Current Research (1986) Newfoundland Department of Mines and Energy,
Mineral Development Division, Report 86-1, pages 161-168

ORDOVICIAN BIOSTRATIGRAPHIC INVESTIGATIONS, GREAT NORTHERN PENINSULA, WESTERN NEWFOUNDLAND

W.D. Boyce
Newfoundland Mapping Section

ABSTRACT

It was determined that Barnes and Tuke's (1970) conodont samples were collected from a distinctive 1.6 m thick algal mound bed 3.1 m above the Boat Harbour 'pebble bed'. Barnes and Tuke's data support Boyce's (1979, 1983a, b) and Stouge's (1982) Ross-Hintze Zone G_2 age determination for the upper member of the Boat Harbour Formation. Trilobite and conodont data indicate that the Catoche Formation is as young as Ross-Hintze Zone I on the Port au Choix Peninsula and on Burnt Island. Bolbocephalus convexus *(Billings) and* Illaenus *sp. nov. occur more commonly in mound beds of the Catoche Formation than in the more typical limestones of the formation. Additional* Phyllograptus*-bearing horizons were discovered in the Catoche Formation at Laignet Point and Eddies Cove West.*

INTRODUCTION

The Ordovician carbonate deposits of the Great Northern Peninsula are the object of regional taxonomic-biostratigraphic studies aimed at correlating their trilobite faunas with those of the standard zonations of Ross (1951) and Hintze (1953). This report discusses new trilobite and graptolite material obtained from Port au Choix Peninsula, Eddies Cove West, Boat Harbour, Cape Norman, Schooner Island and Burnt Island (Figure 1). The sampling results augment and update the work of Fortey (1979), and Boyce (1983a, b, 1985). Lithostratigraphic divisions that were studied in 1985 belong to the Boat Harbour and Catoche formations (St. George Group). Their sedimentology and lithology are described in detail by Knight (1983, *this volume*).

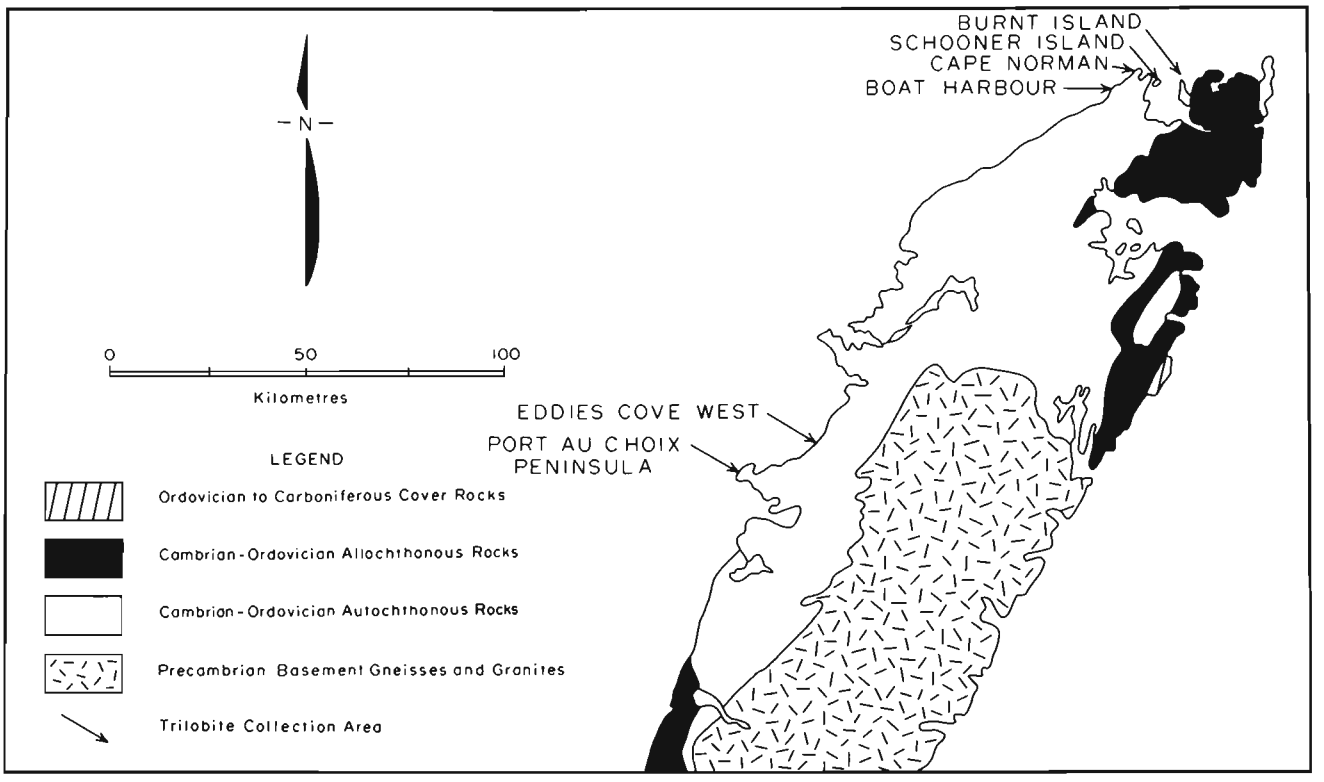


Figure 1: *Geological elements of the Great Northern Peninsula and trilobite collection areas discussed in this report.*

