ABSTRACTS

LOWER CRETACEOUS FORAMINIFERA FROM MOUNT GOODENOUGH NORTHWEST TERRITORIES, CANADA

A. DAVIDSON, JR.
1960, University of Alberta

Thirty calcareous and 26 arenaceous species of Foraminifera are described are illustrated from the Lower Cretaceous of Mount Goodenough, Northwest Territories, Canada.

Species described include: 5 species of *Ammobaculites;* 4 each of *Dentalina* and *Saracenaria*; 3 each of *Glomospira* and *Haplophragmoides*; 2 each of *Discorbis, Lagena, Marginulina, Nodosaria, Proteonina, Robulus, Vaginulina* and *Verneuilina*; and 1 each of ? *Ammobaculoidea, Ammodiscus, ?Bulmina, Dorothia, Eggerella, Eoguttulina, Epistomina, Eponides, Gaudryina, Globigerina, Globulina, Guttulina, Hyperammina, Marginulinopsis, Miliammina, Paleopolymorphina, Pseudoglandulina, Reophex, Saccammina, ?Textularia* and *Tritaxia.*

Six zones are recognized on the basis of abundance and/or diagnostic species. In ascending order these are the *Eipistomina* sp. 1590, *Haplophragmoides* sp. 1490 and *Discorbis* sp. 1470 zones of late Barremian age; the *Tritaxia* sp. 1300 zone of latest Barremian and earliest Aptian age; and the *Globigerina* sp. 1040 and *Haplophragmoides* sp. 510 zones of Aptian age. These foraminiferal assemblages are correlated with the microfossil zones of northwestern Germany.

The upper Barremian fauna reflects changing conditions from an outer sublittoral to a littoral environment, while the Aptian fauna indicates an open sea environment changing to a fluctuating inner littoral and littoral environment.

WAPIABI BIOSTRATIGRAPHY

R. K. GERMUNDSON
1960, University of Alberta

Fourteen ammonites, twenty pelecypods, one gastropod, and one crinoid are described and illustrated from four nearly complete sections of the Wapiabi formation in the Alberta foothills between townships 5 and 45. The fauna contains representatives of the five *Inoceramus* and *Scaphites* zones of the Wapiabi shale established by Jeletzky (1956). Most of the zonal indices have restricted stratigraphic ranges which can be traced throughout the foothills.

The lithology of the members and sub-members of the Wapiabi formation is discussed, and their local or regional significance is indicated.

The characteristics of the Cardium-Wapiabi contact are described, and a comparison is made between the Transition beds at the top of the Wapiabi and the overlying Brazeau or Belly River beds.

THE WESTERN MARGIN OF THE LOWER MANNVILLE GROUP, LOWER CRETACEOUS, CENTRAL ALBERTA

R. L. PLATT
1960, University of Alberta

The lower Mannville Group of the upper Pembina River area, about 80 miles west of Edmonton, is correlated with early Lower Cretaceous type Mannville of east-central Alberta. This correlation is based on petrographic and paleontological evidence, and electric well logs from three wells.

Sediments of the lower Mannville Group were derived from slighty metamorphosed sedimentary rocks in the vicinity of the Selkirk Mountains, and deposited in an estuary that was being drowned by the southward transgression of the Clearwater Sea in Albian time.

PRECAMBRIAN ROCKS OF THE WHISTLERS MOUNTAIN TRAIL MAP-AREA, JASPER

D. B. REMINGTON
1960, University of Alberta

A small area of Precambrian rocks within the Main Ranges of the Canadian Rocky Mountains near Jasper, Alberta, was mapped. Rocks of the map-area

belong to Walcott's Miette Formation. In age, they are most likely Late Precambrian and correspond lithologically and perhaps stratigraphically to the Horsethief Creek Formation of southeastern British Columbia and the Hector and Corral Creek formations of the Bow Valley. About 670 feet of these beds, consisting of nine alternating sandstone-conglemorate and phyllite units, were described and a petrographic and heavy mineral study made on selected samples.

