Current Research (1988) Newfoundland Department of Mines, Mineral Development Division, Report 88-1, pages 177-182

ORDOVICIAN BIOSTRATIGRAPHIC STUDIES IN THE CENTRAL MOBILE BELT AND THEIR IMPLICATIONS FOR NEWFOUNDLAND TECTONICS

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ABSTRACT

Trilobites have been recovered for the first time near Weir's Pond in the Davidsville Group. The faunas range in age from Late Arenig to Early Llandeilo. Poorly preserved graptolites have also been found at Weir's Pond.

Trilobite faunal distributions do not support McKerrow and Cocks' (1977, 1978, 1980, 1981, 1986) contention that the Reach Fault represents the suture along which the Iapetus Ocean closed.

INTRODUCTION

Hoping to clarify and refine age relations in central Newfoundland, B. Kean and P. O'Neill (Newfoundland Department of Mines) requested biostratigraphic assistance in the Long Island, Indian Bay Big Pond and Weir's Pond areas (Figure 1). In accedance with this request, trilobites were discovered at three localities during the course of field work.

BIOSTRATIGRAPHIC INVESTIGATIONS

Dunnage Zone

Weir's Pond (NTS area 2E/1). Three new trilobite localities were discovered within the Davidsville Group in the vicinity of Weir's Pond. An argillaceous sandstone outcrop containing the brachiopod *Orthambonites* was discovered in 1986 by O'Neill (1987, page 277) south-southwest of Weir's Pond. In 1987, the rocks at this locality yielded an abundant brachiopod fauna. The trilobite *Annamitella* sp. cf. *A. insulana* Dean was also discovered. The brachiopod and trilobite fauna appears comparable to the Late Arenig–Early Llanvirn faunas of the Summerford Group on New World Island (Dean, 1973) and that of the Indian Bay Formation of the Indian Bay Big Pond area (Wonderley and Neuman, 1984).

Jenness (1958, 1963) was the first to report fossils from Weir's Pond. He collected articulate and inarticulate brachiopods from two limestone exposures on the northwest side of the lake. He assigned the rocks an Ordovician age.

Williams (1972) also obtained fossil material from the Weir's Pond localities. Bolton (*in* Williams, 1972, page 20) identified for him the following:

dolerorthid brachiopod impression
endocer(o)id(?) cephalopod structure
Maclurites sp. aff. *M. speciosa* (Billings)

Blackwood (1978) subsequently revisited the two exposures, which yielded articulate brachiopods and gastropods. He also collected samples for conodont analysis. From the stratigraphically lower northern locality the following gastropods were collected:

Maclurea speciosa Billings
Pararaphistoma

The two gastropod taxa were identified by Yochelson (*in* Blackwood, 1978, page 75), who assigned them a late Early Ordovician to early Middle Ordovician age. From the stratigraphically higher southern locality the brachiopod *Orthambonites* was collected. The brachiopod was identified by Neuman (*in* Blackwood, 1978, page 75), who assigned it an Early Ordovician to early Middle Ordovician age.

The definitive age determination for the Weir's Pond exposures was provided by Stouge (1979, 1980a,b), who analyzed the conodont samples collected by Blackwood (1978). Stouge found that both localities had essentially identical North Atlantic conodont faunas and assigned the rocks a Late Llanvirn to Early Llandeilo (Chazy) age.

In 1982, S.P. Colman-Sadd (Newfoundland Department of Mines) and R.B. Neuman (Smithsonian Institution) collected more brachiopods from the southern Weir's Pond locality. The following genera were identified (R.B. Neuman, written communication to S.P. Colman-Sadd and W.D. Boyce, June 30, 1987):