This project is a contribution to the Canada-Newfoundland Mineral Development Agreement, 1984-1989

DETAILED BIOSTRATIGRAPHIC WORK

Detailed biostratigraphic sampling for Early Ordovician trilobites and conodonts continued in the Boat Harbour and Catoche formations of the St. George Group. Sampling was done in the following areas: a) Barbace, Catoche and Laignet Points on the Port au Choix Peninsula, b) Eddies Cove West, c) Boat Harbour, and d) Cape Norman.

Port au Choix Peninsula

At Barbace Point and Catoche Point, sampling was done to fill gaps left in the sections by Fortey (1979) and Boyce (1983a, 1985). Lime boundstone mounds and their associated grainstone/packstone interfill were sampled at Catoche Point. This was done to determine if the trilobite faunas of these beds were markedly different from those in the more typical, rubbly weathering, lime mudstones/wackestones and lime packstones/grainstones of the Catoche Formation. The following species were collected from the mound beds:

Bathyurellus abruptus Billings

Bathyurellus platypus Fortey

Bolbocephalus convexus (Billings)

Catochia glabra Fortey

Illaenus sp. nov.

Ischyrotoma anataphra Fortey

Isoteloides latimarginatus Fortey

Jeffersonia angustimarginata Boyce, 1983b (see Stouge and Boyce, 1983; Plate 13, figure 4).

Jeffersonia timon (Billings)

Petigurus nero (Billings)

Punka flabelliformis Fortey

Strigigenalis caudata (Billings)

Uromystrum sp. cf. *U. affine* (Poulsen) of Fortey (1979)

Illaenus sp. nov. was recovered for the first time from the Catoche Point section. This species was previously only known from algal-sponge mound biofacies of the Catoche Formation at Forked Feeder Pond (Port Saunders (12I/11) map area), on Burnt Island in Pistolet Bay, and along the road to Roddickton (Boyce, unpublished data). *Bolbocephalus convexus* (Billings) is the only other trilobite besides *Illaenus* sp. nov. that occurs more commonly in the boundstone mound beds than in the more typical Catoche Formation limestones.

The tidal island at Laignet Point was sampled in detail for trilobites for the first time. It is located at the extreme western tip of the Port au Choix Peninsula. The Catoche Formation here comprises thin bedded, laminated, sparsely bioturbated, platy lime mudstones and grainstones, which are locally peloid rich. The strata were previously referred to as the Laignet Point Member by Knight (1977, 1978), Stouge (1982) and Stouge and Boyce (1983); however, the term is no longer regarded as valid (Knight, personal communication, 1985).

Stouge (1982, Figures 3 and 4) and Stouge and Boyce (1983, Figure 2.2) reported eleven biostratigraphically significant conodont species from the Laignet Point Member on the tidal island. These species also occur in the Pogonip Group at Ibex, Utah (Ethington and Clark, 1981). The species and their Ross-Hintze zonal ranges are as follows:

Drepanodus parallelus Branson and Mehl s.f. - Zone B to Zone L

Scolopodus? gracilis Ethington and Clark s.f. - Zone E to Zone M

Oistodus inaequalis Pander s.f. - Zone G_1 to Zone J

'Scolopodus' quadraplicatus Branson and Mehl s.f. - Zone D to Zone I

Drepanodus? gracilis (Branson and Mehl) s.f. - Zone G_1 to Zone I

Oepikodus communis (Ethington and Clark) - Zone G_2 to Zone J

Drepanodus arcuatus Pander - Zone E to Zone J

Tropodus comptus (Branson and Mehl) - Zone G_1 to Zone I

?Microzarkodina marathonensis (Bradshaw) - Zone G_2 to Zone N

Semiacontiodus asymmetricus (Barnes and Poplawski) - Zone H to Zone L

?Paroistodus parallelus (Pander) - Zone G_1 to Zone I

With reference to Ethington and Clark (1981, Figure 3), the minimum age range of the above species assemblage is Ross-Hintze Zone H to Zone I.

Macrofossils are generally difficult to find on the tidal island. There are a few rich layers, however, which contain articulate brachiopods, cephalopods, echinoderm debris, gastropods, graptolites, ostracodes, receptaculitids and trilobites. Trilobites were collected from nine horizons over a 9.3 m stratigraphic interval. The following species were obtained:

Petigurus sp. nov. (= *Petigurus* sp. indet., Fortey, 1979)

Goniotelus? sp. cf. Ross (1951; Plate 15, figure 12)

Petigurus nero (Billings)

Punka flabelliformis Fortey

Ischyrotoma anataphra Fortey

Jeffersonia timon (Billings)

Strotactinus insularis (Billings)

Isoteloides latimarginatus Fortey

Benthamaspis gibberula (Billings)

Illaenus sp. nov.