Strata of the sandstone-conglomerate units are commonly graded and cross-bedded. The rocks of these units, which are mainly arkosic and subarkosic sandstones and conglomerates with some feldspathic graywackes, consist mostly of angular, poorly-sorted quartz and albite. Many pebbles are composed of chess-board twinned albite, which is thought to have formed from potash and plagioclase feldspar. Other pebbles are composed of vein quartz, recrystallized metamorphic quartz, stretched metamorphic quartz and rarely granitic rock. In addition, large shale inclusions are sometimes present. The remainder of the rock is sand-sized common (probably some plutonic) quartz, detrital muscovite, and sericite and chlorite matrix. Only the ultra-stable heavy accessory minerals, zircon, tourmaline, apatite and rutile are present. Hyacinth and dark purple-brown zircons are well developed and commonly zoned.

The phyllite units are composed of laminated and very thinly bedded phyllite, consisting of sericite, chlorite and small amounts of sand-sized quartz.

The source-area for the sediments was probably close to the site of deposition, topographically high or rugged and composed of metamorphic and possibly some plutonic rocks. Deposition of the psammitic beds was probably in a deltaic environment where deposition was rapid. Frequent periods of loss in stream competency are suggested by the presence of graded beds. The pelitic units may have been dposited during periods in which there was a small relative rise in sea level; alternatively they could be inter-distributary deposits.

The rocks have been subjected to stress, probably during the Rocky Mountain orogeny of Lower Tertiary times. Structurally the area is underlain by an easterly plunging syncline and anticline. Slaty cleavage, which is essentially parallel to the axial planes of the folds, is well developed in the phyllite units. There has been slight metamorphism of the sediments which has fractured pebbles, formed new minerals (albite, sericite, chlorite) and destroyed others (potash feldspar and plagioclase). Mineralogically, the rocks correspond to the greenschist facies of regional metamorphism.

A number of veins cut the area and are resolved into 4 sets based on trend, size and composition. One set is composed essentially of chlorite, but the other three sets are mainly quartz with some albite and calcite. Since there is no twinning of carbonate in the veins, they were probably emplaced after the folding.

THE IMPERIAL FORMATION, NORTHEASTERN MACKENZIE MOUNTAINS, N.W.T.

B. P. ROBBINS

1960, University of Alberta

Provenance, depositional environment and paleoecology of the Imperial Formation were determined by means of a petrological and palaeontological study of four sections in the northeastern Mackenzie Mountains.

The principal source for these rocks was sedimentary and low-rank metamorphic terrain lying to the west or northwest of the report area, probably in the northern Yukon. The Imperial Formation is entirely marine and was deposited in a warm, shallow sea. Terrestrial organic material indicates the presence of land at some intermediate distance to the west or northwest.

SPRAY RIVER FORMATION NEAR BANFF AND CADOMIN

M. SHAFIUDDIN

1960, University of Alberta

The two sections of the Spray River Formation of the Triassic System, one near Banff and the other near Cadomin, Alberta were measured and sampled. The Spray River Formation is divisible here into a Lower Triassic Sulphur Mountain Member and a Middle Triassic Whitehorse Member. The Sulphur Mountain Member consists of dolomitic and calcitic siltstones, silty dolomites and dolomitic limestones and dolomitic very fine sandstones. The Whitehorse

Member comprises dolomites, dolomitic siltstones and limestones and dolomitic and calcitic orthoquartzites and protoquartzites.

Samples were examined in thin sections and grain mounts, X-rayed for dolomite/calcite ratios and analyzed for carbonaceous material and iron content. An attempt was made to correlate the two sections, to determine the provenance and to reconstruct the depositional history of the formation.

Two possible correlations have been suggested: one on the basis of change of angularity, which occurs near the Sulphur Mountain-Whitehorse contact, and the other on the quantitative relationship between tourmaline and zircon. The latter correlation agrees with the questioned position of this contact in Warren and Stelck's correlation.

At the time of deposition of the Sulphur Mountain member, the sediments were largely derived from a low and/or distant Precambrian source, taken to be the Canadian Shield to the east. The Whitehorse Member has greater sedimentary contribution and indicates a possible change of source.

The sediments were laid down in a shallow marine environment. The lower part of Sulphur Mountain Member was deposited in a somewhat reducing environment below the action of the waves and in somewhat deeper water than the Whitehorse Member, which was probably deposited above wave-base.

LOWER DEVONIAN BENTONITES FROM GASPE, P.Q.

