The Canadian Field-Naturalist

Vol. 66 OTTAWA, CANADA, SEPTEMBER-OCTOBER, 1952 No. 5

ORDOVICIAN FOSSILS FROM WASWANIPI LAKE, QUEBEC [1,2]

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DURING THE SUMMER of 1949 the junior author, while mapping the areal geology of Waswanipi Lake Area (east half) for the Department of Mines of Quebec (1, p. 5), collected fossils from three exposures of horizontally bedded limestone on the shores of the lake and from boulders distributed across the intervening terrain. Though boulders of Ordovician limestone have been reported from this area, the first outcrop was not found until 1948. The distribution of boulders suggests that limestone is fairly widespread in this district, possibly underlying an area about the south-central part of the lake some 40 square miles in extent.

The collection consists of seven lots of medium grey crystalline limestone, which weathers light grey and contains patches of buff dolomite. Some argillaceous material occurs scattered along bedding planes, allowing the rock to break easily, and exposes these as thin dark shaly films. Otherwise bedding is rarely apparent. There is no reason to suppose that the exposures and boulders from which the collection was taken represent more than one formation.

Identifiable species of fossils are none too plentiful in the collection. Nevertheless, the following list provides enough information for a sure correlation of the limestone.

Receptaculites oweni Hall
Halysites gracilis Hall
Streptelasma corniculum Hall
  or *S. rusticum* Billings
Plasmopora lambi Schuchert
Pleurocystis sp.
Heterocrinus? sp.
Rafinesquina alternata (Emmons)
R. sp., cf. *R. trentonensis* (Conrad)
Strophomena incurvata (Shepard)
Platystrophia sp.,
  cf. *P. extense* McEwan
Dalmanella sp.
Hormotoma major (Hall)
Liospira angustata Ulrich & Schofield
Lophospira augustina (Billings)
Maclurites crassus (Ulrich & Schofield)
Maclurina manitobensis (Whiteaves)
M. cuneata (Whitfield)
Triptoceras sp.
Actinoceras sp.
Lambeoceras sp.

Though at first sight this fauna seems to be of Trenton age, very few of its species occur in the Trenton beds of the Ottawa—St. Lawrence lowland area. Instead, one finds in the Liskeard formation of Lake Timiskaming (200 miles southwest of Lake Waswanipi, see map) a fauna almost completely embracing that of the present report. Hume (5, p. 24) gave a list of 37 species for the upper Liskeard limestone, and with few exceptions the Waswanipi species occur in this list. Unless further collecting should show sedimentary types differing lithologically from the beds described by Hume, or other important relevant information, it seems best to refer the Waswanipi beds to the upper limestone horizon of the Liskeard formation.

Hume determined the Liskeard limestone to be of Trenton age largely because of the similarity of its fauna with that of the Galena limestone of Minnesota. Since Hume's work doubt has been expressed as to the Trenton age of the Galena limestone beds (9, p. 18; 4, p. 146) and, although it now appears (7, p. 82) that the Galena is to be correlated with the Trenton, parts of its fauna recur in the Arctic Richmond.

Nelson (6, p. 130), as part of a thorough discussion of the correlation of the Richmondian rocks of Central Canada, concludes that "The Waswanipi fauna appears to be very close to that of the Red River formation of the Lake Winnipeg area . . . " The Nelson River and Shamattawa limestones of Hudson Bay, (600 miles northwest of Lake Waswanipi), the Red River and Stony Mountain limestones of Manitoba (750 miles west of Waswanipi lake), and the Liskeard limestone of Lake Timiskaming are now all dated