Catochia glabra Fortey

Bathyurellus platypus Fortey

Punka sp. nov. (= *Punka* sp. indet., Fortey, 1979)

Most of the above species also occur in the stratigraphically lower Catoche Point section. The presence of *Benthamaspis gibberula* (Billings) indicates that the beds on the tidal island are no older than early Arenig Ross-Hintze Zone H (Fortey, 1979; Boyce, 1985). The presence of *Goniotelus?* sp. cf. Ross (1951) further suggests that these beds are of early Arenig Ross-Hintze Zone I age, as *Goniotelus?* sp. of Ross (1951) occurs in Zone I in Utah (Ross, 1951, Plate 15, figure 12).

During the sampling on the island, a *Phyllograptus* - rich horizon was discovered. This horizon occurs 4.81 to 4.95 m above the *Phyllograptus* horizon documented by Boyce (1985, Figure 2). Either of these horizons may be the one originally reported by Kindle (1945).

Eddies Cove West

Lime boundstone beds of the Catoche Formation, originally sampled by Boyce (1983a), were resampled in more detail to determine if their trilobite faunas differed from those of the more typical Catoche Formation limestones. The following species were collected:

Bathyurellus abruptus Billings

Bathyurellus platypus Fortey

Benthamaspis gibberula (Billings)

Bolbocephalus convexus (Billings)

Ischyrotoma anataphra Fortey

Isoteloides latimarginatus Fortey

Jeffersonia angustimarginata Boyce, 1983b (see Stouge and Boyce, 1983; Plate 13, figure 4).

Jeffersonia timon (Billings)

Petigurus nero (Billings)

Strigigenalis caudata (Billings)

Although both *Bolbocephalus convexus* (Billings) and *Illaenus* sp. nov. are common in mound beds of the Catoche Formation elsewhere, only *Bolbocephalus convexus* (Billings) was recovered from the mounds of the Eddies Cove West section.

Phyllograptus was recovered for the first time at Eddies Cove West from the uppermost lime boundstone mound bed of the Catoche Formation. It is probably the same species as that collected from the upper beds of the Catoche Formation on the Port au Choix Peninsula (Boyce, 1985, *this report*).

Boat Harbour

The exact stratigraphic positions of Barnes and Tuke's (1970) conodont samples A and B were identified (see Figure 2). The samples were originally collected from grainstones between algal mounds (R.K. Stevens, personal communication, 1985) and the geographic location of each was visited to find the appropriate unit. Both sampled localities were found to definitely occur above the Boat Harbour pebble bed of Knight (1977, 1978, 1980), and Boyce (1978, 1983b). Furthermore, it was determined that both samples were obtained from the same bed, although they were taken 1 km apart (see Figure 2) and Barnes and Tuke (1970, Table 1) documented slightly differing species assemblages.

The bed from which the samples were obtained is distinctive. It is about 1.6 m thick and consists of algal mounds with highly fossiliferous grainstones between them. The base of the bed occurs about 3.1 m above the top of the 'pebble bed'. The mounds are large, isolated, steep-sided, circular to slightly elliptical, and up to 1.5 m in diameter (Boyce, 1983b).

Twenty-one conodont species were obtained by Barnes and Tuke (1970, Table 1). Of these, ten form an assemblage that is also recognizable in the Pogonip Group at Ibex, Utah (Ethington and Clark, 1981). The species and their Ross-Hintze zonal ranges are as follows:

?Acodus sp. 3 Ethington and Clark, 1981 - Zone F to Zone G_2

Drepanodus sp. 1 Ethington and Clark, 1981 - Zone D to Zone J

Drepanodus parallelus Branson and Mehl s.f. - Zone B to Zone L

Oistodus inaequalis Pander s.f. - Zone G_1 to Zone J

aff. *Oneotodus simplex* (Furnish) - Zone E to Zone I

'Scolopodus' emarginatus Barnes and Tuke - Zone G_2 to Zone I

Scolopodus? gracilis Ethington and Clark s.f. - Zone E to Zone M

Scolopodus multicostatus Barnes and Tuke - Zone G_2

'Scolopodus' quadraplicatus Branson and Mehl s.f. - Zone D to Zone I

Ulrichodina abnormalis (Branson and Mehl) - Zone G_1 to Zone I

With reference to Ethington and Clark (1981, Figure 3), the above species assemblage is firmly indicative of an early Arenig Ross-Hintze Zone G_2 age. The biostratigraphic conclusion of Boyce (1979, 1983a, b) and Stouge (1982) as to the age of the Boat Harbour Formation above the 'pebble bed' is thus supported by the data of Barnes and Tuke (1970).

