REVISED MEGAFOSSIL ZONATION OF MIDDLE AND EARLY UPPER DEVONIAN STRATA OF THE CENTRAL AND LOWER MACKENZIE VALLEY, DISTRICT OF MACKENZIE

by

A.E.H. Pedder

INTRODUCTION

Warren and Stelck, Crickmay, Caldwell and others have recognized faunal zones or sequences of diagnostic faunas in the pre-Canol Devonian succession of the central Mackenzie Valley. However, since publication of their works, new data have emerged, particularly from identification of collections made by geologists working on Operation Norman and related projects, which necessitate revision of their schemes.

In the interests of stability the proposed zonation retains as much of the earlier ones as the new data permit, even so, four of the zones are significantly revised. In all, eight megafossil zones are now recognized; in ascending order, these are the *adoceta*, *dysmorphostrota*, *castanea*, *laevis*, *aleskanus*, *hippocastanea*, *mackenziense*, and *billingsi* Zones.

GENERAL DISCUSSION OF ZONES

Several types of faunal zones are used by earth scientists. As employed in this report, a zone is defined as a body, or thickness of rock, deposited during the time span of the designated zonal index fossil in the Mackenzie drainage area. The relationship between rock units and the recognized megafaunal zones is shown diagrammatically in Figure 1. None of the zones is known to overlap with any other; indeed, one of the disadvantages with the scheme is that significant gaps occur between some of the zones. This would not be the case if the zonation were based on a succession of orthogenetic species. However, it must be remembered that, even if it was possible to establish such a zonation, it probably would be difficult to use, in that large collections normally are required to discriminate species in evolutionary lineages.

With the exception of *Grypophyllum mackenziense*, which is a rugose coral, the designated index fossils are brachiopods. Each of these brachiopods is well described and illustrated, and is known to have a wide geographic but limited temporal range; moreover, they are readily identified with little or no preparation.

The *adoceta* and *dysmorphostrota* Zones are believed now to be Eifelian, that is lower Middle Devonian. The *castanea*, *laevis* and *aleskanus* Zones are Givetian, which is the upper stage of the Middle Devonian. The megafossil zones of *hippocastanea* and *mackenziense* correspond to the *hermanni-cristatus* conodont zone. The long-standing question of whether this should be referred to the Middle (Givetian) or Upper Devonian (Frasnian) is, as yet, unresolved. T.T. Uyeno has identified lowermost *asymmetricus* Zone conodonts in collections from the *billingsi* Zone, which therefore must be regarded as lower Frasnian.