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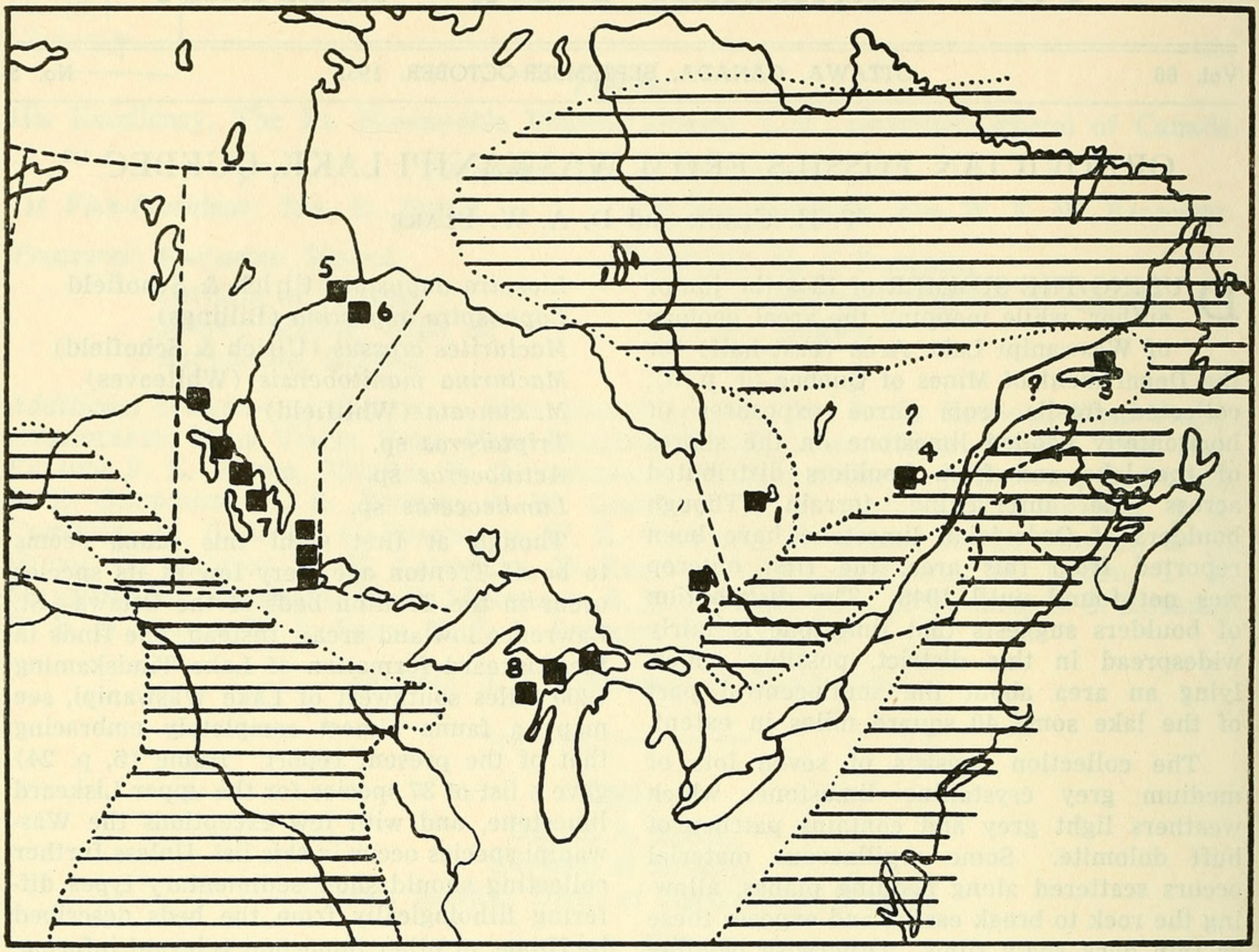
1 Published with the permission of the Department of Mines of Quebec.
2 Received for publication April 24, 1952.

Vol. 66, No. 4, July-August, 1952, was issued December 11, 1952.