Hystricurus sp. cf. *H. crassilimbatus* Poulsen and *Peltabellia* sp. cf. *P. crassimarginata* (Cullison) were recovered for the first time from the same algal mound bed at Boat Harbour. *Hystricurus crassilimbatus* Poulsen occurs in the Cape Weber Formation of East Greenland (Poulsen, 1937, pages 47, 48; Plate 5, figures 5-8) and Ellesmere Island (Poulsen, 1946, page 327, Plate XXII, figure 18). It is also reported from the Deadwood Formation of North Dakota by Lochman (1966, page 533; Plate 65, figure 41). *Peltabellia crassimarginata* (Cullison) is present in the standard deposits of the upper part of the Jeffersonian Stage *sensu* Flower (1978) in Missouri-northern Arkansas. There it occurs in the Blackjack Member of the Theodosia Formation of the Jefferson City Group (Collison 1944, pages 75-77; Plate XXXV, figures 17-22).

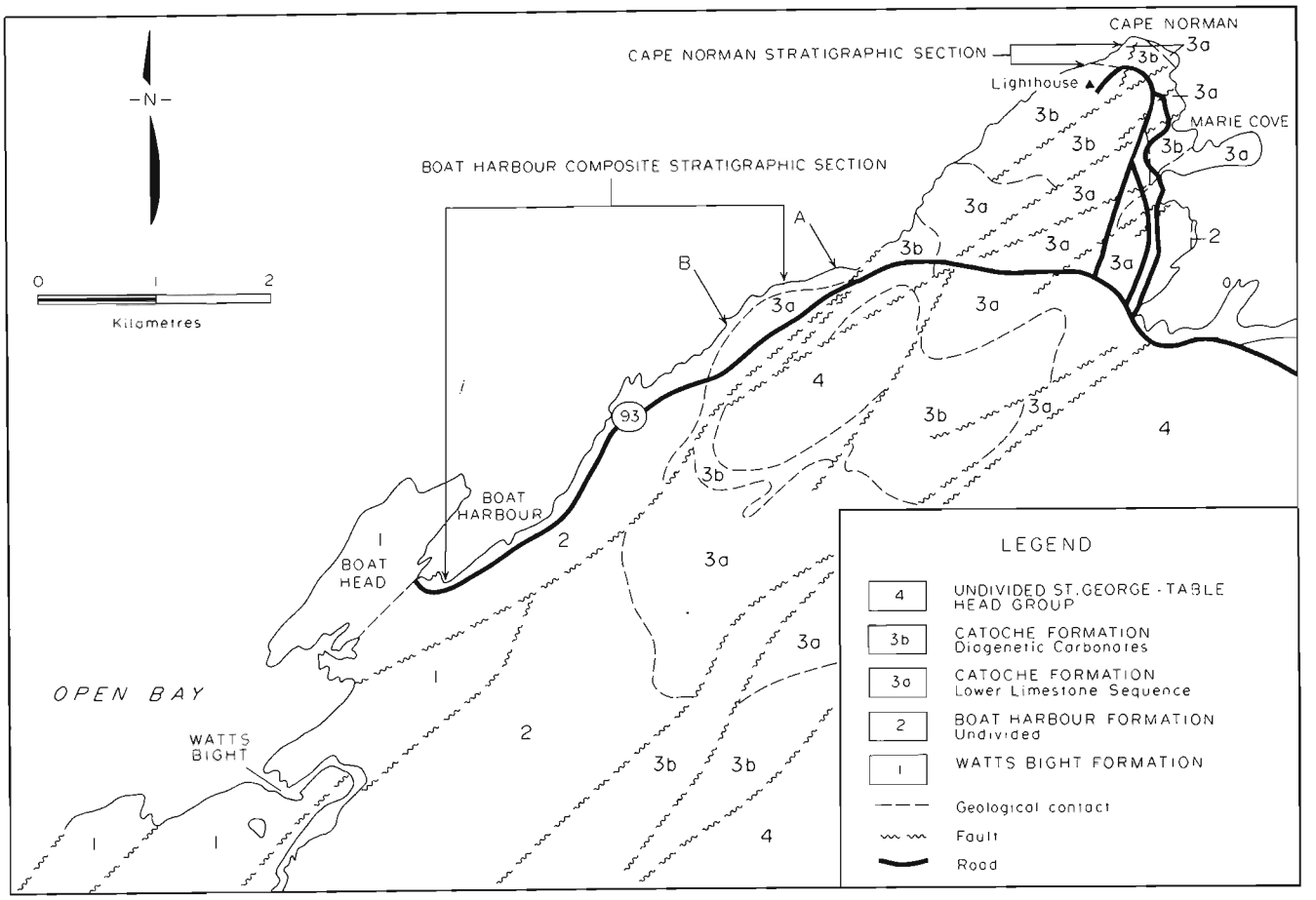


Figure 2: *Geology of the Boat Harbour - Cape Norman study area and location of measured stratigraphic sections of Boyce (1983b, this report). Geology modified from Knight and Edwards (1978a, b). A, B indicate sampled conodont localities of Barnes and Tuke (1970).*

