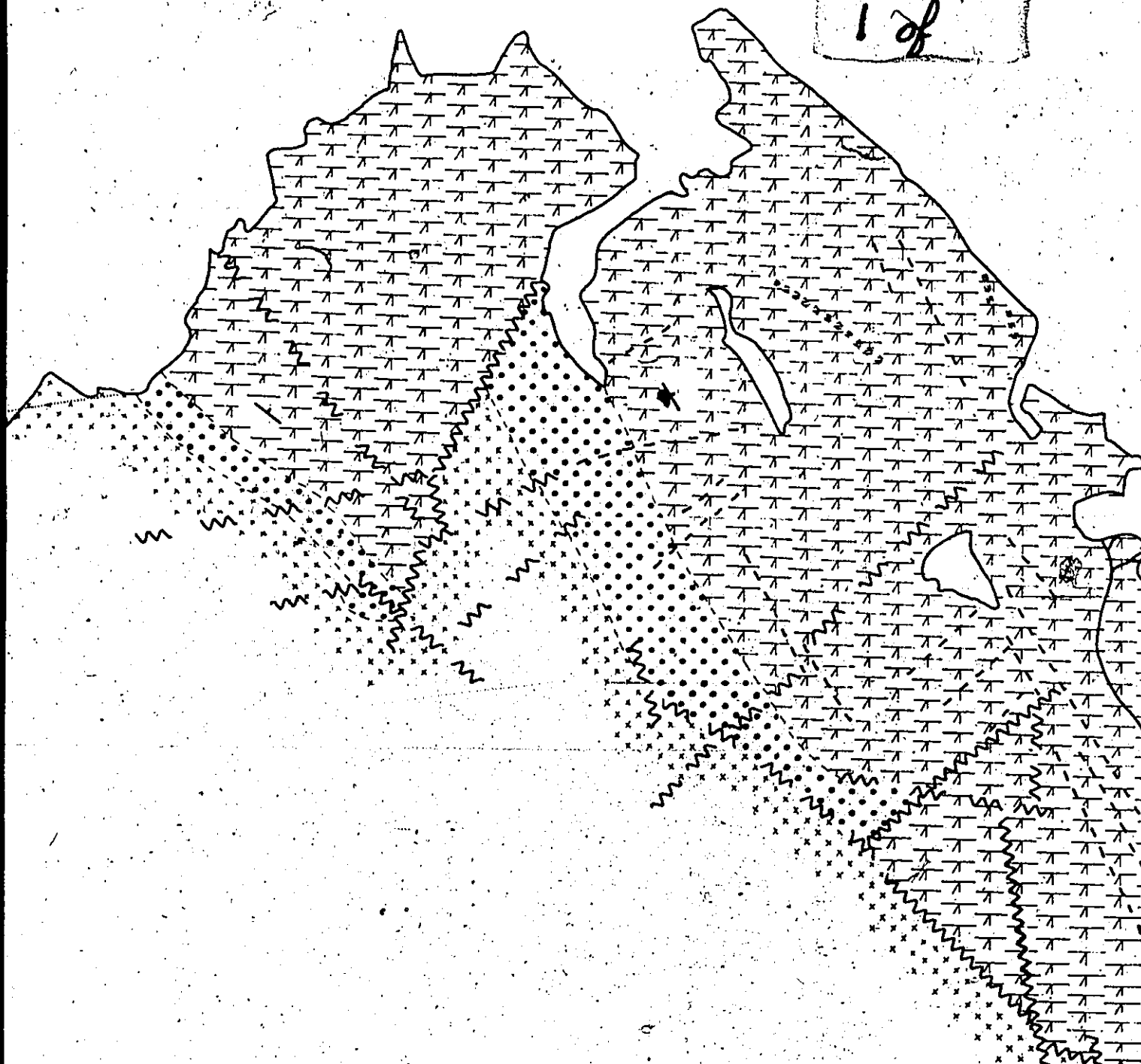
PLATE 34





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UNIVERSITY OF OTTAWA

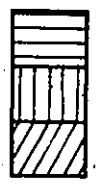
1 of 1



LEGEND



Post-Hunting rocks.