D. G. W. SMITH

1960, University of Alberta

Samples of six bentonites from Shiphead, Gaspe, P.Q., have been collected with the aim of obtaining from them minerals datable by the K/Ar method. The literature on the biostratigraphic age has been reviewed and the conclusion reached that these beds lie in the Onesquethaw Stage of the type section of the U.S.A., and the Lower Coblenzian substage of Europe.

In the course of a detailed petrological study of the bentonites, the presence of three minerals that might be reliable for absolute dating—sanidine, biotite and zircon—has been revealed, and the K/Ar method applied to the first two of these. An average age of 386 m.y. ($\pm 5\%$) has been obtained, a figure which is in accord with other Devonian ages recently reported elsewhere.

The petrological study has shown that the bentonites are made up largely of a randomly interstratified mixed layer illite-montmorillonite clay, with lesser amounts of cryptocrystalline quartzo-feldspathic material, and minor amounts of holocrystalline minerals. Attention has been drawn to the presence of minerals that can only be regarded as contaminants, and the significance of these evaluated. Total chemical and minor element (Ba) analyses have been used, in conjunction with the modal composition to suggest trachytic or rhyolitic affinities for the source materials. The development of certain authigenic minerals has been used to draw limited conclusions regarding the chemical environment in which diagenetic changes took place.

Finally sanidine obtained from the uppermost bentonite has been compared chemically and optically with six others used for absolute dating purposes.

THE MANNVILLE GROUP, CENTRAL ALBERTA

G. D. C. WILLIAMS

1960, University of Alberta

The age, depositional environment and provenance of the Lower Cretaceous Mannville Group in Central Alberta was studied from well cores supplemented by electric and sample logs. Pre-Mannville topography of as much as 400 feet was developed mainly on Upper Palaeozoic rocks. Drainage during Early Mannville time consisted of subsequent rivers flowing to the north. The encroachment from the north of the Middle Albian sea gradually drowned these rivers.

Correlations based on stratigraphic position, continuity of beds in the subsurface and palaeontology indicate that the stratigraphic sequence of McMurray, Clearwater and Grand Rapids formations in the Edmonton-McMurray area is the equivalent of the "Bullhead," Loon River and Peace River formations of the Peace River area. On palaeontological evidence, the Lower Mannville Group (McMurray and "Bullhead" formations) is probably of Lower Albian age and

older, and the Upper Mannville Group (Clearwater, Grand Rapids, Loon River and Peace River formations) is of Middle Albian age.

Sandstones of the Lower Mannville Group are quartz-rich lithic sandstones or quartz sandstones, commonly containing less than 25 per cent metamorphic rock fragments and less than 8 per cent orthoclase feldspar. Sandstones of the Upper Mannville Group range from lithic sandstone at the base through rock fragment sandstone to arkose at the top. Feldspar content increases upward in section to a maximum of about 50 per cent of the framework. Sedimentary rock fragments (including chert) are the most abundant framework particles, and igneous (volcanic) debris occurs in the Grand Rapids Formation. The heavy mineral suite of the Lower Mannville Group is composed of well rounded tourmaline and zircon; whereas that of the Upper Mannville Group contains fresh apatite, garnet and euhedral zircon.

Lower Mannville sediments were derived from an area of regionally metamorphosed clastic sedimentary rocks in the vicinity of the Canadian Shield. Fluviatile, lacustrine and possibly aeolian conditions of deposition permitted strong reworking. Upper Mannville sediments were probably derived from a source in southern British Columbia where carbonate-rich sedimentary rocks in part metamorphosed by intrusive igneous masses were being eroded. However, the igneous masses were not exposed during most or all of Upper Mannville time. Volcanoes were active in the source area of the Grand Rapids Formation, which was deposited rapidly in an environment that ranged from marine at the base to continental at the top.

Glauconite from sandstones of the Clearwater Formation was dated by the potassium-argon method. An average age of 95 million years or 79 per cent of the assigned age was obtained. Glauconite from the Lower Cretaceous of the Northwest Territories and from the Cenomanian of Northern Ireland yielded ages of 83 and 88 million years respectively. X-ray study of all glauconite dated suggests that the "mineral" is composed of several phases. The discrepancy between experimentally-determined and assigned ages is attributed to potassium adsorption and/or argon leakage.

