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THE TARDY, TASTY AND CHILLY THERMOPHILES OF THE CHAMPLAIN SEA*

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INTRODUCTION

Wagner (1970) reports five thermophilous molluscs in her collections from the late Pleistocene Champlain Sea of Ontario and Québec. Otherwise, this sea was dominated by boreal and boreal-arctic faunas. The presence of these thermophiles in proglacial sediments is surprising. None of them have been previously radiocarbon dated, and therefore, they are mostly ignored in discussions of the paleoenvironments of the Champlain Sea. Unless they all represent cultural contamination, or are misidentified, their presence, if authenticated by ^{14}C dating, would substantially alter interpretations of marine paleoenvironments in the Champlain Sea and Gulf of St. Lawrence to Gulf of Maine region. These thermophiles belong today to the Virginian faunistic zone, which is the zone warmed by the Gulf Stream, and the oyster (*Crassostrea virginica*), in particular, requires minimum summer sea surface temperatures of 20 °C for reproduction.

Some Virginian taxa, including the oyster, now form a disjunct population in the southwestern Gulf of St. Lawrence. This group is separated from the main range of the Virginian molluscs by a 1300 km wide cold-water gap centred on the Gulf of Maine. The Virginians evidently extended their range into the Gulf of St. Lawrence sometime during the late Pleistocene to Early Holocene. They became separated from the main range as submergence of the continental shelf off New England allowed development of the high tidal ranges of the region today and therefore destruction of the summer thermal stratification of the upper water column (Bousfield and Thomas, 1975; Dyke *et al.*, 1996). Existing chronological data would place the initial incursion of the Virginian molluscs in the Gulf of St. Lawrence at 7000-8000 years ago. If Wagner's oysters and other thermophiles are authentic fossils, however, and not from the back door of a diner, the initial incursion necessarily occurred 10 000-11 500 years ago. This would be a very significant revision, with implications for other aspects of late Pleistocene paleogeography, including the Gulf Stream position and temperature of the periglacial zone. Accordingly, we attempted to find the critical fossils, confirm identifications if necessary, and obtain radiocarbon dates. There follows a list of earlier reports, some reidentifications of shells, and two AMS age determinations.

PREVIOUS REPORTS

Sir J.W. Dawson (1893), in his book, *The Canadian Ice Age*, records nearly 80 Pleistocene fossils from southeastern Canada. Among these are reports of the following animals thought to be Virginian or low boreal in modern distribution (Abbott, 1974):

> p. 241: *Yoldia limatula* Say: Leda clay at Rivière-du-Loup. It now ranges from Gulf of St. Lawrence to Long Island, New York. "The specimens are as good as any now living in the Gulf. Although they have the number of teeth of *Yoldia limatula*, they approach in form the allied species *Y. sapotilla*." The latter ranges from Arctic seas to North Carolina.
>
> p. 243: *Ostrea virginiana* Gmelin: "I have picked up a loose specimen at Saco [Maine?] which has the appearance of being a fossil specimen from the Leda clay and Mr. Paisley has sent me specimens from the Bay des Chaleurs, which are said to have come from Pleistocene beds 16 feet from the surface."
>
> p. 243: *Haminoea solitaria* Say: Montréal, rather common. It now ranges from southwestern Gulf of St. Lawrence to Georgia.

Edward Ardley (1912, p. 67) of the Redpath Museum of McGill University mentioned two collections of oysters from the Champlain Sea besides that listed by Dawson. He noted that "The late Mr. E. T. Chalmers, some years ago, presented to the Peter Redpath Museum of McGill University, a specimen of *Ostrea* which he had collected at Beauport, Québec and which he believed had been derived from the Pleistocene of that locality." Ardley, himself "... collected Pleistocene fossils from the Leda clay and Saxicava sand, exposed in an excavation made for a drain in the town of DeLormier, near Montréal, found at a depth of 9 feet below the surface... specimens of *Ostrea* were associated with *Mya truncata*, *Macoma calcarea*, *Astarte laurentiana*, and *Saxicava rugosa*." The latter is an archaic term for *Hiatella arctica*.