member 3
member 2
member 1

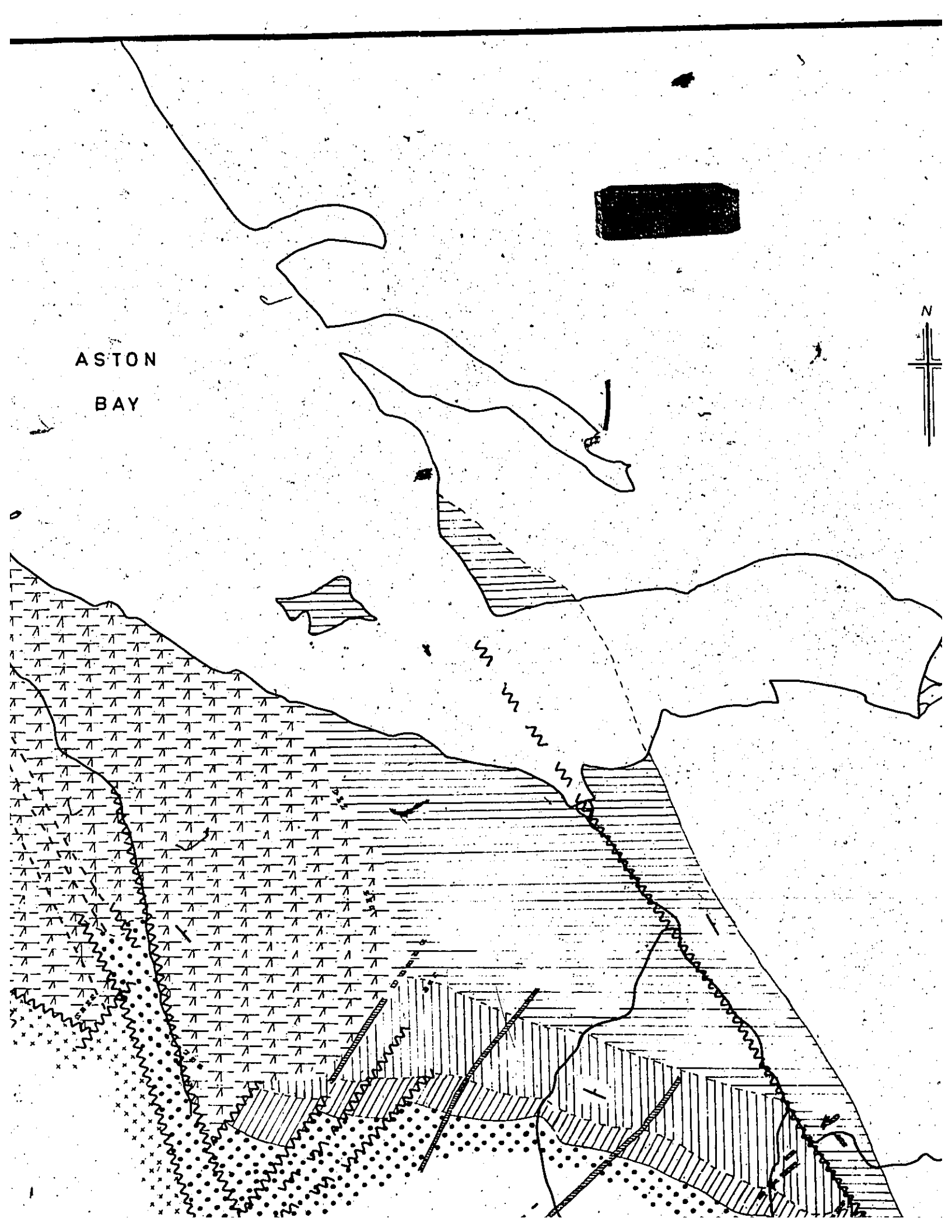