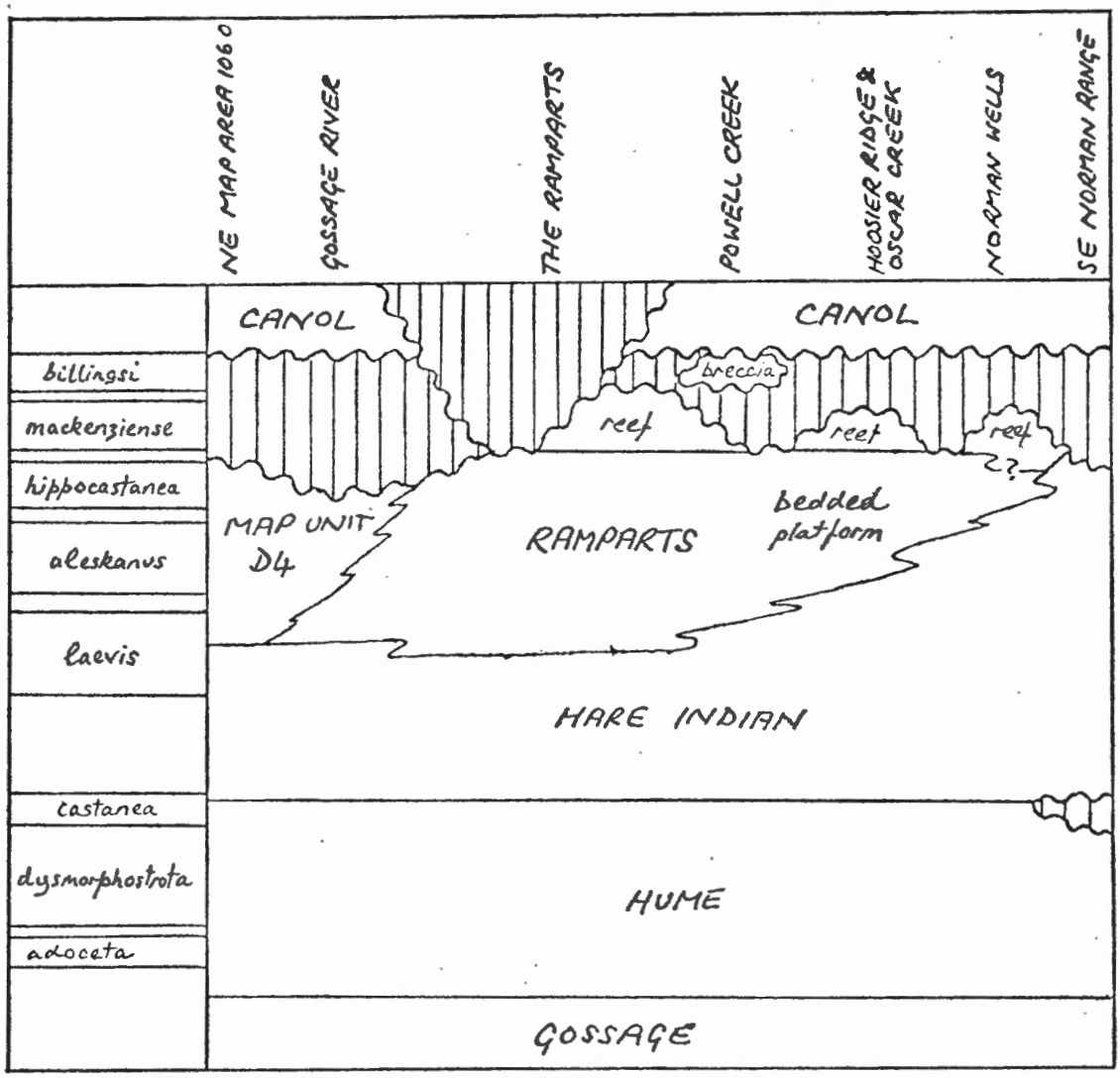

Figure 1. Diagrammatic representation of the relationship between rock units, named and unnamed, and megafossil zones in the central Mackenzie Valley. The figure is simplified and not to scale. Certain carbonate units such as were encountered between the Ramparts and Hume Formations in the Atlantic Col. Can. Manitou Lake L-61 well, are omitted.

adoceta Zone

The *"Schuchertella" adoceta* Zone, which was founded by Crickmay (1960, p. 1), is the lowest of the megafossil zones currently recognized in the Hume Formation. On Anderson River, where the Hume Formation is only 228 feet (68 m) thick, it occurs in the basal beds of the formation; in thicker sections in the Franklin and Mackenzie Mountains, the *adoceta* Zone normally occurs 25 to 220 feet (7.5 to 66 m) above the base of the Hume Formation. In northeastern British Columbia and southwestern District of Mackenzie, the index fossil has been found in the Dunedin and Headless Formations.

Most of the brachiopods that accompany *"Schuchertella" adoceta* extend into overlying zones, but the corals *"Microcyclus" multiradiatus* (Meek), *Radiastraea trichomisca* (Crickmay), *R. verrilli* (Meek) strictest sense and *Taimyrophyllum triadorum* Pedder probably are diagnostic of the zone.

In addition to the original description (Crickmay, 1960, p. 18, Pl. 10, figs. 10-17; Pl. 11, fig. 1), illustrations of the index species have been given by Warren and Stelck (1956, Pl. 1, figs. 2, 3) and Caldwell (1971, Pl. 1, figs. 1, 2). The generic name is placed in parentheses because *"S." adoceta* is impunctate, whereas *S. lens*, the type species of *Schuchertella*, is pseudopunctate.

dysmorphostrota Zone

This zone closely approximates the *verrilli* Zone of Crickmay (1960, p. 2) and the rocks recognized by Norris (1968, p. 773) and Caldwell (1971) as containing the *Spinulicosta stainbrooki* fauna. *Carinatrypa dysmorphostrota* is preferred as the zonal index as both *Radiastraea verrilli* and *"Spinulicosta" stainbrooki* occur with *Schuchertella adoceta* in the basal Hume beds on Anderson River. Typically, the zone ranges through all but the top few feet

of the upper half of the Hume Formation. Some of the diagnostic corals occur in the Headless and Nahanni Formations of southwestern District of Mackenzie and forms identical with or very close to the index brachiopod are known from the Rogers City Limestone of Michigan (Ehlers and Kesling, 1970, Pl. 12, figs. 50, 51) and the Lake Church Formation of Wisconsin (Griesemer, 1965, Pl. 4, figs. 12-14).