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

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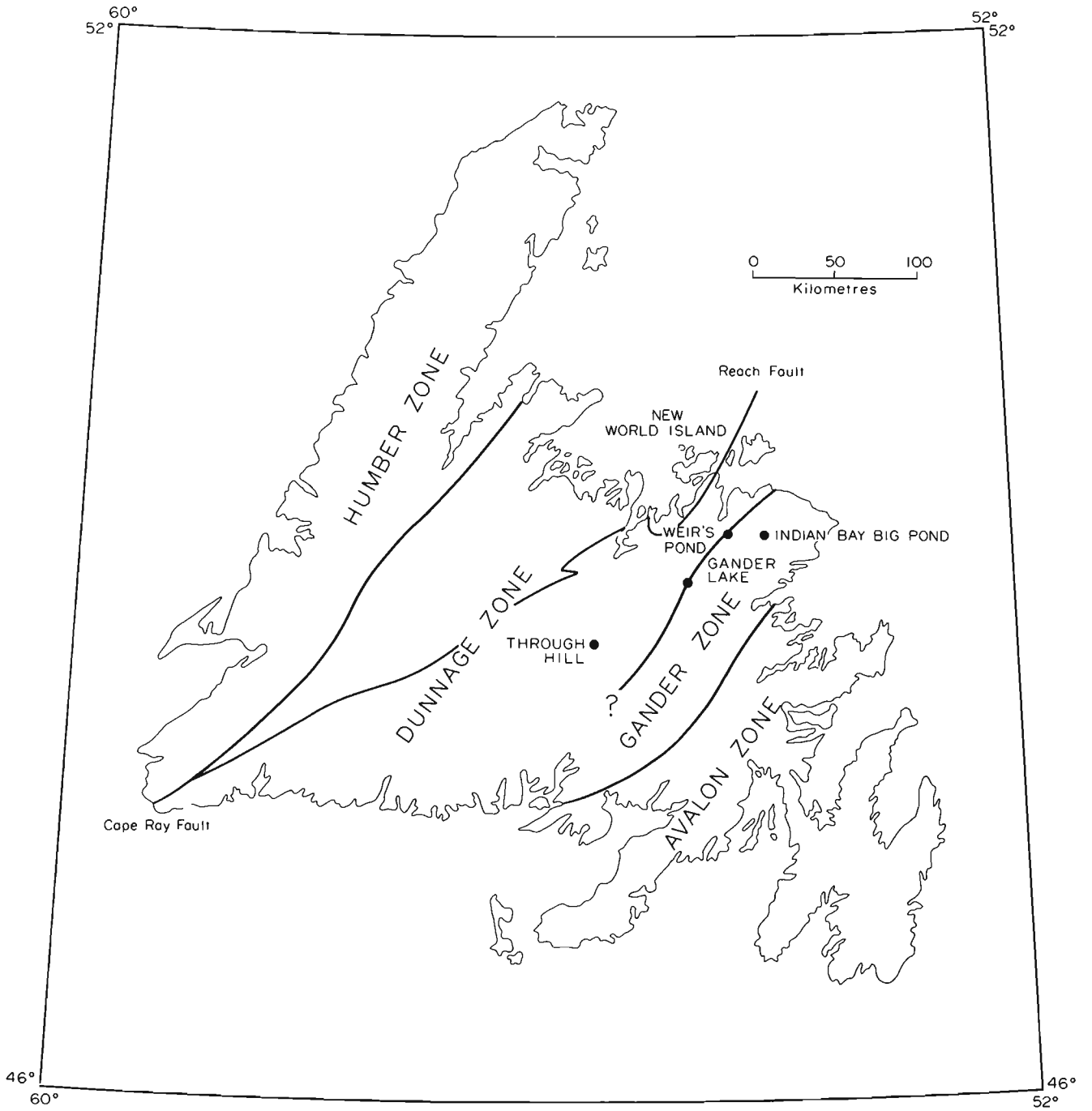

Figure 1. *Trilobite collection areas discussed in this report. The location of McKerrow and Cocks' (1977) proposed Iapetus suture (Cape Ray Fault–Reach Fault) is also indicated.*

Orthambonites
Chaulistomella
Platystrophia
Eremotoechia
Atelesma
Leptaena

In 1987, I. Knight discovered trilobites at the southern Weir's Pond locality. Bioclastic limestone stratigraphically overlying the brachiopod-rich layer yielded the following trilobites:

Annamitella sp. undet.
Geragnostus/Trinodus sp. undet.
Hyboaspis sp. cf. *H. depressa* Raymond
Illaenus sp. undet.

Hyboaspis depressa Raymond occurs in the uppermost Day Point and basal Valcour formations of the Chazy Group of New York State (Shaw, 1968, page 63). Therefore, according to the correlation chart of Ross *et al.* (1982), *Hyboaspis* is strictly a Llandeilo genus. The Chazy Group as a whole is Late Whiterock (formerly Chazy), Late Llanvirn–Early Caradoc in age (Ross *et al.*, 1982; Shaw, 1968; Shaw and Fortey, 1977).