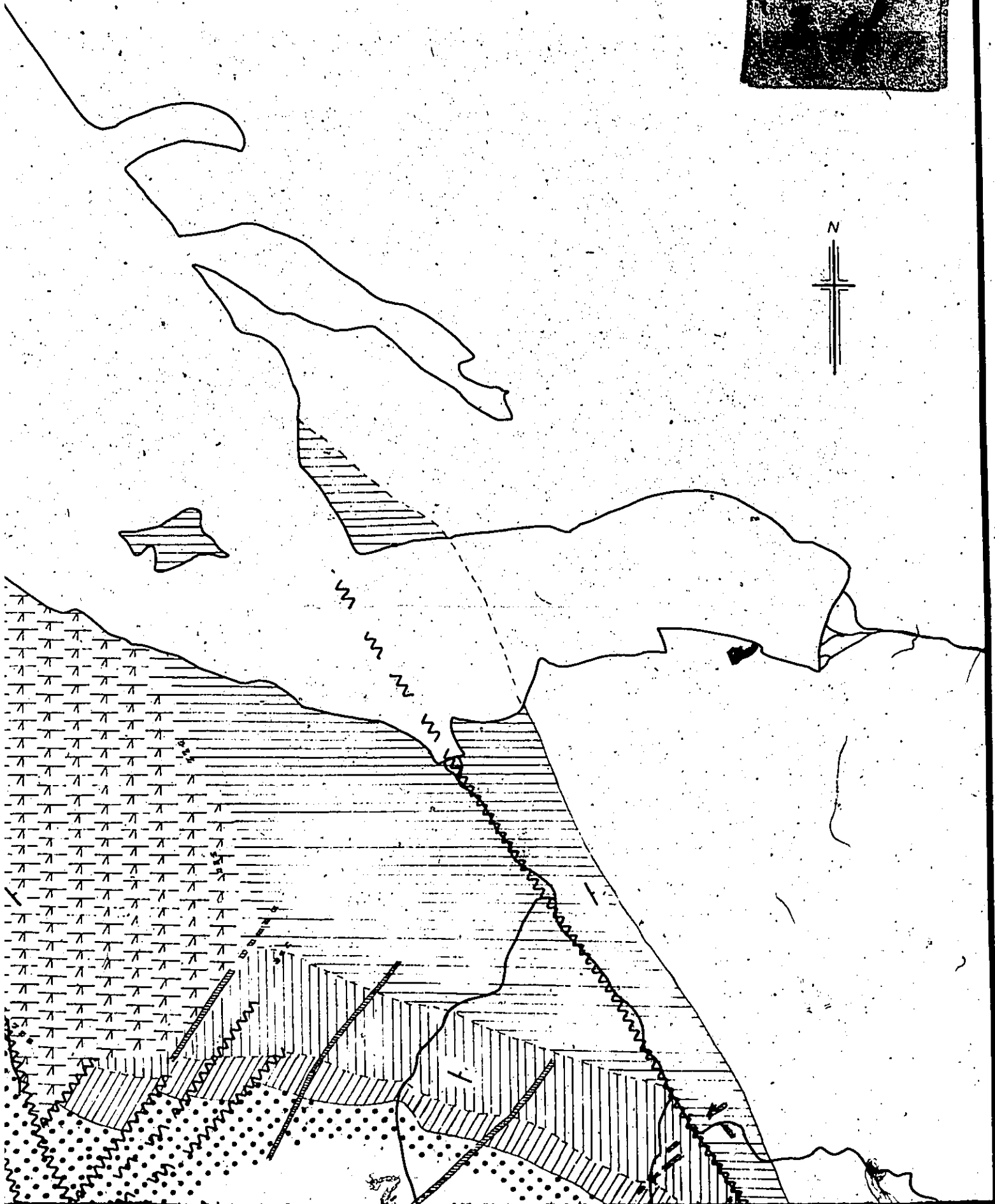
undifferentiated Hunting Fm.

