Reports

Paleogene Terrestrial Vertebrates: Northernmost Occurrence, Ellesmere Island, Canada

Abstract. *Recently discovered Paleogene land vertebrates from the Eureka Sound Formation at about latitude 78° north in Arctic Canada include fish, turtles, an alligatorid, and several taxa of mammals. The assemblage, which is probably early or middle Eocene in age, adds to previously known paleobotanical evidence in suggesting temperate to warm-temperate climatic conditions.*

During the summer of 1975 M.R.D. and R.M.W. discovered Paleogene terrestrial vertebrates on Ellesmere Island, the northeasternmost island of the Canadian Arctic Archipelago (Fig. 1). To the best of our knowledge, these are the first to be reported from within the Arctic Circle. The vertebrate assemblage includes several taxa of fish, one taxon of alligatorid, three taxa of turtles, and three of mammals. An Eocene age is probable for the assemblage.

Two major lines of evidence led to our northern fieldwork in Paleogene rocks. First, it has long been recognized that early Eocene (Sparnacian-Wasatchian) mammal faunas of western North America and western Europe show a remarkably high degree of similarity at the generic level—at least 50 percent, which is higher than at any other time during the Cenozoic. In the succeeding interval (Lutetian-Bridgerian) the generic similarity drops to about 10 percent and endemism increases. The second line of evidence comes from data supporting the plate tectonics theory, according to which there was a North Atlantic land connection between the northeastern Canadian Arctic, Greenland, and continental Europe, by way of either the DeGeer route (Svalbard, Norway, and the Barents Shelf) or the Thulean route (Iceland and the British Isles). This land route appears to have been broken by further plate motion around 45 to 48 million years ago, just after the time, around 49 million years ago, of the Sparnacian-Wasatchian mammalian similarity (*1*). Thus, fossils found somewhere along one of the postulated North Atlantic routes might show

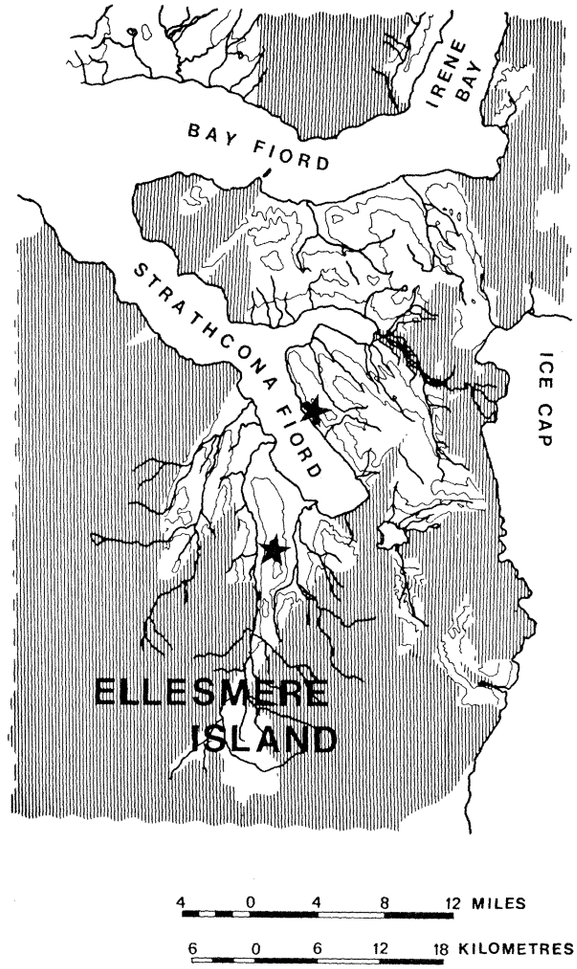

Fig. 1 (left). Location of Ellesmere Island with respect to Greenland and southern Canada. Fig. 2 (right). Strathcona Fiord region, Ellesmere Island. Stars indicate vertebrate fossil localities. Unshaded areas are Eureka Sound Formation exposures and shaded areas pre-Eureka Sound deposits.

whether this was indeed an area of faunal continuity between North America and Europe.

The presence of Late Cretaceous to Paleogene plant-bearing deposits, the Eureka Sound Formation, on various islands of the Canadian Arctic Archipelago (*2*) makes the eastern Canadian Arctic a logical place to search for vertebrate fossils that might provide evidence for North American–European land connections. These rocks are especially well exposed on Ellesmere and Axel Heiberg islands, and occur in more scattered exposures on Devon, Cornwallis, Somerset, Banks, Ellef Ringnes, Melville, and Lougheed islands. The Eureka Sound Formation is a thick sequence of sandstones, mudstones, shales, and limestones with some interbedded conglomeratic channel deposits. Both fluviatile and marine deposits occur in the formation. Fossil plant remains are one of the outstanding features of the unit. In addition, both terrestrial and marine fossil invertebrates have been found at numerous localities, but before the 1975 field season the only fossil vertebrates from the Eureka Sound Formation were marine fish, probably Eocene in age, represented by otoliths, calcareous inclusions of the otic region (*3*).