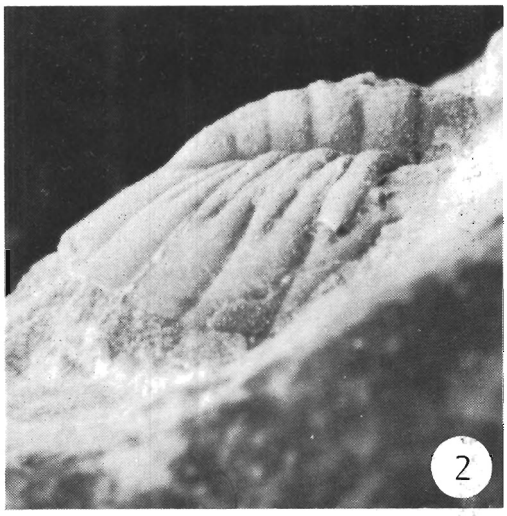
Plate 1: *Bolbocephalus* sp. nov.

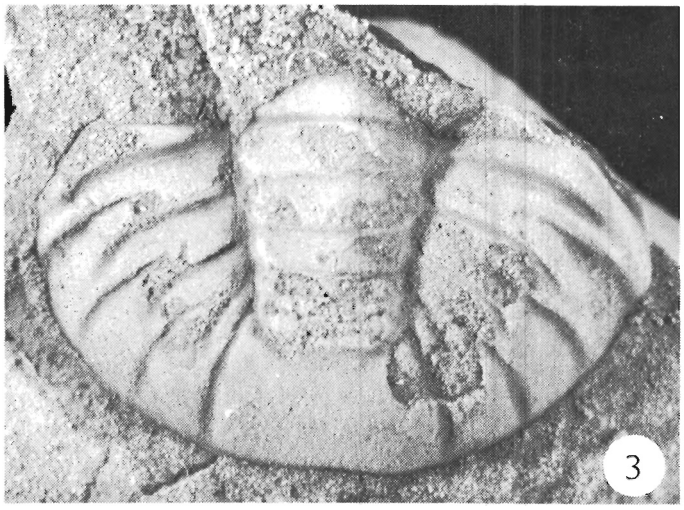
Figures 1, 2: *Pygidium, dorsal and lateral views, MMH 3714 (the original of Poulsen, 1937; Plate 8, figure 2), x 9, Cape Weber Formation, Ella Island, East Greenland. MMH = Geologisk Museum, University of Copenhagen, Copenhagen, Denmark.*

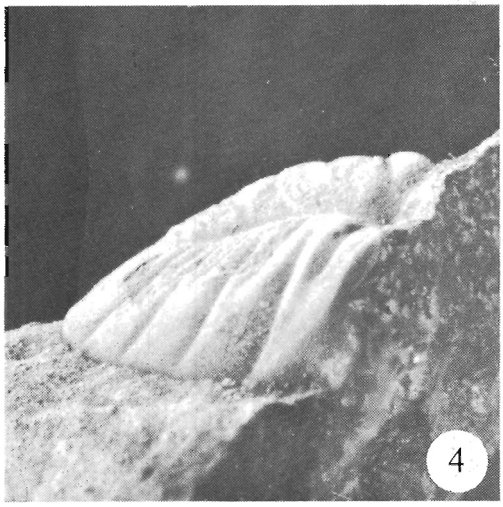
Figures 3, 4: *Pygidium, dorsal and lateral views, NFM F-209, x 6, Catoche Formation, Cape Norman, Newfoundland. NFM = Newfoundland Museum, St. John's, Newfoundland, Canada.*

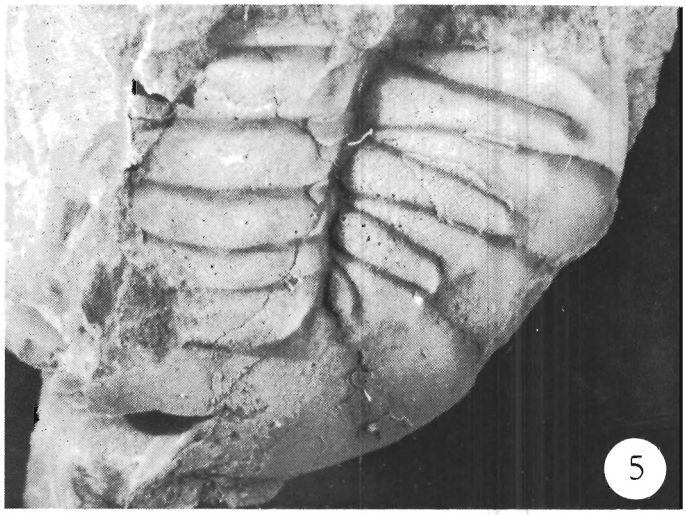
Figures 5, 6: *Pygidium, dorsal and lateral views, G.S.C. 82296, x 3.75, Catoche Formation, Burnt Island, Newfoundland. G.S.C. = Geological Survey of Canada, Ottawa, Ontario, Canada. Specimen originally collected by C.H. Kindle (1945).*