DEVONIAN WINNIPEGOSIS REEFS IN WEST CENTRAL SASKATCHEWAN

R. D. YONT

1960, University of Saskatchewan

Winnipegosis reefs in the Meadow Lake area are considered to be a continuation of the northwesterly trending belt of Middle Devonian reefs that extend from Manitoba into Saskatchewan. Within the study area, four reef masses have been outlined where the total Winnipegosis carbonate development exceeds 200 feet. Dolomitization in the Winnipegosis has been less intensive in the Meadow Lake area than in many parts of Saskatchewan and original rock textures are often preserved.

The Winnipegosis Formation has been divided, in the Meadow Lake area, into two lithologic units. The lower, termed the Lower Winnipegosis, is an organic fragmental limestone characterized by the occurrence of abundant bituminous material, crinoidal debris, *Tentaculites*, and numerous amber-colored spore cases. The thickness distribution and lithologic nature of this unit suggest that shoals were developed in the early Winnipegosis seas providing local platforms for later reef growth. The upper unit of the Winnipegosis Formation, termed the Upper Winnipegosis, consists of reef and off-reef deposits. The reefs are composed predominantly of a pale yellowish grey calcarenite with angular to subangular limestone fragments well cemented by finely crystalline, clear calcite. Associated with the calcarenites are minor precipitated limestones and skeletal material consisting of calcipheres, ostracods, Foraminifera, and algae. The off-reef facies consists largely of two rock types; a back-reef yellowish grey, unfossiliferous, dense, finely crystalline limestone and a forereef saccharoidal dolomite with minor bituminous shale partings.

NORTH AMERICAN TENTACULITIDAE

L. J. BILAN

1961, University of Alberta

Tentaculites ranges from Lower Ordovician to middle Upper Devonian. Twenty species are described from mainly western North American Devonian and Silurian

formations, and a schematic representation of the various external shapes is given. Nine species are new and eleven are referred to previously named species.

Tentaculitids are divided into two groups on the basis of internal structures, external ornament, and skeletal characteristics. The two groups are termed "Forma A" and "Forma B." This division may have fundamental significance in indicating different modes of life for the two forms.

The present investigation suggests that tentaculitids are closely related to orthoconic cephalopods and possibly ancestral to the belemnites. Previous classifications are also discussed.

THE PRECAMBRIAN ROCKS OF THE OLD FORT POINT FORMATION - JASPER, ALBERTA

C. R. EVANS
1961, University of Alberta

The Old Fort Point Formation of the Jasper anticlinorium comprises some 1200 feet of argillite, siltstone, limestone, and limestone-breccia, probably Precambrian in age. The sequence, divided into four members, probably records the westward migration of an ancient delta. Member A, the oldest, displays some 350 feet of argillaceous bottomset beds, while the overlying 500 feet of member B strata represent the foreset beds, characterized by numerous lenses of intraformational limestone-breccia. A break in the orderly sequence of events is recorded by the several hundred feet of homogeneous argillite of member C. However the 150 feet of silty argillite and siltstone of member D, overlain conformably by sandstone and quartz pebble conglomerate of the Miette Formation probably represents the final phase of the transition from fairly deep water, to very shallow water deposition.

These rocks were tightly folded into a series of overturned anticlines and synclines, comprising the Jasper anticlinorium, and elevated to their present structural position by movement along the Pyramid thrust-fault during the Laramide orogeny. Flow-cleavage, fracture-cleavage, and cleavage-boudinage are well developed and excellently exposed. Nine joint-sets record the complicated nature of local stress systems throughout the tectonic history of the anticlinorium.

Observed mineral assemblages are typical of the quartz-albite-muscovite-chlorite subfacies of the greenschist facies. These minerals appear to have been in stable equilibrium with calcite, indicating very low grade regional metamorphism in the presence of a relatively high carbon dioxide partial pressure.

GEOLOGY OF THE GHOST RIVER MAP-AREA, ALBERTA

E. L. FITZGERALD
1961, University of Alberta

Middle Cambrian rocks of the Ghost River area west of Calgary, Alberta, are correlatives of the type Cathedral, Stephen, Eldon and Pika formations near Field, British Columbia. Sandstones and shales of the Lower Cathedral Formation are thought to be lithologic equivalents of a transgressive diachronic Middle Cambrian unit in the subsurface and the Lower Cambrian St. Piran Formation near Field. Younger carbonate units represent deposition in deeper water, at a greater distance from the eastern shoreline.