The presence of *Hyboaspis* sp. cf. *H. depressa* Raymond and the generic composition of the Weir's Pond fauna indicates a correlation with the Late Llanvirn–Early Llandeilo (Chazy) faunas of the Spruce Brook Formation in the Through Hill area (Boyce, 1987) and the Cobbs Arm Limestone of New World Island (Dean, 1971). The trilobite age determination supports the previous conodont (Stouge, 1979, 1980a,b) and brachiopod (R.B. Neuman, personal communication, 1987) age determinations.

Deformed shales and slates of the Davidsville Group, stratigraphically above the bioclastic limestone at Weir's Pond, contain abundant graptolites. These fossils were first reported from here by Williams (1972, page 20) and were later mentioned again by Dean (1978, pages 124, 203). Erdtmann (*in* Williams, 1972, page 20) identified the following species:

Climacograptus sp. cf. *C. scharenbergi* Lapworth
Climacograptus sp.
Orthograptus sp. cf. *O. calcaratus grandis* Ross and Berry
Orthograptus sp. cf. *O. quadrimucronatus* (Hall)

According to Dean (1978, page 124), this graptolite assemblage is Middle Caradoc (probably *Diplograptus multidens* Zone) in age.

S.P. Colman-Sadd obtained more graptolites from Weir's Pond in 1982. D. Boyce and J. Ash subsequently collected additional specimens from the lakeshore in 1985 and 1987. This material is currently being investigated by S.H. Williams (Memorial University of Newfoundland).

P. O'Neill also discovered a fossiliferous, pyrite-rich Davidsville limestone boulder close to outcrop in the vicinity of Weir's Pond. The boulder yielded the trilobite *Annamitella* and a gastropod. No brachiopods were recovered. The age, based solely on the occurrence of *Annamitella*, is Late Arenig to Early Llandeilo. However, the gastropod is identical to one of the species that occurs at the northern Weir's Pond fossil locality, reported by Yochelson (*in* Blackwood, 1978). The probable age of the limestone is therefore Late Llanvirn–Early Llandeilo.

Long Island (NTS area 2E/12). Strong and Kean (1972) documented cephalopods, conulariids, crinoids and ostracodes from the Cutwell Group on Long Island. The fossils came from beds and pockets of limestone associated with pillow lavas and pyroclastic rocks. A Middle Ordovician age was tentatively suggested for the Cutwell Group there.

In 1987, D. Boyce and B. Kean revisited the fossil localities of Strong and Kean (1972). Unfortunately, there were no new macrofossil finds either there or in roadside exposures in the area. However, five (5) samples were taken for conodont analysis.

Gander Zone

Indian Bay Big Pond (NTS area 2E/1). P. O'Neill obtained more brachiopod and trilobite material from argillaceous tuffs in the Indian Bay Formation of the Indian Bay Big Pond area. His collections, which Boyce is studying, augment those of Wonderley and Neuman (1984) and Boyce (1987). The new material is probably the best preserved of all the collections. Unfortunately, like the others, it was obtained from talus. However, O'Neill believes the talus is very close to outcrop because it is restricted to the north and south shores of Indian Bay Big Pond along regional strike. *Annamitella* remains the only trilobite recorded from Indian Bay Big Pond.

The *Annamitella* from Indian Bay Big Pond closely resembles *Annamitella insulana* Dean. This Late Arenig–Early Llanvirn species was originally described by Dean (1973) from the middle volcanic unit (Unit B) of the Summerford Group (Horne, 1970) exposed at Virgin Arm, New World Island (NTS area 2E/10).

REGIONAL SIGNIFICANCE OF LATE ARENIG–EARLY LLANVIRN AND LATE LLANVIRN–EARLY LLANDEILO TRILOBITE FAUNAS IN CENTRAL NEWFOUNDLAND

Faunal Provincialism

Late Arenig–Early Llanvirn trilobite faunas in central Newfoundland are known mainly from argillaceous tuffs and sandstones. These faunas are of mixed North American and Baltoscandian (European) aspect (Bruton and Harper, 1985) and are typically dominated by the nearly cosmopolitan

leiostegiid genus *Annamitella*. Rich brachiopod faunas indicative of the Celtic Faunal Province (Williams, 1973; Neuman, 1976, 1984) are characteristically associated with these trilobite faunas (Bruton and Harper, 1985).