Much of the very rich *dysmorphostrota* fauna remains to be described. At the present time, *Spinatrypa coriacea* Crickmay and the occurrence together of *"Atrypa" borealis* Warren and *Spinatrypa andersonensis* are diagnostic of the zone, as are the following corals:

Radiastraea tapetiformis (Crickmay)

Utaratuia laevigata Crickmay

U. acupicta Crickmay

Redstonea sperabilis (Crickmay)

Kozlowiaphyllum hesperium (Crickmay)

Taimyrophyllum stirps (Crickmay) strict sense

Aphroidophyllum howelli Lenz

A. meeki Pedder

Mackenziephyllum insolitum Pedder

The distinctive zone fossil has been described or illustrated in several works: Warren and Stelck, 1956, Pl. 2, figs. 14-16; Crickmay, 1960, p. 13, 14, Pl. 9, figs. 1-5; McLaren, Norris and McGregor, 1962, Pl. 8, figs. 22-24; Crickmay, 1967, p. 5, Pl. 1, figs. 14, 15; Caldwell, 1971, Pl. 2, figs. 2a-c; and Copper, 1973, p. 496, 497, Pl. 3, figs. 10-13.

castanea Zone

Warren and Stelck (1950, p. 73) were the first to point out that

Leiorhynchus castanea, in the strict sense, is confined to a narrow stratigraphic interval in western Canada. They designated this interval as the *Leiorhynchus castanea* Zone and referred to the stratum containing it in the lower Mackenzie Valley as the "basal bed of the Fort Creek Shale", which, in current terms, comprises the top few feet (<20) of the Hume Formation, or beds transitional to the overlying Hare Indian Formation. The zone falls within Crickmay's (1960, p. 2, 3, 19) *arctica* Zone, but this zone was particularly ill-founded as it was proposed for the Hare Indian Formation, whereas the name-giving species, *Variatrypa arctica*, occurs commonly in the underlying Hume Formation and only sparingly in the lowermost Hare Indian strata. Beyond the lower and middle Mackenzie Valley region, *Leiorhynchus castanea* is known in the Horn River and Pine Point Formations of the Great Slave Lake area, the topmost Nahanni and Dunedin Formations of southwestern District of Mackenzie and northeastern British Columbia, and also in the Woodpecker Limestone of Nevada (Johnson, 1970, Pl. 2, figs. 12-17; 1971, Pl. 43, figs. 27-31).

Leiorhynchus castanea typically occurs in great numbers and commonly dominates the fauna. Other brachiopods that appear to be equally diagnostic of the zone are *Pentamerella(?) borealis* (Meek), *Cassidirostrum pedderi* McLaren and *Warrenella kirki* (Merriam), although it must be noted that, in Nevada, *Warrenella kirki* apparently underlies *Leiorhynchus castanea* (Johnson, op. cit.).

Numerous figures have been published of Canadian specimens of *L. castanea:* Meek, 1867, Pl. 13, figs. 9a-c; Warren, 1944, Pl. 1, figs. 6-8; Crickmay, 1952, Pl. 70, figs. 6, 7; 1963, Pl. 2, figs. 15-22; Warren and Stelck, 1956, Pl. 9, figs. 12-16; McLaren, 1962, Figs. 24, 25, Pl. 14, figs. 2a-6c; Pl. 15, figs. 1a-11c; McLaren, Norris and McGregor, 1962, Pl. 9, figs. 1-3, 16-18; and Caldwell, 1971, Pl. 2, figs. 3a-4d.

laevis Zone

Warren (1944, p. 116) was perhaps the first to recognize the stratigraphic importance of *Ectorensselandia laevis*, which was referred then to the genus *Rensselandia* when he wrote of its occurrence in "Ramparts limestone but in a very definite zone below the *Stringocephalus* horizon". More formal recognition of the zone dates from subsequent works by Warren and Stelck (1950, p. 75; 1956, Pl. 4). In their early works, these authors held that *Ectorensselandia laevis* indexed a zone below the zone of *Stringocephalus*. This is now known to be incorrect, as the earliest known species of *Stringocephalus* in the Mackenzie Valley occur in the upper part of the *laevis* Zone. In fact, the two specimens figured by Warren and Stelck (1956, Pl. 5, figs. 1-4) as *Stringocephalus burtini*, and considered by them to have come from their *Stringocephalus* Zone, are specimens of *S. asteius* Crickmay and *S. transversa* Grabau, both of which in the Mackenzie Valley are restricted to the upper part of the *laevis* Zone.

