Article

"Vertebrates of the Last Interglaciation in Canada: A Review, with New Data"

C. Richard Harington

Géographie physique et Quaternaire, vol. 44, n° 3, 1990, p. 375-387.

Géographie physique et Quaternaire, 1990, vol. 44, n° 3, p. 375-387, 8 fig., 1 tabl.

VERTEBRATES OF THE LAST INTERGLACIATION IN CANADA: A REVIEW, WITH NEW DATA

C. Richard HARINGTON, Paleobiology Division, National Museum of Natural Sciences, Ottawa, Ontario K1P 6P4.

ABSTRACT Vertebrate fossils and faunas that are reasonably inferred to be of last (Sangamonian) interglacial age are considered in geographic order from east to west to north in Canada. Data on localities, vertebrate taxa, stratigraphy, geochronology, paleoenvironment and paleoclimate are considered. Information on key faunas from Toronto, Fort Qu'Appelle, Saskatoon, Medicine Hat and Old Crow River is supplemented by data on smaller faunas and, in some cases, individual specimens. New data are included for several localities. Fishes, such as whitefish (*Coregonus* sp.) and pike (*Esox* sp.), had broad distributions from eastern to northwestern Canada. Except for a turtle (*Emydoidea blandingi*) from Innerkip, Ontario, amphibians and reptiles have not yet been reported from Canada during the Sangamon Interglaciation. Several species of grouse-like birds (Tetraonidae) are known from western Canada. Among the mammals, American mastodons (*Mammut americanum*), mammoths (*Mammuthus* sp.), beavers (*Castor canadensis*), giant beavers (*Castoroides ohioensis*), muskrats (*Ondatra zibethicus*), voles (*Microtus* sp.), white-tailed deer (*Odocoileus virginianus*), stag moose (*Cervalces* sp.), bison [perhaps mainly giant bison (*Bison latifrons*)] and muskoxen (Ovibovini) were evidently most widespread during the last interglacial interval. The western plains had a characteristic large mammal fauna that included Columbian mammoths (*Mammuthus columbi*), Scott's horses (*Equus scotti*), small horses (*Equus conversidens*), western camels (*Camelops hesternus*), pronghorns (Antilocapridae), giant bison (*Bison latifrons*) and helmeted muskoxen (*Symbos cavifrons*).

RÉSUMÉ *Vertébrés du dernier interglaciaire au Canada: revue et nouvelles données.* Les fossiles et les faunes de vertébrés du Canada que l'on peut vraisemblablement attribuer au dernier interglaciaire (Sangamonien) sont passés en revue d'est en ouest, du sud au nord. On tient compte des données sur les sites, les taxons, la stratigraphie, la géochronologie, les paléo-environnements et les paléoclimats. Les renseignements sur les faunes clés de Toronto, Fort Qu'Appelle, Saskatoon, Medicine Hat et Old Crow River sont complétés par des données sur des faunes plus réduites et, dans certains cas, sur des spécimens. Les nouvelles données concernent plusieurs sites. Les poissons, comme le *Coregonus* sp. et l'*Esox* sp. sont largement répartis de l'est vers le nord-ouest du Canada. Sauf pour la tortue *Emydoidea blandingi* d'Innerkip, en Ontario, on n'a pas encore rapporté l'existence d'amphibiens ou de reptiles pendant l'Interglaciaire du Sangamonien. Plusieurs espèces de Tétraonidées ont été rapportées dans l'ouest du Canada. Parmi les mammifères, le *Mammut americanum*, le *Mammuthus* sp., le *Castor canadensis*, le *Castoroides ohioensis*, l'*Ondatra zibethicus*, le *Microtus* sp., l'*Odocoileus virginianus*, le *Cervalces* sp., le *Bison latifons* et l'Ovibovini étaient de toute évidence les plus répandus au cours du dernier interglaciaire. Les plaines de l'Ouest étaient habitées par une faune de grands mammifères qui comprenaient le *Mammuthus columbi*, l'*Equus scotti*, l'*Equus conversidens*, le *Camelops hesternus*, des Antilocapridées, le *Bison latifrons* et le *Symbos cavifrons*.