The Late Arenig–Early Llanvirn *Annamitella* fauna is widespread in central Newfoundland. It is known from the following areas:

1) Gander Lake–Davidsville Group (Jenness, 1958, 1963; McKerrow and Cocks, 1977);

2) New World Island–Unit B, Summerford Group (Dean, 1973; Neuman, 1976; McKerrow and Cocks, 1981);

3) Indian Bay Big Pond–Indian Bay Formation (Wonderley and Neuman, 1984; Boyce, 1987; this report); and

4) South-southwest of Weirs Pond–Davidsville Group (this report).

The Late Llanvirn–Early Llandeilo (Chazy) trilobite faunas of central Newfoundland typically occur in limestones. These faunas display strong North American affinities, although minor Baltoscandian elements are present. The cosmopolitan agnostid genera *Geragnostus/Trinodus* and the North American illaenid genus *Illaenus* predominate. Rich conodont faunas characteristic of the North Atlantic Faunal Province (Barnes *et al.*, 1973; Bergström, 1973) typically accompany these trilobite faunas (Stouge, 1979, 1980a,b,c).

The Late Llanvirn–Early Llandeilo (Chazy) fauna seems to be less widespread in central Newfoundland than the older *Annamitella* fauna. However, it is recognized in the following areas:

1) New World Island–Cobbs Arm Limestone, Summerford Group (Dean, 1971; Bergström *et al.*, 1974; McKerrow and Cocks, 1977);

2) Through Hill–Spruce Brook Formation (Boyce, 1987); and

3) Weir's Pond–Davidsville Group (this report).

Paleontological Controls on Structural Models

McKerrow and Cocks (1977, 1978, 1980, 1981, 1986) have long maintained that the Reach Fault, in central Newfoundland, represents the suture where the Iapetus Ocean closed. McKerrow and Cocks (1977, page 488) stated, 'This suture can be recognized by three types of evidence:

1. fundamental faunal differences over a long period of time;

2. ophiolitic suites and overlying deep-water sediments;

3. calc-alkaline igneous suites, which are characteristic of areas (adjacent to the old oceans) above subducting oceanic crust.'

McKerrow and Cocks (1977) compared the Late Arenig–Early Llanvirn *Annamitella* fauna of the Davidsville Group (east of the Reach Fault) to the Late Llanvirn–Early Llandeilo (Chazy) fauna of the Cobbs Arm Limestone (west of the fault). Because the two faunas are markedly different they assumed that each side of the fault belonged to different faunal provinces and crustal plates from the Late Arenig onward. This assumption has been the cornerstone of their hypothesis. However, faunas of different ages on either side of the fault were compared, rather than faunas of the same age, thus their assumption is unfounded.

Stouge (1979, 1980a,b,c) subsequently documented essentially identical Late Llanvirn–Early Llandeilo North Atlantic conodont faunas from either side of the Reach Fault. These faunas came from limestones of the Cobbs Arm Limestone on New World Island and the Davidsville Group at Weir's Pond. McKerrow and Cocks (1980) maintained that conodonts were strictly pelagic organisms and dismissed Stouge's results. They ignored the findings of Barnes and Fahraeus (1975) who demonstrated that most conodonts were probably benthic or nektobenthic.

The discovery of undeniably benthic trilobite faunas east of the Reach Fault (Boyce, 1987; this report) now enables the comparison of Late Arenig–Early Llanvirn and Late Llanvirn–Early Llandeilo (Chazy) faunas on either side.

Late Arenig–Early Llanvirn rocks on both sides of the Reach Fault are dominated by the trilobite *Annamitella*. This genus is known from three areas east of the fault, i.e., Gander Lake, Indian Bay Big Pond and immediately south-southwest of Weir's Pond. West of the fault, it occurs on New World Island. McKerrow and Cocks (1977, page 494) emphasized the apparent lack of *Annamitella* west of the Reach Fault. However, Dean (1973) had earlier described *Annamitella insulana* Dean from the Summerford Group of New World Island.

Late Llanvirn–Early Llandeilo (Chazy) trilobites of dominantly North American affinity are now known from east of the Reach Fault. They occur in limestones of the Spruce Brook Formation in the Through Hill area (Boyce, 1987) and the Davidsville Group at Weir's Pond (this report). These new faunas favorably compare with that described by Dean (1971) from the Cobbs Arm Limestone of New World Island, immediately west of the Reach Fault.