In the Ramparts Gorge section, just upstream from Fort Good Hope, *Ectorensselandia laevis* ranges from 83 feet (25 m) below the top of the Hare Indian Formation to approximately 50 feet (15 m) above the base of the Ramparts Formation. In the same section, the brachiopod identified by Caldwell (1971, Pl. 2, figs. 9, 10) as *Rhyssochonetes aurora* ranges from 90 to 30 feet (27 to 9 m) below the top of the Hare Indian Formation. Thus Caldwell's *aurora* fauna or zone corresponds approximately to the lower half of the *laevis* Zone as here used. The zones of *Hadrorhynchia vallorum* and *Stringocephalus asteius*, proposed by Crickmay (1966, p. 33) for the upper 10 feet (3 m) of the Hare Indian Formation and lower 12 feet (4 m) of the Ramparts Formation at Ramparts Gorge, also lie within the *laevis* Zone.

Although *Cyrtina panda* occurs commonly in the *laevis* Zone, the zone of that name proposed by Warren and Stelck (1950, p. 73) is far from being synonymous with the *laevis* Zone of this report, as Warren and Stelck's *Cyrtina panda* fauna was based on mixed collections from the Waterways and Upper Ramparts *hippocastanea* Zone (*see* Crickmay, 1968, p. 2).

The typical *Ectorensselandia laevis* fauna has not been recognized south of Ramparts Gorge or north of Payne Creek (Lat. 66°49 1/2'N; Long. 129°54'W), nor is it well known in the Mackenzie Mountain Front, although *E. laevis* itself occurs approximately 15 feet (4.5 m) below the top of the Hare Indian Formation on Gayna River. North of this rather restricted area, the typical fauna is displaced by another containing abundant stromatoporoids, *Grypophyllum subtile*, cf. *Cyathophyllum* sp. nov. and *Moravophyllum* sp. nov. South of this area, it appears to have been replaced by darker, less calcareous shales referred to the Hare Indian Formation.

Other species with known ranges falling within the *laevis* Zone are corals best identified as *Argutastrea* sp. cf. *A. arctica* (Meek) and *Stringophyllum* sp. cf. *S. buechelense* (Schluter), and the brachiopods *Hadrorhynchia vallorum* Crickmay, *Warrenella franklini* (Meek), *Cyrtina panda* Meek (one only of two species confounded in the original description; the other being a Hume species) and *Stringocephalus asteius* Crickmay, which, unlike *Ectorensselandia laevis*, normally is found only in beds containing abundant species of *Stachyodes*. The Mackenzie form commonly identified as *Rhyssochonetes aurora* (probably better assigned to the subspecies *solox* than to the nominate subspecies) is strongly suggestive of the lower part of the *laevis* Zone as its earliest occurrences only just predate those of *Ectorensselandia laevis*.

Description and illustration of the zone-index fossil may be found in the following works: Meek, 1867, p. 108, 109, Pl. 13, figs. a-e; Pl. 14, fig. 4; Hall and Clarke, 1894, Pl. 78, figs. 17, 18; Warren, 1944, p. 116, Pl. 1, figs. 12, 13; Warren and Stelck, 1956, Pl. 4, figs. 2, 3; McLaren, Norris and McGregor, 1962, Pl. 9, figs. 4-6; Johnson, 1969, p. 832-834, text-figs. 1, 2, Pl. 105, figs. 1, 2; 1973, p. 105-107, text-fig. 3.

aleskanus Zone

This zone, based on *Stringocephalus aleskanus*, was established by Crickmay in 1963 (p. 27, Table on p. 28) and 1966 (p. 31, 32). In the reference section at The Ramparts of the Mackenzie, it ranges from 59 to 119 feet (18 to 36 m) above the base of the Ramparts limestone. South and southwest from there, it occurs nearer the base of the limestone. Thus at Powell Creek (Lat. 65°16'30"N; Long 128°46'W) and Carcajou Ridge (Lat. 65°37'45"N; Long. 128°14'30"W) its known range is from 2 to 31 feet (1 to 9 m), and from 9 to approximately 55 feet (3 to 17 m) above the base of the Ramparts Formation, respectively. Northwest from the Ramparts section, the zone is present in thin limestones within map-unit D4 of this paper. Several species that are characteristic, but not necessarily diagnostic of the zone, including an undescribed species of *Moravophyllum* and the gastropods *Mastigospira alata* and *Buechelia tyrrelli*, are known also from the Sulphur Point Formation of Great Slave Lake and the Dawson Bay Formation of Manitoba (McCammon, 1960). Crickmay (1968, p. 11) has suggested that the zone index may be present in the Ramparts limestone equivalent of the Sentinal Mountain area of British Columbia, but evidence for this has not yet been presented.