Wagner (1970), recorded from the Champlain Sea the following species of molluscs that now have a Virginian range:

> *Neptunea despecta tornata* occurs at Wagner's localities 145, 159, 205, 223, and 229, including GSC hypotype specimen 20140 from Grande Rivière du Chêne, Québec. It ranges north to Gulf St. Lawrence today, south to Cape Cod.
>
> *Crassostrea virginica* occurs at Wagner's localities 134 and 145. Geological Survey of Canada (GSC) hypotype 20150, found at Montréal at 171 feet. It now ranges north to Baie des Chaleurs, Gulf of St. Lawrence. Wagner (1970, p. 38) remarked: "The actual

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presence of *C. virginica* as a fossil in the Champlain Sea is open to some doubt. Some occurrences observed have been of shells on or near the surface of the ground, which undoubtedly date from modern times. This is probably the case with the specimen from locality 134; it was found in the soil layer. The *Crassostrea* collected from locality 145 (not collected by the writer) unfortunately was not accompanied by stratigraphic data." Locality 145 was collected by V.K. Prest (see below). The same collection also contained *Neptunea despecta tornata*, identified by Wagner.

Mysella planulata occurs at Wagner's locality 225 and is GSC hypotype 20155 from Ancienne Lorette, Québec, 197 feet asl. Today it ranges from Prince Edward Island to Texas in shallow water attached to wharf pilings and eel grass.

Lyonsia hyalina occurs in Wagner's locality 223; GSC hypotype 20166, east bank of Grande Rivière du Chêne, Québec, 330 feet asl. Today it ranges from Texas to southwestern Gulf of St. Lawrence.

Haminoea solitaria occurs at Wagner's locality 77; GSC hypotype 20141, Kenyon Township, Glengary County, Ontario, 295 feet asl. It ranges from Georgia to Gulf of St. Lawrence.

Yoldia limatula occurs at Wagner's localities 206 and 220. It ranges from New Jersey to Gulf of St. Lawrence.

Prest and Hode-Keyser (1977, p. 20) stated "The common oyster, *Crassostrea virginica*, a very rare species in the Champlain Sea, was found in place at only two sites, both on the northwest side of Mont Royal: one at elevation 310 feet (93 m) on Côte-Sainte-Catherine Road west of Decelles Avenue, and the other (in clay) at elevation 171 feet (51.3 m) on Westbury Avenue near Mackenzie Street." The latter is the specimen from Wagner's locality 145.

In response to Wagner's comment about the lack of stratigraphic data regarding the oyster collected at site 145, Prest appended a handwritten note to his copy of Wagner's publication. This note describes the following stratigraphic sequence, which was exposed in an excavation for a building: 0-1 foot — very black soil, slightly sandy; 1-2 feet - grey "B" [soil] zone, calcareous sand; 2-3 feet — clayey sand; 3-3.5 feet — clay with shells; real coquina in places; both grey and red clay bands; 90-95 % of the shells are *Macoma*; also *Mytilus*, *Saxicava rugosa* [= *Hiatella arctica*] and barnacles. Wagner listed the *Macoma* as *M. balthica* and the following additional shells at this site: *Neptunea despecta tornata* (see above), *Portlandia arctica, Mya arenaria, Mya truncata*.

NEW IDENTIFICATIONS AND RADIOCARBON DATES

We attempted to find the specimens of thermophilous molluscs listed above in collections of the Redpath Museum and the Geological Survey of Canada. Unfortunately, the collections of Mr. Paisley from Baie des Chaleurs and of Mr. Ardley from DeLormier, both evidently collected well below the surface, were not found. However, we obtained the following specimens and new identifications, where noted, by Dr. André Martel, a malacologist at the Canadian Museum of Nature (unpublished report to GSC dated 96-02-15):

1. A large shell fragment identified by Wagner as *Yoldia limatula* (GSC locality 27310) included the hinge area and dentition. This shell was identified by Martel as *Yoldia hyperborea hyperborea*, based on the characters found on the condrophore and the muscle insertion scar. This animal has an arctic-subarctic distribution, ranging south to Newfoundland today. The specimen was returned undated to the GSC collection. Note that Dawson (above) left open the possibility that the *Yoldia limatula* identified by him was actually an arctic-subarctic species.