ZUSAMMENFASSUNG *Wirbeltiere der letzten Interglazialzeit in Kanada: Eine Übersicht mit neuen Daten.* Fossile und Faunas von Wirbeltieren, die man mit ziemlicher Sicherheit der letzten (sangamonischen) Interglazialzeit zuschreibt, werden in geographischer Ordnung von Ost- nach West- und Nord-Kanada durchgegangen. Dabei werden Daten an den Plätzen, Wirbeltier — Taxa, Stratigraphie, Geochronologie, Paläoumwelt und Paläoklima berücksichtigt. Informationen über Schlüssel — Faunas von Toronto, Fort Qu'Appelle, Saskatoon, Medicine Hat und Old Crow River werden durch Daten über kleinere Faunas ergänzt und in manchen Fällen durch einzelne Exemplare. Für mehrere Plätze gibt es neue Daten. Fische wie z.B. *Coregonus* sp. und *Esox* sp. waren weit verbreitet von Ost— bis Nordwestkanada. Ausser einer Schildkröte *Emydoidea blandingi* von Innerkip, Ontario, wurden bis jetzt keine Amphibien und Reptile während der sangamonischen Interglazialzeit in Kanada festgestellt. Einige Arten von Tetraonidae sind aus Westkanada bekannt. Unter den Säugetieren waren *Mammut americanum, Mammuthus* sp., *Castor canadensis, Castoroides ohioensis, Ondatra zibethicus, Microtus* sp., *Odocoileus virginianus, Cervalces* sp., Bison (vielleicht vor allem *Bison latifrons*) und *Ovibovini* offensichtlich während des letzten interglazialen Intervalls am weitesten verbreitet. Die westlichen Ebenen besassen eine charakteristische breite Säugetier-Fauna, zu der *Mammuthus columbi, Equus scotti, Equus conversidens, Camelops hesternus, Antilocapridae, Bison latifrons* und *Symbos cavifrons* gehörten.

Manuscrit reçu le 25 avril 1989; manuscrit révisé accepté le 8 mai 1990

INTRODUCTION

When dealing with last interglacial faunas, it is difficult to be sure that the faunas are, in fact, of last interglacial age (warmest peak about 125,000 years BP), because radiocarbon-dating methods commonly used to discover the age of Late Pleistocene organic material do not reliably extend back that far in time. Even if a fauna can be recognized as of interglacial status (as warm as or warmer than the present), and data indicate it is older than Late or Middle Wisconsinan, it is difficult to be sure that it is not *pre*-Sangamonian (Sangamonian is used here as an alternative for "last interglaciation").

In this paper I mention vertebrate fossils and faunas that are reasonably inferred to be of Sangamonian age — considering the present state of our knowledge and geochronological techniques. Matthews (1988) gives an example of problems that can arise when he states that, until recently, the Worth Point Formation on Banks Island, Northwest Territories was considered to be of last interglacial age: it is now known to be preglacial and probably late Pliocene in age. Few pre-Rancholabrean faunas are recorded for Canada (*e.g.* Harington, 1978, Fig. 3), and those known to contain taxa characteristic of Blancan and Irvingtonian Land Mammal Ages (Kurtén and Anderson, 1980, Appendix 2) are excluded from consideration. With these caveats, last interglacial fossils and faunas from Canada are treated in geographical sequence by province and territory from east to west to north, with brief comments on: their locations (Fig. 1); vertebrate taxa reported; stratigraphic and geochronological data; paleoenvironmental and paleoclimatic inferences; and, where warranted, faunal comparisons (*e.g.* Table I).

New data are supplied on: (1) a beaver skeleton from East Milford, Nova Scotia; (2) fishes of the Don Formation at Toronto, Ontario, courtesy of S. L. Cumbaa; (3) a ground squirrel skeleton from Minnedosa, Manitoba; (4) a small pronghorn from Echo Lake Gravels at Fort Qu'Appelle, Saskatchewan; and (5) the paleoenvironment and age of the vertebrate fossil fauna from Old Crow River Locality 44, Yukon Territory, through identification of *in situ* logs, and Uranium-series dating trials on samples from them.

REGIONAL COVERAGE

NOVA SCOTIA

Lower Middle River

A right femur of an American mastodon (*Mammut americanum*) was ploughed up by a farmer about 1834 on Cape Breton Island (Dawson, 1868; Piers, 1912). It was found about 13 cm below the surface in sandy, meadow soil approximately 0.8 km west of Lower Middle River. The femur has yielded radiocarbon dates of 32,000 ± 630 years BP (GSC-1220; bone collagen date) and 31,300 ± 500 years BP (GSC-1220-2; bone apatite date) (Blake, 1984). Pollen analysis of organic detritus adhering to the bone yielded "... a rather large hardwood component compared to the modern boreal forest" (D. R. Grant *in* Blake, 1984). If that detritus is coeval with the bone, then there is no similarity to pollen assemblages of supposed Middle Wisconsinan deposits at Bay St. Lawrence and Castle Bay (de Vernal *et al.*, 1986). However, there is a strong affinity to several Sangamonian deposits in the region, and the mastodon femur is best assigned to the last interglaciation (Harington *et al.*, in preparation).