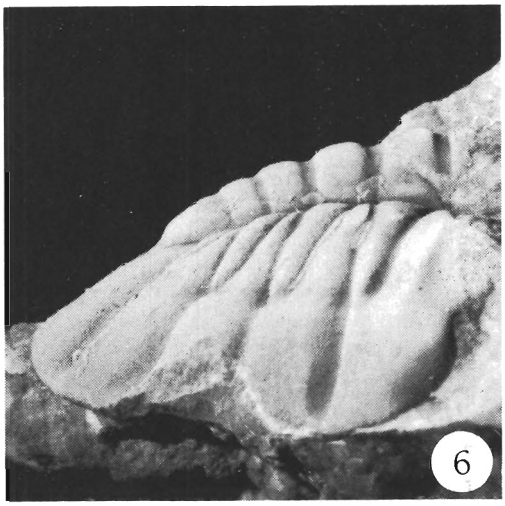

1


2


3


4


5


6

Cape Norman

Limestones of the Catoche Formation at Cape Norman were the object of detailed biostratigraphic sampling for trilobites and conodonts. The section exposed north of the lighthouse (see Figure 2) was previously investigated by Whittington (1968), Whittington and Kindle (1969) and Boyce (1978, 1979, 1983b). Boyce (1983b) documented seven species from twenty sampled horizons within a 17 m stratigraphic interval. This past summer, thirty-three horizons were sampled within a 21 m stratigraphic interval. The closer sample spacing and sampling of the additional 4 m (lower in the section) has resulted in a considerable revision of the biostratigraphic ranges of the species. Most have substantially longer ranges than indicated by Boyce (1983b, Figure 3.1). In addition, the number of species identified has been doubled. The revised biostratigraphic chart will be published later. The following species were collected:

Trilobita

Bathyurellus abruptus Billings

Bolbocephalus convexus (Billings)

Bolbocephalus sp. nov. (= Genus et sp. ind., Poulsen, 1937; Plate 8, figure 2; see also Plate 1, *this report)*

Catochia ornata Fortey

Illaenus sp. nov.

Ischyrotoma parallela Boyce, 1983b (see Stouge and Boyce, 1983; Plate 13, figure 3)

Petigurus nero (Billings)

Uromystrum affine (Poulsen)

Jeffersonia timon (Billings)

Ischyrotoma anataphra Fortey

Uromystrum sp. cf. *U. affine* (Poulsen) of Fortey (1979)

Benthamaspis conica Fortey

Benthamaspis sp. cf. *B. conica* Fortey

Strotactinus insularis (Billings)

Cephalopoda

Cassinoceras wortheni (Billings)

Protocycloceras lamarcki (Billings)

Whittington and Kindle (1969, page 659) reported the trilobite *Carolinites* sp. from Cape Norman. Fortey (1979) identified *Isoteloides peri* Fortey, *Punka flabelliformis* Fortey and *Benthamaspis* sp. cf. *B. gibberula* (Billings) from collections obtained by Whittington and Kindle.

The Catoche Formation trilobite fauna at Cape Norman correlates broadly with the early Arenig Ross-Hintze Zone G_2 to Zone H fauna of the lower 30 m of the Catoche Point section of Fortey (1979, Figure 11) and Boyce (1985, Figure 2) on the Port au Choix Peninsula.

The cephalopod *Protocycloceras lamarcki* (Billings) also occurs in the Romaine Formation of the Mingan Islands, Quebec (Billings, 1865) and in the Oxford Formation in southeastern Ontario (Billings, 1865).

RECONNAISSANCE BIOSTRATIGRAPHIC WORK

Reconnaissance biostratigraphic sampling for Early Ordovician trilobites and conodonts commenced in the Boat Harbour and Catoche formations on Schooner Island and Burnt Island in Pistolet Bay. These islands have not been examined in detail since the investigations of Kindle (1945) and Johnson (1949). The upper part of the Catoche Formation consists of fossiliferous limestone on the islands, whereas in most other places on the Great Northern Peninsula this stratigraphic interval consists of diagenetic dolostones. The dolostones are generally unfossiliferous except for local silicified cephalopods and/or gastropods.

Schooner Island

Twelve collections were made on Schooner Island. Three were obtained from the upper member of the Boat Harbour Formation. They collectively yielded the following trilobites:

Peltabellia knighti Boyce, 1983b (see Stouge and Boyce, 1983; Plate 16, figures 3-5)

Jeffersonia angustimarginata Boyce, 1983b (see Stouge and Boyce, 1983; Plate 13, figure 4)

Bolbocephalus convexus (Billings)

Bolbocephalus stevensi Boyce, 1983b

Isoteloides peri Fortey

Strigigenalis brevicaudata Boyce, 1983b (see Stouge and Boyce, 1983; Plate 16, figure 6)

The above fauna correlates with the early Arenig Ross-Hintze Zone G_2 fauna that occurs above the 'pebble bed' and its equivalents in the upper member of the Boat Harbour Formation at Boat Harbour, Barbace Point and Eddies Cove West (Boyce 1983a, b, 1985).