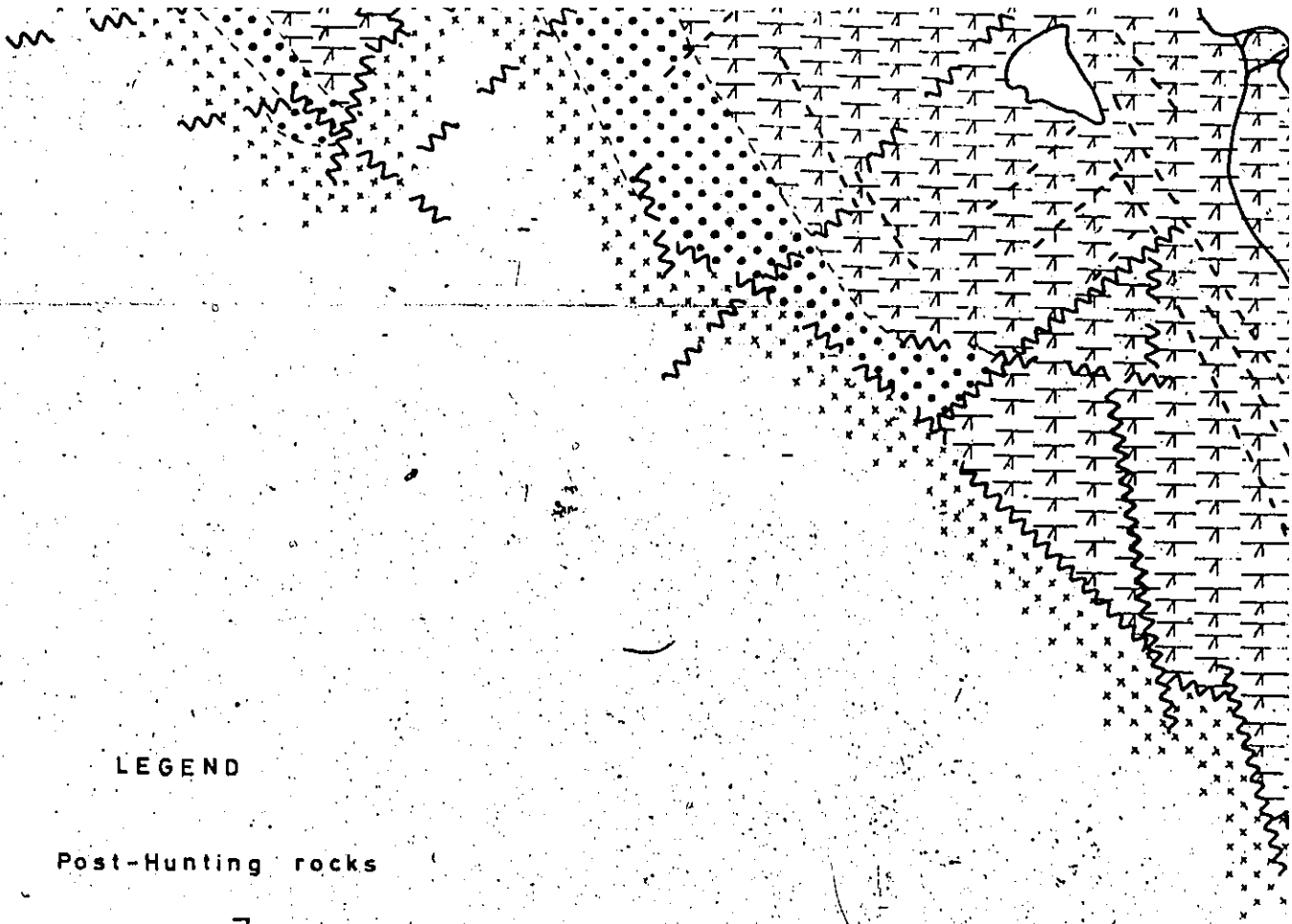


Aston Fm.

ASTON
BAY



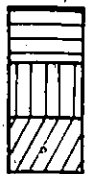




LEGEND



Post-Hunting rocks



member 3
member 2
member 1



undifferentiated Hunting Fm.



Aston Fm.



