tion? We can only imagine a Cambrian world very different from that existing now.

With the Ordovician we have a more classic marine sedimentation, with the development of a transgressive regularly bedded series (Haouaz formation) which ended with erosion and an infilling which is stratigraphically chaotic (Memouniat sandstone). From then on the sedimentary structures never had the homogeneity of the Cambrian, being affected by local factors.

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PETROLOGY OF THE WESTERN CANADA BASEMENT

The Western Canada sedimentary basin is floored almost completely with igneous and high-grade metamorphic rocks which crystallized during the Hudsonian orogeny, dated at 1,800 m. y. Since that time most movements in the basement have been epeirogenic, in response to isostatic adjustments following long periods of erosion. Five areas of the basin floor, defined on the basis of geophysical anomalies, inferred faults, and positive or negative tectonic history, show distinct variability in percentage of rock types. Basement areas of persistent negative tendency contain higher than average percentages of sedimentary, volcanic, and basic intrusive rocks. The isostatically positive arches are composed dominantly of granitic gneisses.

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ENVIRONMENTAL AND STRATIGRAPHIC SIGNIFICANCE OF DEVONIAN STROMATOLITES OF COLORADO

Upper Devonian carbonates of west-central Colorado contain abundant stromatolites. These finely laminated, crenulated, and commonly brecciated calcareous dolomites and dolomitic limestones comprise most of the Dyer member of the Chaffee formation along the west side of the Sawatch Range, in the McCoy area, and in the White River Plateau.

These fine-grained carbonates display striking structural and textural resemblance to laminated sediments now being produced by algae on western Andros Island, B.W.I., and in Florida Bay. The environment of present-day stromatolitic sedimentation is intertidal where only occasional flooding occurs during spring tides or periods of storm waves. Carbonate mud deposited by these waters is laminated by the trapping and binding functions of filamentous blue-green algae. Desiccation polygons may become dislodged during flooding to form intraclastic breccias. If, in this case, "the present is the key to the past," these Devonian sediments represent quiet-water carbonate deposition in the littoral environment.

The Dyer in the eastern and northeastern part of the study area is predominantly stromatolitic, but to the west the lower portion is a neritic carbonate accumulation. During lower Dyer time the intertidal environment existed on the east and northeast and an offshore environment existed on the west. During upper Dyer time the intertidal environment regressed westward and southwestward behind the waning Upper Devonian sea.

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GEOLOGY OF A PORTION OF THE CONTWOYTO LAKE AREA, NORTHWEST TERRITORIES

Approximately 24 square miles of Archean(?) igneous and metamorphic rocks have been mapped at a scale of 1 inch equals 1,000 feet in an area centered 5 miles south of the central part of Contwoyto Lake, N.W.T.

The oldest rock unit is apparently a quartz-plagioclase-biotite-K-feldspar paragneiss containing numerous pegmatitic segregations of quartz, plagioclase, K-feldspar, and minor amounts of muscovite, tourmaline, and apatite. A sequence of low- to medium-grade metasediments overlies the paragneiss. In the northern part of the area, these rocks are largely quartz-chlorite-muscovite phyllites. As the grade of metamorphism increases southward, biotite, almandite, andalusite, cordierite, and staurolite become common. Approximately 20 beds of quartz-hornblende-almandite amphibolite up to 10 feet in width have been mapped in the schist sequence. The phyllites, schists, and amphibolites are believed to be correlative with the Yellowknife group.

Two biotite granite bodies approximately one mile in diameter intrude the Yellowknife group metasediments. The sediments are also cut by diabase dikes 20–100 feet in width, and a gabbro stock $\frac{3}{8}$ mile in diameter.

Pyrrhotite, pyrite, and arsenopyrite are found locally in a few of the amphibolite beds. Gold mineralization is locally present in some of the tightly folded pyrrhotite and arsenopyrite-bearing amphibolites.

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DISTRIBUTION OF PTEROPODS IN WESTERN NORTH ATLANTIC SEDIMENTS

The pteropod assemblages in 120 post-Wisconsin cores were studied from an area between the Atlantic continental shelf of North America and the Mid-Atlantic Ridge. Pteropod shells are one of the major constituents in the calcareous pelagic sediments at depths ranging from 350 to 4,200 m., particularly along the Mid-Atlantic Ridge, the Bermuda Pedestal, the Blake Plateau, and the Gulf of Mexico.

The subarctic species *Limacina retroversa* and the temperate species *Clio pyramidata* are present in the Mid-Atlantic Ridge sediments north of about 45° N. Lat. They indicate the faunal mixing zone between subarctic and warmer North Atlantic Drift waters.

Subtropical species *Limacina inflata*, *L. bulimoides*, and *Styliola subula* are the dominant pteropod species in the middle-latitude sediments of the Mid-Atlantic Ridge and the Bermuda Pedestal, and the overlying water of the Sargasso Sea. The subarctic species was present in the pelagic sediments of the Bermuda Pedestal, but is at present not living in the overlying water; it is inferred from this that subarctic waters invaded the Bermuda region some time ago. The maximum concentration of pteropod shells was found in the pelagic sediments of the Bermuda Pedestal at a depth of approximately 2,200 m. The number of specimens decreases considerably in sediments containing less than 80 per cent calcium carbonate at water depths greater than 3,600 m. No pteropods were found below 4,200 m.

Tropical *Creseis acicula* is the predominant species on the ocean floor of the Gulf of Mexico and Blake Plateau, and the overlying water of the Gulf Stream currents. The delicate hexagonal surface reticulation of *Peraclis reticulata* shells were obscured after deposition on the ocean floor; probably this resulted from greater solution of its projecting ridges. Two pteropod species, *Peraclis*

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triacantha and *P. bispinosa*, with thin, fragile shells were absent from the sediments but are known to inhabit the deep waters in low and middle latitudes.