Nine collections were obtained from the Catoche Formation on Schooner Island. The lower burrowed limestone member and the middle limestone mound member of Knight (*this volume*) were sampled and the following trilobite species identified:

Bathyurellus abruptus Billings

Benthamaspis sp. undet.

Bolbocephalus convexus (Billings)

Jeffersonia angustimarginata Boyce, 1983b (see Stouge and Boyce, 1983; Plate 13, figure 4)

Uromystrum affine (Poulsen)

Isoteloides peri Fortey

Punka sp. nov. (=*Punka* sp. indet., Fortey, 1979)

Petigurus nero (Billings)

Illaenus sp. nov.

The above fauna correlates with the early Arenig Ross-Hintze Zone G_2 to Zone H faunas of the lower part of the Catoche Formation at Boat Harbour, Cape Norman, Eddies Cove West and Barbace Point (Boyce 1983a, b, 1985).

Burnt Island

Eighteen collections were obtained from the Catoche Formation on Burnt Island. The upper burrowed limestone member and the white limestone member of Knight *(this volume)* were sampled and the following trilobites recovered:

Bolbocephalus convexus (Billings)

Bolbocephalus sp. nov. (= Genus et sp. ind., Poulsen, 1937; Plate 8, figure 2; see also Plate 1, *this report)*

Gignopeltis rarus (Billings)

Ischyrotoma sp. cf. *I. anataphra* Fortey

Jeffersonia sp. cf. *J. jenii* Cullison

Strotactinus sp. cf. *S. insularis* (Billings)

Uromystrum affine (Poulsen)

Uromystrum sp. undet.

The Burnt Island fauna most probably correlates with the early Arenig Ross-Hintze Zone H to Zone I fauna of the upper part of the Catoche Formation at Catoche Point and Laignet Point on the Port au Choix Peninsula.

Gignopeltis rarus (Billings) and *Bolbocephalus convexus* (Billings) also occur in the Oxford Formation of southeastern Ontario (Ludvigsen, 1979; Plate 1, figures 4-6). *Uromystrum affine* (Poulsen) and *Bolbocephalus* sp. nov. (see Plate 1, *this report)* are also present in the Cape Weber Formation of East Greenland (Poulsen, 1937; Plate 7, figures 6, 7, and Plate 8, figure 2).

ACKNOWLEDGEMENTS

Dr. C. H. Kindle (Nyack, New York) provided access to his superb western Newfoundland trilobite collection. Drs. T. E. Bolton (Geological Survey of Canada) and S. Floris and V. Poulsen (Geologisk Museum - University of Copenhagen) are also acknowledged for the loan of trilobite material. Stephen Ash discovered the graptolites on the Laignet Point tidal island. His keen-eyed field assistance was greatly appreciated. His attempts to provide video competition are also duly acknowledged. Drs. N.P. James, I. Knight and S.H. Williams provided stimulating field discussions. Austin Patey (River of Ponds), Lawrence Patey and his family (Hawkes Bay) and Lyle Campbell and his family (Cape Norman) are thanked for their assistance and hospitality. Drs. I. Knight and S.P. Colman-Sadd critically read the manuscript.

REFERENCES

Barnes, C.R. and Tuke, M.F.
1970: Conodonts from the St. George Formation (Ordovician), northern Newfoundland. Geological Survey of Canada, Bulletin 187, pages 79-97.

Billings, E.
1865: Palaeozoic fossils. Volume 1. Containing descriptions and figures of new or little known species of organic remains from the Silurian rocks. 1861-1865. Geological Survey of Canada, 426 pages.

Boyce, W.D.
1978: Recent developments in western Newfoundland Cambro-Ordovician trilobite biostratigraphy. *In* Report of Activities for 1977. Newfoundland Department of Mines and Energy, Mineral Development Division, Report 78-1, pages 80-84.

1979: Further developments in western Newfoundland Cambro-Ordovician biostratigraphy. *In* Report of Activities for 1978. Newfoundland Department of Mines and Energy, Mineral Development Division, Report 79-1, pages 7-11.

1983a: Preliminary Ordovician trilobite biostratigraphy of the Eddies Cove West - Port au Choix area, western Newfoundland. *In* Current Research. Newfoundland Department of Mines and Energy, Mineral Development Division, Report 83-1, pages 11-15.

1983b: Early Ordovician trilobite faunas of the Boat Harbour and Catoche Formations (St. George Group) in the Boat Harbour - Cape Norman area, Great Northern Peninsula, western Newfoundland. Unpublished M.Sc. thesis, Memorial University of Newfoundland, St. John's, 272 pages.