2. Redpath Museum collection 6638 contained shells listed as *Yoldia limatula*, enclosed in hardened clay from Rivière-du-Loup, possibly Dawson's sample. We soaked the bulk sample in water to soften the clay and remove the shells to verify their identifications. These were identified by Martel as *Y. hyperborea hyperborea* based on the condrophore and muscle scar characteristics. The clay also contained *Nuculana pernula* (Arctic to Cape Cod), *Nucula tenuis* (Labrador and Greenland to Florida), and *Portlandia arctica*.

3. An unnumbered sample from Redpath museum collected at Mile End Quarries, Montréal, contained shells of *Neptunea despecta*. These were identified by Martel as *N. despecta despecta*, which ranges from Greenland to Maine.

4. The oyster from Wagner's site 145 is represented by a single whole valve housed in the GSC Paleontology Type Collection as hypotype 20150, the type of Champlain Sea oysters. We were permitted to cut a 267 mg piece from the ventral margin of this shell. Its age was determined by AMS dating to be 520 ± 50 years (TO-5626, normalized to $\delta^{13}C_{PDB}$ = -25 ‰). Clearly this is not an authentic member of the Champlain Sea fauna. Reasonably, it was introduced to the marine sediment from which Prest collected it by the excavation activity then in progress. If we apply the conventional marine reservoir correction of 400 years, then this oyster was harvested and brought to Montréal, in all likelihood to be used as food, about 120 years before Prest's 1952 AD collection. The original place and year of collection (harvest) and local marine reservoir age are thus unknown. Therefore, the age determination merely provides an upper limit on a reservoir age and the shell could have arrived in Montréal any time during the century or so before AD 1952. However, if we assume that the shell was discarded just before excavation and that the oysters came from the nearest commercial supplies in the western Gulf of St. Lawrence, which is reasonable given 1950s transportation facilities, the apparent age of the shell at time of its harvesting (say 1950) was 520 years minus the correction for industrial carbon buildup to that date (given as 80 years by Mangerud and Gulliksen, 1975). This amounts to 440 years and is a reasonable result.

5. The oyster shell collected by E.T. Chalmers from Beauport, Québec some years before 1912 AD is Redpath Museum specimen RM-2.1802. We removed a 392 mg piece from the ventral edge and its age was determined to be 780 ± 50 years (TO-5702, normalized to $\delta^{13}C_{PDB}$ = - 25 ‰). Again this specimen clearly was not derived from the Champlain Sea sediments, although it appeared to have been to the collector. If this oyster was harvested

in 1910 AD, the latest possible date according to the description, the industrial carbon effect was then about 15 years in the upper ocean (Mangerud and Gulliksen, 1975). Assuming this date, it was taken from water with a reservoir age of 725 years (780-(1950-1910)-15). However, because the oyster could have been harvested many years earlier, this is a maximum estimate of the reservoir age at the harvesting site, likely somewhere in the western Gulf of St. Lawrence.

CONCLUSION

We attempted to test the authenticity of the rare finds of warm-water mollusc shells from the Champlain Sea by reidentification and by radiocarbon dating of material in two paleontological collections. Although not all specimens were found, shells previously identified as *Yoldia limatula* (warm) are instead *Y. hyperborea hyperborea* (cold), and at least some *Neptunea despecta* shells are assignable to the subspecies *despecta* (cold) rather than *tornata* (warm). Two oyster shells thought to have come from Pleistocene beds date instead from the historic period. They probably represent oysters brought in as food. Although we have not tested all reported occurrences of Virginian taxa from Champlain Sea sediments, these reports should be treated cautiously until they are confirmed by both identification and age determinations.

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