The Ghost River Formation is the western shoreline deposit of the transgressing Devonian sea and rests unconformably on Middle Cambrian strata. Younger Devonian, Mississippian, Pennsylvanian, Triassic and Upper Cretaceous units are similar to those described from other areas in western Alberta. Jurassic, Lower Cretaceous and lower Upper Cretaceous rocks are not exposed in the area.

Gently dipping Palaeozoic formations outcrop above the McConnell fault in a broad doubly-plunging syncline that is overridden on the west by the Costigan fault which underlies a westerly dipping homocline in Palaezoic and Triassic rocks. Locally, erosion has removed much of the McConnel thrust sheet to expose the junction of the two faults. Formation of the Panther River thrust sheet below the McConnell fault folded the latter and formed the End Mountain syncline and an anticline to the west. The Costigan thrust and Ghost River tear faults resulted from the folding of this thrust sheet and are complexly related. West of the Costigan fault the Exshaw thrust is overlain by a homocline of Mississippian and younger beds.

Topography is controlled to a marked degree by structure and massive Middle Cambrian limestone which form steep-walld canyons in the eastern part of the area.

THE GEOLOGY OF THE SKI-LODGE ROAD MAP-AREA, JASPER, ALBERTA

M. R. STAUFFER

1961, University of Alberta

The strata of the Ski-Lodge Road map-area, near the town of Jasper, Alberta, belong to Walcott's Miette Formation. These strata, which consist of lenticular, interbedded arenaceous and argillaceous units up to 300 feet thick, are probably Precambrian in age, and correlate lithologically, if not temporally, with the Hector Formation of the Bow Valley and the Horsethief Creek Formation of southeastern British Columbia. Graded bedding and cross-stratification are particularly common in the arenaceous units, which also contain load-casts, flow-casts, penecontemporaneous folds, and ripple marks. Heavy mineral studies of fine-grained sandstones show that only the ultra-stable suite of zircon, tourmaline, apatite, and rutile, is present.

The conglomerates and sandstones of the arenaceous units have a composition similar to Pettijohn's feldspathic graywacke, are composed of poorly sorted and angular grains of quartz and feldspar, mica, patchy carbonate cement, and a recrystallized matrix of chlorite and muscovite. Some pebbles are composed of chess-board twinned feldspar. Argillite-fragments are common and sometimes form intraformational argillite-fragment conglomerates. Authigenic pyrite cubes in various stages of weathering are scattered throughout the arenaceous units. The argillaceous units consist of thinly bedded and laminated argillite composed of muscovite, chlorite, and silt- to fine-sand sized quartz.

The mineralogy and texture of the rocks suggest a close, topographically high source consisting of igneous and metamorphic rocks. Deposition was probably rapid in a subsiding deltaic area, with the arenaceous rocks representing the top-set beds, and the argillaceous rocks representing fore-set beds and interdistributary deposits. Cross-stratification studies indicate that the source of the sediments was to the northeast, possibly within the Canadian Shield.

Structural deformation probably occurred during the Laramide orogeny and is reflected by folding, fracturing, and metamorphism of the rocks. Eleven joint-sets, most of which are vein-filled, have been recognized in the arenaceous units. The rocks and the vein material, though having different mineral assemblages, are within the quartz-albite-muscovite-chlorite subfacies of the greenscrist metamorphic facies.

MID-DEVONIAN PRODUCTELLID AND CHONETID BRACHIPODS FROM NORTHERN CANADA

M. A. ROED

1961, University of Saskatchewan

Brachiopods present in the Mid-Devonian rocks of Northern Canada include seven representatives of the family Productellidae (six of the subfamily Productellinae and one of the Chonopectinae) and two of the family Chonetidae. Two of the Productellinae are new species of the genera *Productella* and *Spinulicosta*.

Most of the specimens were recovered from the Hume Formation and few from the overlying Hare Indian(Kee Scarp and Canol formations.

Some species appear to be restricted stratigraphically and promise to be useful zonal indices: a new species of *Productella* has been found only in the lower part of the Hume Formation, *Spinulicosta straimbrooki* only in the upper part of the Hume Formation, and *Chonetes aurorus* only in the upper part of the Hare Indian Formation.