The present study shows that pteropods as a group are useful for paleoecological interpretations of their fossil assemblages on the ocean floor.

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TECTONIC HISTORY OF THE BOOTHIA ARCH

Boothia arch is a northerly trending, Lower Devonian horst in which Precambrian crystalline rocks have risen over 5,000 feet. Cambrian to Lower Devonian clastic and carbonate rocks dip gently away from the exposed basement complex, which rose mainly by vertical movement along major thrust and normal faults rather than by flexure. Northerly trending folds and faults in Cornwallis Fold Belt on Bathurst and Cornwallis Islands and on Grinnell Peninsula are continuations of the Boothia basement structures.

Cambrian to Devonian rocks were deposited over the site of the arch under conditions of quiescence and gradual subsidence; correlative formations in the Franklinian geosyncline are thicker and indicate more rapid subsidence. Principal movement on Boothia arch and Cornwallis Fold Belt is dated by unconformities within the Lower Devonian at three places: (1) on Cornwallis Island the Snowblind Bay formation rests in places conformably and in other places with angular unconformity on Lower Devonian rocks; (2) on Bathurst Island the Driftwood Bay formation lies with angular unconformity upon rocks as young as Lower Devonian and grades laterally into the conformable sequence of Bathurst Island and Stuart Bay formations; and (3) on Prince of Wales and Somerset Islands the Peel Sound formation variously rests with gradational contact and with angular unconformity on the Middle Silurian to Lower Devonian Read Bay formation. Conglomerates in the Peel Sound formation contain boulders of lower Palaeozoic and Precambrian rocks, and are themselves cut by horst-forming faults.

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PEMBROKE BRECCIA: SOLUTION—COLLAPSE OF THE LOWER WINDSOR GROUP (MISSISSIPPIAN) IN CENTRAL NOVA SCOTIA

The Pembroke Breccia disconformably overlies the basal limestone of the Mississippian Windsor group in central Nova Scotia and has previously been considered a primary breccia in the Windsor group. The breccia is estimated to be as much as 100 feet thick. It is absent in deep borings; at depth, the basal limestone is apparently conformably overlain by interbedded limestone and anhydrite.

The Pembroke typically is a jumbled mass of unsorted angular limestone fragments in a matrix of muddy massive limestone. Most of the fragments are similar to the basal laminated limestone of the Windsor group, although some are of massive limestone and red marl apparently derived from beds higher in the section. Irregular pipes, channels, and masses of sandy breccia containing scattered quartzose pebbles occur within the typical breccia. In a few exposures the breccia contains relict beds; in others, thin graded calcarenite beds appear to fill pockets in the breccia.

Late Paleozoic regional deformation extensively folded the Windsor group; the Pembroke Breccia is younger than this deformation. Stratification in floored cavities is virtually horizontal and is independent of the attitude of the adjacent Windsor strata. The deformation produced veins normal to bedding in the Windsor limestone; many rotated fragments within the breccia contain similar veins normal to their bedding. Metamorphic fabric, absent in the breccia matrix, varies in nature and orientation from fragment to fragment. Sand grains, pebbles, and heavy minerals within sandy parts of the breccia appear to have been derived from Triassic rocks, suggesting that the breccia originated in either Triassic or post-Triassic time.

It is here proposed that the breccia formed only near an erosion surface by collapse and disintegration following solution of anhydrite interbeds and part of the limestone. The sandy breccia appears to be composed of surficial debris which filled solution channels within the typical breccia.

Because the Pembroke Breccia was formed long after the deposition of the Windsor group, it should not be regarded as a stratigraphic unit of the group. The actual depositional sequence of the basal Windsor is (in ascending order): limestone, interbedded limestone and anhydrite, anhydrite, and halite.

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SEDIMENTARY STRUCTURES: MISSISSIPPI RIVER DELTAIC PLAIN

Minor sedimentary structures were studied in cores and exposures from the deltaic and marginal deltaic plains of the Mississippi River. Selected active environments were sampled, and the occurrence of sedimentary structures from each was recorded. Individual structures were found to occur in more than one environment; however, suites of structures were characteristic. Within the study area the following twelve depositional environments have been investigated: shelf, prodelta, delta front (distal bar, distributary mouth bar, channel, and subaqueous levee), subaerial levee, marsh and swamp, interdistributary bay, mudflat, and fresh-water lake.

Shelf deposits consisted of: (1) fine-grained clastics, burrowed and showing parallel laminations and (2) marine organic debris. Prodelta deposits are similar to clayey shelf deposits, but contain lenticular and parallel lamination with finely divided plant inclusions. The delta front is a complex of sub-environments constituting the advancing locus of active deposition of the prograding delta. The sloping seaward margin on this zone—the distal bar—exhibits current structures such as trough cross-laminations and current ripples as well as parallel and lenticular laminations, wave ripples, and burrows. The silty and sandy distributary mouth bar is characterized by a variety of small-scale, multi-directional cross-laminations and gas-heave structures. Channel deposits exhibit trough cross-laminations, scour and fill, and distorted laminations, whereas subaqueous levees contain abundant ripple and unidirectional cross-laminations, parallel, wavy, and distorted laminations. In addition, subaerial levees are burrowed and oxidized. Marsh and swamp deposits are distinguished by abundant plant remains, burrows, and parallel laminations. Lenticular laminations, wave ripples, burrows, shell, and plant remains are characteristic of both interdistributary bay and fresh-water lakes. The mudflat assemblage of structures includes lenticular laminations, current and wave ripples, burrows, and shell remains.

Not only are associations of sedimentary structures