CONCLUSIONS

When trilobite (and conodont) faunas of the same age on opposite sides of the Reach Fault are compared, there is no contrast in their faunal provinciality. Consequently, faunal evidence cannot be used to support McKerrow and Cocks' (1977, 1978, 1980, 1981, 1986) contention that the Reach Fault

represents the suture along which the Iapetus Ocean closed. In any event, as Stouge (1980c, page 1600) correctly emphasized, distribution of faunal provinces cannot be used as evidence for plate boundaries. Taylor (1976, 1977) demonstrated the coexistence of two contrasting Late Cambrian trilobite faunal provinces on the same continental plate and related it to contrasting water temperatures and depths. Furthermore, if the entire Dunnage Zone is allochthonous, as Colman-Sadd and Swinden (1984) have suggested, any suture is bound to lie beneath it and not be exposed at the surface.

ACKNOWLEDGMENTS

B. Kean is thanked for an educational and enjoyable introduction to the geology of Long Island. Dr. R.B. Neuman (Smithsonian Institution) is gratefully acknowledged for his continuing identification of our brachiopods. S.P. Colman-Sadd, W.L. Dickson and S.J. O'Brien critically reviewed the manuscript.

REFERENCES

Barnes, C.R. and Fahraeus, L.E.
1975: Provinces, communities and the proposed nektobenthic habit of Ordovician conodontophorids. Lethaia, Volume 8, pages 133-149.

Barnes, C.R., Rexroad, C.B. and Miller, J.F.
1973: Lower Paleozoic conodont provincialism. *In* Conodont Paleozoology. *Edited by* F.H.T. Rhodes. Geological Society of America, Special Paper 141, pages 156-190.

Bergström, S.M.
1973: Ordovician conodonts. *In* Atlas of Palaeobiogeography. *Edited by* A. Hallam. Elsevier, Amsterdam, London, New York, pages 47-58.

Bergström, S.M., Riva, J. and Kay, M.
1974: Significance of conodonts, graptolites, and shelly faunas from the Ordovician of western and north-central Newfoundland. Canadian Journal of Earth Sciences, Volume 11, pages 1625-1600.

Blackwood, R.F.
1978: Northeastern Gander Zone, Newfoundland. *In* Report of Activities for 1977. Newfoundland Department of Mines and Energy, Mineral Development Division, Report 78-1, pages 72-79.

Boyce, W.D.
1987: Cambrian-Ordovician trilobite biostratigraphy in central Newfoundland. *In* Current Research. Newfoundland Department of Mines and Energy, Mineral Development Division, Report 87-1, pages 335-341.

Bruton, D.L. and Harper, D.A.T
1985: Early Ordovician (Arenig–Llanvirn) faunas from oceanic islands in the Appalachian–Caledonide orogen. *In* The Caledonide Orogen–Scandinavia and related areas. *Edited by* D.G. Gee and B.A. Sturt. John Wiley and Sons Limited, pages 359-368.

Colman-Sadd, S.P. and Swinden, H.S.
1984: A tectonic window in Newfoundland? Geological evidence that the Appalachian Dunnage Zone may be allochthonous. Canadian Journal of Earth Sciences, Volume 21, pages 1349-1367.

Dean, P.L.
1978: The volcanic stratigraphy and metallogeny of Notre Dame Bay, Newfoundland. Memorial University of Newfoundland, Geology Report 7, 205 pages.

Dean, W.T.
1971: Ordovician trilobites from the Central Volcanic Mobile Belt at New World Island, northeastern Newfoundland. Geological Survey of Canada, Bulletin 210, 37 pages.

1973: Lower Ordovician trilobites from the Summerford Group at Virgin Arm, New World Island, northeastern Newfoundland. Geological Survey of Canada, Bulletin 240, 43 pages.

Horne, G.S.
1970: Complex volcanic-sedimentary patterns in the Magog belt of northeastern Newfoundland. Geological Society of America Bulletin, Volume 81, pages 1767-1788.

Jenness, S.E.
1958: Geology of the Gander River ultrabasic belt, Newfoundland. Geological Survey of Newfoundland, Report 11, 58 pages.

1963: Terra Nova and Bonavista map-areas, Newfoundland. Geological Survey of Canada, Memoir 327, 184 pages.

McKerrow, W.S. and Cocks, L.R.M.
1977: The location of the Iapetus Ocean suture in Newfoundland. Canadian Journal of Earth Sciences, Volume 14, pages 488-495.