Pending further descriptive work on the fauna of the zone, the only fossil absolutely diagnostic of it is *Stringocephalus aleskanus* itself.

This has been described and figured by Crickmay (1962, p. 12, 13, Pl. 1, figs. 10, 11; Pl. 6, figs. 1-6; Pl. 8, figs. 4-7; Pl. 9, figs. 1-3; 1968, p. 11, Pl. 10, figs. 1-7) and by Caldwell (1971, Pl. 3, fig. 2). However, the corals *Temnophyllum decaeni* Pedder and *T. richardsoni* (Meek), which have recently been described by the writer (Pedder, 1972), and *Argutastrea arguta* Crickmay (*see* Hill and Jell, 1970, p. 51, 52, Pl. 7, figs. 1a, b) have only very slightly greater ranges than *Stringocephalus aleskanus*. They are not, for example, known to the writer from either the underlying *laevis* or overlying *hippocastanea* Zones.

hippocastanea Zone

The *Leiorhynchus hippocastanea* Zone was proposed by Crickmay in 1960 (p. 3) and was said to be present in a well-bedded limestone known as Beavertail, which was believed to overlie the Ramparts limestone, or be "merely equivalent to the uppermost beds of Ramparts reef of places where bioherm makes up most of that formation". The fauna listed as representative of the zone contained essentially the same mixture of Ramparts and Waterways fossils that previously had constituted Warren and Stelck's (1950, p. 73; 1956, Pls. 8,9) *Cyrtina panda* Zone. These errors were corrected eventually by Crickmay himself (1968, 1970), who was the first to demonstrate the true position of the *Leiorhynchus hippocastanea* fauna above the last occurrences of *Stringocephalus* in the Mackenzie Valley and below the Rampart reefs, which he assigned to the Beavertail Formation. Crickmay, however, remained mistaken on one important point, and that was his belief that the reefs are separated by a significant unconformity from the underlying platform beds. Any sedimentary break that may exist between the reefs and platform beds is certainly of minor significance since conodonts, indicative of the *hermanni-*

cristatus Zone, have been recovered from both the *hippocastanea* and *mackenziense* Zones (T.T. Uyeno *in* Lenz and Pedder, 1972, p. 36, 37).

Leiorhynchus hippocastanea occurs in the Ramparts limestone from Oscar Creek (Lat. 65°30'N; Long. 127°21'W) to The Ramparts of the Mackenzie. At the latter locality, the zone ranges from approximately 122 to 164 feet (37 to 49 m) above the base of the Ramparts limestone. Northwest of Fort Good Hope, the zone fossil and some of its usual associates have been found near the top of map-unit D4 at several localities. At one of these (GSC loc. C-19863), the facies is so arenaceous that shell material has been completely leached away, resulting in a cast and mould preservation. The zone has been recognized in the Denay Limestone of Nevada (Johnson, 1970) and also is reported from subsurface rocks near Great Slave Lake (Crickmay, 1966, p. 16), 70 to 90 feet (21 to 27 m) below an occurrence of *Ladogioides kakwaensis*, which should represent the *billingsi* Zone, and on Whistler Mountain (Lat. 56°26'N; Long. 123°32'W), British Columbia, where it is said (Crickmay, 1967, p. 8) to occur 350 feet (105 m) above *Stringocephalus axius* (possibly equivalent to the *laevis* Zone) and 700 to 800 feet (210 to 240 m) below *Eleutherokomma killeri* (younger than the *billingsi* Zone shown in Fig. 1).