Paleogeographic map of part of North America during Richmond time showing the locations of the exposures mentioned in the text, and the suggested distribution of land (ruled) and sea (plain). 1. Waswanipi Lake. 2. Lake Timiskaming. 3. Anticosti Island. 4. Lake St. John. 5. Nelson River. 6. Shamattawa River. 7. Lake Winnipeg. 8 Galena limestone.

as Richmond (2, p. 186; 6). This means that the Waswanipi Lake exposures carry the area of outcrop of this western (Arctic) type of Richmond 150 miles further east than has hitherto been recognized, and as a consequence a correction in the standard paleogeographic maps of North America for Richmondian time should be made. It is customary (e.g. 3, p. 154) to show a land area from James Bay extending southwestwards across the International Border. The assumption of such a land barrier is rendered untenable by the reasonable lithologic and faunal correlation of the Richmond limestone from Lake Winnipeg, Nelson River, Lake Timiskaming and Waswanipi Lake. Few faunal and fewer lithological characteristics of the Richmondian beds of southern Quebec and of the Lake St. John outlier recommend them as correlatives of the Liskeard Richmond beds of Waswanipi Lake or of Lake Timiskaming. However, further research may still extend the Liskeard sea eastward possibly as far as Anticosti, a prediction made by Twenhofel (8, p. 67) as a result of his finding so great a faunal, though not lithologic, similarity between the Vaureal formation of Anticosti and the Stony Mountain beds of the Lake Winnipeg area. Such an extension would indicate a land barrier between the Liskeard sea and the St. Lawrence-Cincinnati sea. These paleogeographic speculations are indicated on the accompanying map. The Lake St. John outlier is shown to be north of this barrier, though it may have lain to the south of it because its fauna is more closely related to that of the St. Lawrence lowland than to either the Arctic or the Anticosti faunas. The Gaspé embayment is not shown.

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ON THE CYCLIC ABUNDANCE OF ANIMAL POPULATIONS[1]

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A CRITICAL EXAMINATION of cyclic abundance in animal populations reveals the fact that all such are not basically similar. In the cases of such animals as the varying hare, *Lepus americanus;* the field mouse, *Microtus montanus canescens;* the ruffed grouse, *Bonasa umbellus umbelloides,* and many others, the populations over periods of years vary regularly from relatively few to very large numbers of individuals. Each peak of abundance is followed by an interval in which there is a rather sudden decrease in numbers and this in turn by a lengthy period of increase, slow at first but accelerating with the years. Each growth period of the population should be capable of being illustrated by a sigmoid curve which is characteristic of population growths in general (Pearl and Reed, 1920). Each decline of the population should be represented by a line of steep slope. The period of years from peak to peak or from depression to depression is remarkably constant and constitutes the cycle. For the varying hare the period is approximately 9.7 years; for the mouse 4 years; for the ruffed grouse 10 years.

With these animals there may be one or more litters or broods per year and the individuals may live several years with the result that there is a mixed population through the interbreeding among the individuals of the various litters and broods. The whole population follows a cycle of growth and decline as outlined.

On the other hand consideration of the cycles in abundance of certain fishes, insects and other animals shows that it is not mixed populations that are involved but pure year-classes. One of the best examples is that of the pink salmon, *Oncorhynchus gorbuscha.* This species of Pacific salmon has a two-year life-history, that is, the individuals mature invariably at two years of age, spawn and die. In view of this invariability of maturing and dying there can be no mixed population. In some regions of British Columbia no pink salmon appear in the alternate years. In other regions pink salmon do appear in the even as well as in the odd numbered years, but the two populations must be as distinct as though they spawned in widely separated streams.

The data available on the pink salmon run to McClinton creek, Queen Charlotte islands, as published by Pritchard (1948) may be used to illustrate the year-class cycle.

As stated previously the pink salmon spawns without exception at two years of age and all individuals die. The next generation is represented first by a relatively large number of eggs deposited in the gravel of the streams, six months later by fry proceeding to sea reduced to approximately 14 per cent of the number of eggs and 18 months later by adult fish reduced by natural and fishing mortalities to approximately one per cent of the fry which went to sea. Figure 1 illustrates these features. It will be seen

[1] Received for publication December 29, 1951.