1978: A lower Paleozoic trench-fill sequence, New World Island, Newfoundland. Geological Society of America Bulletin, Volume 89, pages 1121-1132.

1980: Conodonts from the Davidsville Group, northeastern Newfoundland: Discussion. Canadian Journal of Earth Sciences, Volume 17, page 1599.

1981: Stratigraphy of eastern Bay of Exploits, Newfoundland. Canadian Journal of Earth Sciences, Volume 18, pages 751-764.

1986: Oceans, island arcs and olistostromes: the use of fossils in distinguishing sutures, terranes and environments around the Iapetus Ocean. Journal of the Geological Society of London, Volume 143, pages 185-191.

Neuman, R.B.
1976: Early Ordovician (late Arenig) brachiopods from Virgin Arm, New World Island, Newfoundland. Geological Survey of Canada, Bulletin 261, pages 11-61.

1984: Geology and paleobiology of islands in the Ordovician Iapetus Ocean: review and implications. Geological Society of America Bulletin, Volume 95, pages 1188-1201.

O'Neill, P.
1987: Geology of the west half of the Weir's Pond (2E/1) map area. *In* Current Research. Newfoundland Department of Mines and Energy, Mineral Development Division, Report 87-1, pages 271-281.

Ross, R.J., Jr., Adler, F.J., Amsden, T.W., Bergström, D., Bergström, S.M., Carter, C., Churkin, M., Cressman, E.A., Derby, J.R., Dutro, J.T. Jr., Ethington, R.L., Finney, S.C., Fisher, D.W., Fisher, J.H., Harris, A.G., Hintze, L.F., Ketner, K.B., Kolata, D.L., Landing, E., Neuman, R.B., Sweet, W.C., Pojeta, J. Jr., Potter, A.W., Rader, E.K., Repetski, J.E., Shaver, R.H., Thompson, T.L. and Webers, G.F.
1982: The Ordovician System in the United States—correlation chart and explanatory notes. International Union of Geological Sciences, Publication Number 12, 73 pages.

Shaw, F.C.
1968: Early Middle Ordovician trilobites of New York. New York State Museum and Science Services, Memoir 17, 163 pages.

Shaw, F.C. and Fortey, R.A.
1977: Middle Ordovician facies and faunas in N America. Geological Magazine, Volume 114, pages 409-443.

Stouge, S.
1979: Conodonts from Davidsville Group of the Botwood Zone, Newfoundland. *In* Report of Activities for 1978. Newfoundland Department of Mines and Energy, Mineral Development Division, Report 79-1, pages 43-44.

1980a: Lower and Middle Ordovician conodonts from central Newfoundland and their correlatives in western Newfoundland. *In* Current Research. Newfoundland Department of Mines and Energy, Mineral Development Division, Report 80-1, pages 134-142.

1980b: Conodonts from the Davidsville Group, northeastern Newfoundland. Canadian Journal of Earth Sciences, Volume 17, pages 268-272.

1980c: Conodonts from the Davidsville Group, northeastern Newfoundland: Reply. Canadian Journal of Earth Sciences, Volume 17, pages 1600-1601.

Strong, D.F. and Kean, B.R.
1972: New fossil localities in the Lush's Bight Terrane of central Newfoundland. Canadian Journal of Earth Sciences, Volume 9, pages 1572-1576.

Taylor, M.E.
1976: Indigenous and redeposited trilobites from Late Cambrian basinal environments of central Nevada. Journal of Paleontology, Volume 50, pages 668-700.

1977: Late Cambrian of western North America: trilobite biofacies, environmental significance and biostratigraphic implications. *In* Concepts and Methods of Biostratigraphy. *Edited by* E.G. Kauffman and J.E. Hazel. Dowden, Hutchinson and Ross Incorporated, Stroudsburg, pages 397-425.

Williams, A.
1973: Distribution of brachiopod assemblages in relation to Ordovician palaeogeography. *In* Organisms and Continents through Time. *Edited by* N.F. Hughes. Special Papers in Palaeontology, Number 12, pages 241-269.

Williams, H.
1972: Stratigraphy of Botwood map area, northeastern Newfoundland. Geological Survey of Canada, Open File 113, 103 pages.

Wonderley, P.F. and Neuman, R.B.
1984: The Indian Bay Formation: Fossiliferous Early Ordovician volcanigenic rocks in the northern Gander Terrane, Newfoundland, and their regional significance. Canadian Journal of Earth Sciences, Volume 21, pages 525-532.