1985: Cambrian-Ordovician biostratigraphic investigations, Great Northern Peninsula, western Newfoundland. *In* Current Research. Newfoundland Department of Mines and Energy, Mineral Development Division, Report 85-1, pages 60-70.

Cullison, J.S.
1944: The stratigraphy of some Lower Ordovician formations of the Ozark Uplift. Bulletin of the University of Missouri School of Mines and Metallurgy, Volume 15, 112 pages.

Ethington, R.L. and Clark, D.L.
1981: Lower and Middle Ordovician conodonts from the Ibex area, western Millard County, Utah. Brigham Young University Geology Studies, Volume 28, Part 2, 155 pages.

Flower, R.H.
1978: St. George and Table Head cephalopod zonation in western Newfoundland. *In* Current Research, Part A. Geological Survey of Canada, Paper 78-1A, pages 217-224.

Fortey, R.A.
1979: Lower Ordovician trilobites from the Catoche Formation (St. George Group), western Newfoundland. Geological Survey of Canada, Bulletin 321, pages 69-114.

Hintze, L.F.
1953: Lower Ordovician trilobites from western Utah and eastern Nevada. Utah Geological and Mineralogical Survey, Bulletin 48, 249 pages.

Johnson, H.
1949: Excerpts from 'Geology of Western Newfoundland'. Unpublished manuscript, Newfoundland Geological Survey, 48 pages, [NFLD. (188)].

Kindle, C.H.
1945: Geology of the Pistolet Bay area, summary report. Unpublished manuscript, Newfoundland Geological Survey, 12 pages, [2M (3)].

Knight, I.
1977: Cambro-Ordovician platformal rocks of the Northern Peninsula, Newfoundland. Newfoundland Department of Mines and Energy, Mineral Development Division, Report 77-6, 27 pages.

1978: Platformal sediments on the Great Northern Peninsula: stratigraphic studies and geological mapping of the North St. Barbe District. *In* Report of Activities for 1977. Newfoundland Department of Mines and Energy, Mineral Development Division, Report 78-1, pages 140-150.

1980: Cambro-Ordovician stratigraphy of western Newfoundland; sedimentation, diagenesis and zinc-lead mineralization. Unpublished manuscript, Newfoundland Department of Mines and Energy, Mineral Development Division, 43 pages, [NFLD. (1154)].

1983: Geology of Cambro-Ordovician rocks in parts of the Castors River, St. John Island and Port Saunders map sheets. *In* Current Research. Newfoundland Department of Mines and Energy, Mineral Development Division, Report 83-1, pages 1-10.

This volume: Ordovician sedimentary strata of the Pistolet Bay and Hare Bay area.

Knight, I. and Edwards, J.
1978a: Raleigh (2M/12). Newfoundland Department of Mines and Energy, Mineral Development Division, Map 78-65.

1978b: Big Brook (12P/9). Newfoundland Department of Mines and Energy, Mineral Development Division, Map 78-66.

Lochman, C
1966: Lower Ordovician (Arenig) faunas from the Williston Basin of Montana and North Dakota. Journal of Paleontology, Volume 40, pages 512-548.

Ludvigsen, R.
1979: Lower Ordovician trilobites of the Oxford Formation, eastern Ontario. Canadian Journal of Earth Sciences, Volume 16, pages 859-865.

Poulsen, C.
1937: On the Lower Ordovician faunas of East Greenland. Meddelelser om Gronland, Volume 119, pages 1-72.

1946: Notes on Cambro-Ordovician fossils collected by the Oxford University Ellesmere Land Expedition, 1934-5. Quarterly Journal of the Geological Society of London, Volume 102, pages 299-337.

Ross, R.J., Jr.
1951: Stratigraphy of the Garden City Formation in northeastern Utah and its trilobite faunas. Yale University, Peabody Museum of Natural History, Bulletin 6, 161 pages.

Stouge, S.
1982: Preliminary conodont biostratigraphy and correlation of Lower to Middle Ordovician carbonates of the St. George Group, Great Northern Peninsula, Newfoundland. Newfoundland Department of Mines and Energy, Mineral Development Division, Report 82-3, 59 pages.

Stouge, S. and Boyce, W.D.
1983: Fossils of northwestern Newfoundland and southeastern Labrador: conodonts and trilobites. Newfoundland Department of Mines and Energy, Mineral Development Division, Report 83-3, 55 pages.

Whittington, H.B.
1968: Zonation and correlation of Canadian and early Mohawkian Series. *In* Studies of Appalachian Geology: Northern and Maritime. *Edited by* E-an Zen, W.S. White, J.B. Hadley and J.B. Thompson, Jr. Wiley-Interscience, New York, pages 49-60.

Whittington, H.B. and Kindle, C.H.
1969: Cambrian and Ordovician Stratigraphy of western Newfoundland. *In* North Atlantic-Geology and Continental Drift. *Edited by* M. Kay. American Association of Petroleum Geologists, Memoir 12, pages 655-664.

Note: Mineral Development Division file numbers are included in square brackets.