SOME PROBLEMS CONCERNING THE SILURIAN DEVONIAN BOUNDARY

R. C. BROWN

Queen's University

The boundary between the Silurian and the Devonian has not been established internationally. In England the dispute arises over the age of the Downtonian

beds which have been regarded by many British geologists as Late Silurian. Recently, they have been placed in the Lower Devonian with the base of the Ludlow Bone Bed marking the contact with the Upper Silurian. In continental Europe, the Gedinnian stage has long been considered the base of the Devonian and its lower part is correlated with the Downtonian of England. Rapidly changing facies and facies fossils around the border of the Old Red Sandstone continent render regional correlation difficult.

In northeastern United States, sedimentation was continuous across the boundary in the type areas and the problem involves the age of Manlius and Keyser limestones. Recently, the upper Keyser and the Manlius have been placed in the Lower Devonian. Poorly fossiliferous Upper Silurian strata make correlation with the type European sections insecure.

Comparison of the Canadian Arctic sections with the type areas of Europe and eastern North America is presently insoluble, due mainly to insufficient detailed information. The boundary is obscured by earth movements of restricted extent resulting in isolated, unfossiliferous sediments that present no bases for regional or local correlation.

MICROCRYSTALLINE LIMESTONES OF THE RUNDLE GROUP

CHRISTOPHER J. HODGSON
Queen's University

In the southern Canadian Rocky Mountains the Mount Head and Etherington formations of the Rundle Group (Mississippian) contain abundant microcrystalline and pelleted limestones which some geologists believe were produced by zlue-green algae. There is little evidence, however, that such is the case. Rather do these limestones closely resemble modern carbonate sediments in the form of drewite and bahamites which are forming on the Bahama Banks through inorganic processes. The various bahamite grains recognized by Illing (1954) were identified in the pelleted limestones of the Rundle; namely, skeletal grains, faecal pellets, structureless grains, and composite grains.

Rarely observed filamentous molds, laminations, and algal pisolites suggest that the bue-green algae may have been locally abundant. No stromatolitic structures were observed.

It is concluded that the microcrystalline and pelleted limestones formed through inorganic processes in a shallow, warm water environment with restricted current movement, similar to that of the interior of the Bahamas Banks today.

PROTEROZOIC STROMATOLITES

R. N. McNEELY
Queen's University

Samples from stromatolitic sections in the Epworth Group, (Port Epworth, N.W.T.), and the Parry Bar Formation, (Kent Peninsula, N.W.T.) were collected and studied. Both the megascopic and microscopic features of the stromatolites were described. Spectographic and insoluble residue analyses failed to emphasize any feature characteristic of the stromatolitic zones.

A survey of the literature concerning the problems of stromatolite nomenclature, origin, and environment of development was undertaken. Also a superficial study of carbonate sedimentation with specific reference to dolomitization was initiated.

As a result of the aforementioned research, it was concluded that stromatolites are of organic origin and can be used as depth and top indicators, but are of no value as salinity or temperature indices. It is believed that stromatolites should be given descriptive (e.g. conical) rather than Linnean (e.g. Conophyton) names. The dolomite of the Epworth sequence is believed to have been deposited as a primary dolomite.

PETROLOGY OF THE RIDEAU BEDS, BASAL MEMBER OF THE BLACK RIVER GROUP, NEAR SYDENHAM, ONTARIO

F. G. YOUNG
Queen's Univrsity

Several stratigraphic sections of the Rideau beds (basal Black River group) near Sydenham, Ontario, were described and sampled. From these samples a set of thin sections was made and the mineralogies and textural features displayed of each were studied in detail. One of many interesting textural features found was the replacement of terrigenous particles by interstitial calcite. The green pigment of the Rideau beds is probably a mixture of chlorite and illite.

Four mechanical analyses of the basal conglomeratic sandstones were made and the size distributions statistically analysed. The separated sands were examined by microscope in detail in order to make determinations of mineralogy, roundness, and sphericity.

The environment of deposition of the Rideau beds appears to have been the shallow neritic zone of a transgressing epicontinental sea. Terrigenous material was locally derived from the underlying Precambrian rocks and the Potsdam sandstone. The modal sand sizes common to each sandstone analysed reflect the size distribution of source materials, not selective sorting during deposition. Fluctuating currents passed over the base level of deposition during most of Rideau sedimentation.