In 1975 fossil bone was found at 16 localities in a banded gray and brown mudstone sequence exposed near the head of Strathcona Fiord, Ellesmere Island (Fig. 2), at about latitude 78°N. Most of the bone was found as surface accumulation, but much of it seems to be derived from dense ironstone concretions. Fragments of concretions containing bone as well as impressions were collected. Similar concretions within the Eureka Sound Formation have also produced unionid pelecypods and gastropods. The bone-producing mudstones appear to be part of a shoreline depositional sequence, the base of which is a fine-grained, buff to white, poorly consolidated sandstone containing marine invertebrates. The sandstone is overlain by a highly carbonaceous unit, coaly in places, which is in turn overlain by the dark mudstones and shales of the bone-producing unit. This is followed by more coals and sandstones. Lateral facies changes occur within these units.

The nonmarine Eureka Sound Formation vertebrate fauna appears to be derived from a lagoonal or swampy habitat. At least two kinds of fish are present. Reptiles make up the best-represented part of the fauna. The alligatorid *Allognathosuchus* is the most abundant single taxon. The specimens show some similarity to *A. haupti*, from the European middle Eocene, and to *A. wartheni* from the early Eocene in North America, but appear distinct from other known European or North American species. The genus is known to range from the Paleocene to early Oligocene in North America. At least three turtles are present: the soft-shelled turtle *Trionyx*, a genus having a Cretaceous to Recent range; a testudinid cf. *Manouria* (=*Hadrianus*), a tortoise known from the Eocene of both Europe and North America; and at least one indeterminate form, probably referable to the Baenidae.

Three mammalian genera can be differentiated, but precise identification is not possible on the basis of known fragmentary material. The best specimen, found in a freshly broken concretion, consists of numerous postcranial bones, several upper cheek teeth with the occlusal surfaces shattered, and one almost complete upper third premolar, which is characterized by a bulbous outline and a broad posterior shelf. It is similar to that premolar in the Early Eocene European equid *Propachynolophus gaudryi*, and also resembles that in *Lambdotherium popoagicum* from the North American late early Eocene.

The other mammalian specimen includes a partial upper molar with an elongate protocone region. This is similar in proportions to molars of *Plagiolophus cartieri*, a paleothere from the European middle Eocene. An upper third premolar with a shattered crown, found at the same locality as the molar fragment, may represent the same taxon.

The third mammal is represented by a dentary fragment with all teeth broken off. Its small size distinguishes it from the other Eureka Sound Formation mammals.

This vertebrate fauna, though numerically small, strongly suggests an Eocene age. The reptiles are almost certainly Eocene, while the mammals are closest to early and middle Eocene taxa. This assignment correlates well with the likely Eocene age of the otoliths found in marine beds of the same depositional sequence (*3*).

The Eureka Sound Formation assemblage is the northernmost Paleogene terrestrial vertebrate assemblage known. A number of Paleogene terrestrial vertebrate localities cluster around latitude 50°N (southern British Columbia, Alberta, Saskatchewan; London basin; and Paris basin), but exploration for terrestrial vertebrates at high latitudes in Alaska and Svalbard has been fruitless (*4*). An amiid fish of possible Eocene age has been reported from Svalbard (*5*). Other high-latitude Paleogene areas (northern Rocky Mountains and northern Greenland) are as yet nearly unexplored by vertebrate paleontologists.

Perhaps the main conclusion to be reached from the terrestrial vertebrates now known from the Eureka Sound Formation is that the far north was occupied during the Paleogene by vertebrates with at least warm-temperate climatic requirements. Plant fossils, both leaves and pollen, had previously indicated a temperate climate for the northeastern Canadian Arctic during part of the time of deposition of the Eureka Sound Formation, as have microfossils (phytoplankton) from the floor of the Arctic Ocean (*6*). Farther south, about at latitude 70°N, on Greenland and Baffin Island, warm-temperate floras of Paleogene age have been reported (*7*). Thus, although terrestrial vertebrates now known do not show decisively whether American, European, or mixed affinities prevail in the fauna, they do suggest that conditions favorable to a continuous European–North American terrestrial fauna were present during part of the Paleogene in the far north.

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