Typically, the *Leiorhynchus hippocastanea* fauna is dominated by brachiopods, many of which have been described. Those that appear to be diagnostic of the zone include:

Schizophoria mcfarlanei (Meek)

Helaspis caurina Crickmay

Productella gulosi Crickmay

Stelckia galearius Crickmay

Hadrorhynchia sandersoni (Warren)

Ladogioides mollicomus Crickmay

Leiorhynchus optimum Crickmay

L. rhabdotum Crickmay

"Atrypa" percrassa Crickmay

Warrenella occidentalis timetea Crickmay

Descriptions and figures of the zonal index have been provided by Warren and Stelck (1956, Pl. 8, figs. 29, 30), Crickmay (1960, p. 13, Pl. 9, figs. 10-17; 1963, p. 9, Pl. 2, figs. 1-14), Johnson (1970, p. 2099, 2100, Pl. 3, figs. 6-17) and Caldwell (1971, Pl. 3, figs. 3a-4c).

mackenziense Zone

Although the zone of *Grypophyllum mackenziense* was first proposed by the present writer (*in* Lenz and Pedder, 1972, p. 36, 37), the stratigraphic importance of the zone marker previously had been made known by Crickmay (1968, p. 1-3; 1970). The zone has been recognized (Pedder, 1973) over a wide area in western Canada extending from the platform of the Swan Hills Formation of west-central Alberta, to the Slave Point Formation of northern Alberta and southern District of Mackenzie, and to reefs of the Ramparts Formation (broad sense), as far north as the south end of The Ramparts of the Mackenzie. In the reference section at The Ramparts of the Mackenzie, the zone fossil ranges from 170 to 220 feet (51 to 66 m) above the base of the Ramparts Limestone. North of this section, rocks of this age were either not deposited, or were removed by either pre-Canol or pre-Cretaceous erosion.

The zone is confined to beds containing abundant tabulate corals and stromatoporoids which greatly outnumber the more stratigraphically important rugose corals and brachiopods. Described species, which, for the present at least, may be regarded as co-markers of the *Grypophyllum mackenziense* Zone, are *Temnophyllum lenzi* Pedder, *T. macconnelli* Pedder, *Emanuella vernilis* Crickmay and *Ladjia landesi* Crickmay.

Description and figures of the zonal index were published by the writer in 1966 (p. 133, 134, Pl. 19, figs. 1-6) and 1973 (p. 107-111, Text-figs. 48-58, Pl. 13, figs. 7-12; Pl. 14, figs. 1-8; Pl. 15, figs. 1-3, ?4, 5-10).

billingsi Zone

This zone, which was first used by the writer (*in* Lenz and Pedder, 1972, p. 37), corresponds closely to Warren and Stelck's (1950, p. 72; 1956, Pls. 10-12) zone of *Allanaria allani*, to McLaren's (1954, p. 168, 169; 1962, p. 15) zone of *Ladogioides kakwaensis*, and to Crickmay's (1957, p. 11; 1966, 13, 15-17, 20, 21) zone of *Eleutherokomma impennis*. The zonal index was changed because of the very considerable geographic range of *Tecnocyrtina billingsi* and also because of the extreme ease with which it may be identified. Each of the earlier authors mentioned above appears to have considered it to be an important index to the stratigraphic interval in question.

In the lower and middle Mackenzie Valley, the time of the zone was essentially one of non-deposition or active erosion. The only locality known at present where the existence of the zone can be demonstrated is in the allochthonous beds on Powell Creek (Lat. 65°16 1/2'N; Long. 128°46'W). These are labelled as breccia in Figure 1.

Excellent description and figures and a carefully documented account of the distribution of *Tecnocyrtina billingsi* and related forms have been given by Johnson and Norris (1972, p. 566-571, Pl. 1, figs. 19-24; Pl. 2, figs. 1-19).

REFERENCES

Caldwell, W.G.E.
1971: The biostratigraphy of some Middle and Upper Devonian rocks in the Northwest Territories: An historical review; The Musk-ox, Publication 9, p. 15-34.

Copper, Paul
1973: New Siluro-Devonian atrypoid brachiopods; J. Paleont., v. 47, p. 484-500.

Crickmay, C.H.
1952: Discrimination of late Upper Devonian; J. Paleont., v. 26, p. 585-609.

1957: "Elucidation of some western Canada Devonian Formations"; Imperial Oil Ltd., Calgary.

1960: "The older Devonian faunas of the Northwest Territories"; Evelyn de Mille Books, Calgary.

1962: "New Devonian fossils from western Canada"; Evelyn de Mille Books, Calgary.

1963: "Significant new Devonian brachiopods from western Canada"; Evelyn de Mille Books, Calgary.