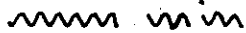
Basement



Diabase intrusions (thickness exaggerated) [assumed defined]



Lineaments



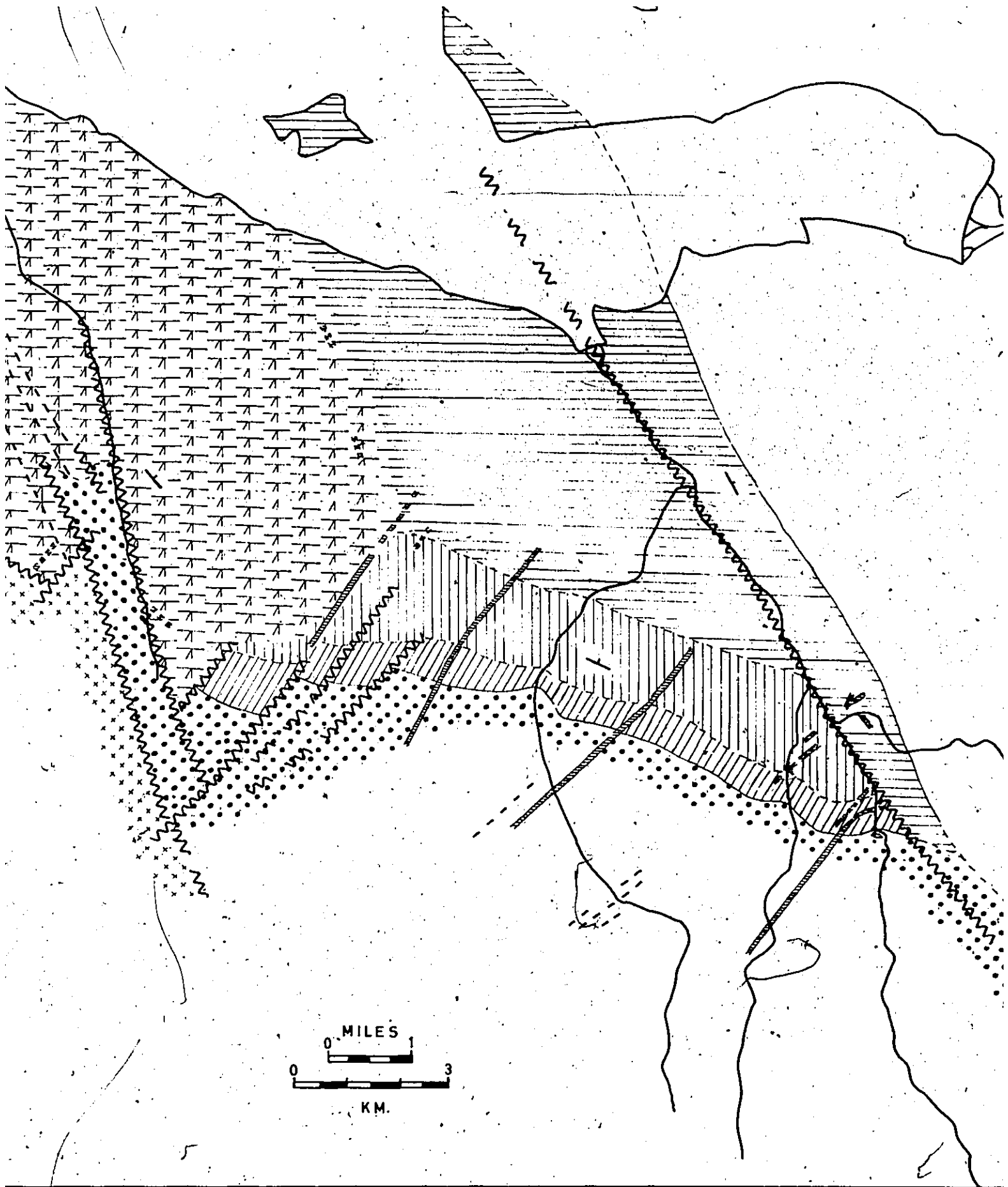
Faults (probable, possible)

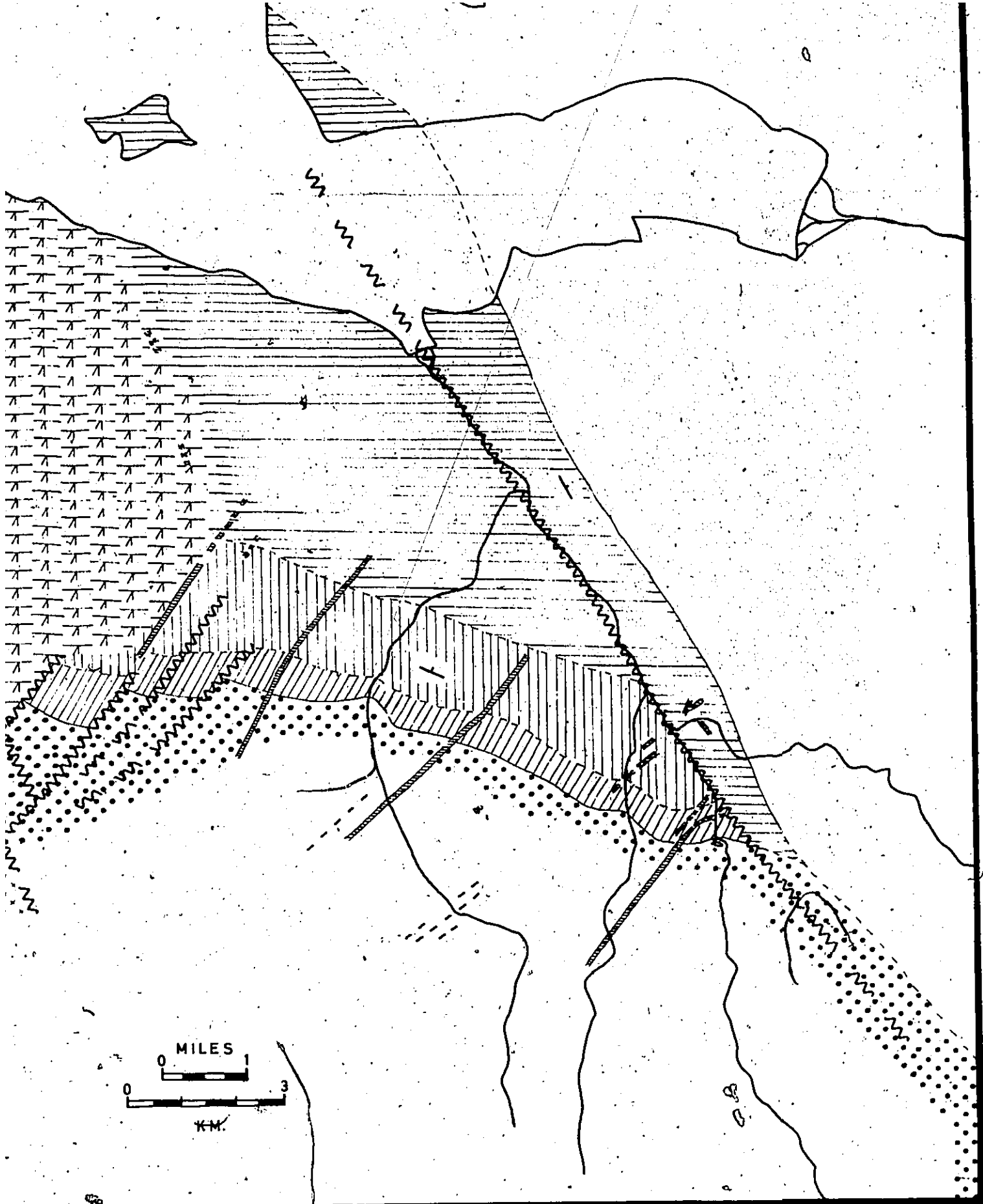


Contacts (defined, assumed)

4 of

FIGURE 21. PHOTOGEOLOGICAL INTERPRETATION OF T





SOUTH OF ASTON BAY

6 of 6