1966: "Devonian time in western Canada"; Evelyn de Mille Books, Calgary

1967: "The method of indivisible aggregates in studies of the Devonian"; Evelyn de Mille Books, Calgary.

1968: "Discoveries in the Devonian of western Canada"; Evelyn de Mille Books, Calgary.

1970: Ramparts, Beavertail, and other Devonian Formations; Bull. Can. Petrol. Geol., v. 18, p. 67-79.

Ehlers, G.M. and Kesling, R.V.
1970: Devonian strata of Alpena and Presque Isle Counties, Michigan; Mich. Basin Geol. Soc., guidebook for field trips.

Griesemer, A.D.
1965: Middle Devonian brachiopods of southeastern Wisconsin; Ohio J. Sci., v. 65, p. 241-295.

Hall, James and Clarke, J.M.
1893-1894: An introduction to the study of the genera of Paleozoic Brachiopoda; Natural History of New York, New York Geol. Surv., Paleont., v. 8, pt. 2. Plates published in 1894.

Hill, Dorothy and Jell, J.S.
1970: Devonian corals from the Canning Basin, Western Australia; Geol. Surv. West Australia, Bull. 121.

Johnson, J.G.
1969: Some North American rensselandiid brachiopods; J. Paleont., v. 43, p. 829-837.

1970: Taghanic onlap and the end of North American Devonian provinciality; Bull. Geol. Soc. Am., v. 81, p. 2077-2105.

1971: Lower Givetian brachiopods from central Nevada; J. Paleont., v. 45, p. 301-326.

1973: Some North American rensselandiid brachiopods, Pt. 2; J. Paleont., v. 47, p. 1102-1107.

Johnson, J.G. and Norris, A.W.
1972: *Tecnocyrtina*, a new genus of Devonian brachiopods; J. Paleont., v. 46, p. 565-572.

Lenz, A.C. and Pedder, A.E.H.
1972: Lower and Middle Paleozoic sediments and paleontology of Royal Creek and Peel River, Yukon, and Powell Creek, N.W.T.; XXIV Intern. Geol. Congr., Guidebook, Field Excursion A14.

McCammon, Helen
1960: Fauna of the Manitoba Group in Manitoba; Manitoba Dept. Mines Nat. Res., Mines Branch, Paper 59-6.

McLaren, D.J.
1954: Upper Devonian rhynchonellid zones in the Canadian Rocky Mountains; Western Canada Sedimentary Basin Symposium (L.M. Clark, ed.), p. 159-181.

1962: Middle and early Upper Devonian rhynchonelloid brachiopods from western Canada; Geol. Soc. Can., Bull. 86.

McLaren, D.J., Norris, A.W. and McGregor, D.C.
1962: Illustrations of Canadian fossils, Devonian of western Canada; Geol. Surv. Can., Paper 62-4.

Meek, F.B.
1867: Remarks on the geology of the valley of Mackenzie River, with figures and descriptions of fossils from that region, in the Museum of the Smithsonian Institution, chiefly collected by the late Robert Kennicott, Esq.; Chicago Acad. Sci., v. 1, p. 61-114.

Norris, A.W.
1968: Devonian of northern Yukon Territory and adjacent District of Mackenzie; International Symposium on the Devonian System, Calgary 1967 (D.H. Oswald, ed.), v. 1, p. 753-780.

Pedder, A.E.H.
1963: *Alaiophyllum mackenziense* sp. nov., a Devonian tetracoral from Canada; Palaeontology, v. 6, p. 132-135.

1972: Species of the tetracoral genus *Temnophyllum* from Givetian/Frasnian boundary beds of the District of Mackenzie, Canada; J. Paleont., v. 46, p. 696-710.

1973: Description and biostratigraphical significance of the Devonian coral genera *Alaiophyllum* and *Grypophyllum* in western Canada; Geol. Surv. Can., Bull. 222, p. 93-127.

Warren, P.S.
1944: Index brachiopods of the Mackenzie River Devonian; Trans. Roy. Soc. Can., v. 38, 3rd ser., sec. 4, p. 105-135.

Warren, P.S. and Stelck, C.R.
1950: Succession of Devonian faunas in western Canada; Trans. Roy. Soc. Can., v. 44, 3rd ser., sec. 4, p. 61-78.

1956: Reference fossils of Canada. Part 1. Devonian faunas of western Canada; Geol. Assoc. Can., Spec. Paper 1.