East Milford

Beaver-cut sticks and other unspecified mammal remains have been reported from a sinkhole in gypsum at East Milford

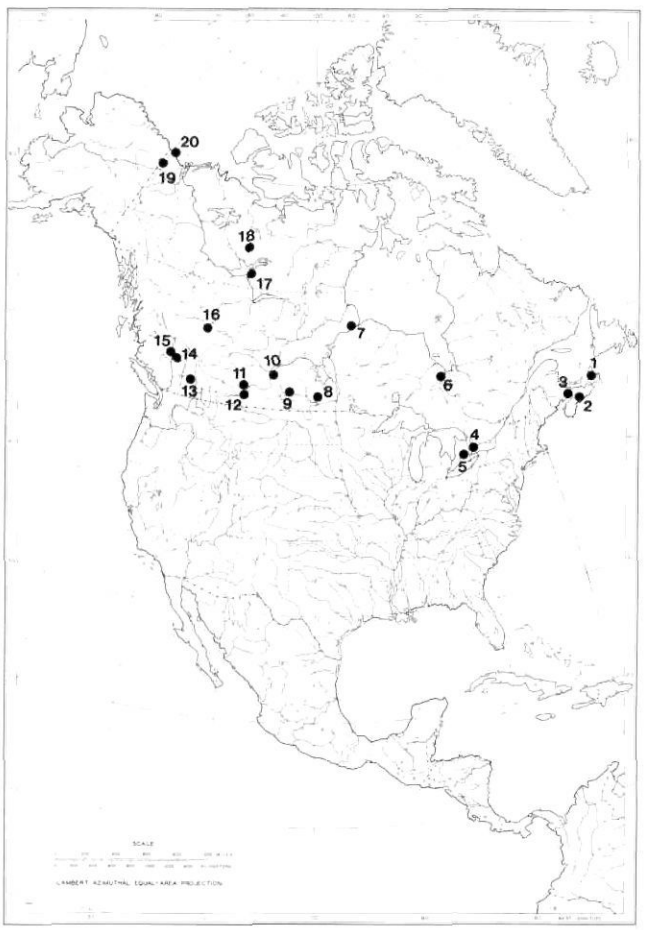

FIGURE 1. Fossil localities of last interglacial age that are mentioned in the text. Key: 1) Lower Middle River, Nova Scotia; 2) East Milford, Nova Scotia; 3) Hillsborough, New Brunswick; 4) Toronto, Ontario; 5) Innerkip, Ontario; 6) Moose River Crossing, Ontario; 7) Bird, Manitoba; 8) Minnedosa, Manitoba; 9) Fort Qu'Appelle, Saskatchewan; 10) Saskatoon, Saskatchewan; 11) Bindloss, Alberta; 12) Medicine Hat, Alberta; 13) Westwold, British Columbia; 14) Quesnel Forks, British Columbia; 15) Quesnel, British Columbia; 16) Watino, Alberta; 17) Rat River, NWT; 18) Lower Carp Lake NWT; 19) Old Crow River Locality 44, Yukon; 20) Herschel Island localities 2 and 5, Yukon.

Sites fossilifères du dernier interglaciaire mentionnés dans le texte: 1) Lower Middle River (Nouvelle-Écosse); 2) East Milford (Nouvelle-Écosse); 3) Hillsborough (Nouveau-Brunswick); 4) Toronto (Ontario); 5) Innerkip (Ontario); 6) Moose River Crossing (Ontario); 7) Bird (Manitoba); 8) Minnedosa (Manitoba); 9) Fort Qu'Appelle (Saskatchewan); 10) Saskatoon (Saskatchewan); 11) Bindloss (Alberta); 12) Medicine Hat (Alberta); 13) Westwold (Colombie-Britannique); 14) Quesnel Forks (Colombie-Britannique); 15) Quesnel (Colombie-Britannique); 16) Watino (Alberta); 17) Rat River (T.N.-O.); 18) Lower Carp Lake (T.N.-O.); 19) Old Crow River Locality 44 (Yukon); 20) sites 2 et 5 de Herschel Island (Yukon).

TABLE I

Comparison of last Interglacial vertebrate faunas from Fort Qu'Appelle and Saskatoon, Saskatchewan, Medicine Hat, Alberta, and Old Crow River Location 44, Yukon Territory

Vertebrate Taxa	SASKATCHEWAN Fort Qu'appelle	SASKATCHEWAN Saskatoon	ALBERTA Medicine Hat	YUKON Old Crow Loc. 44
Fishes	X	X	—	X
Whitefish (*Coregonus* sp.)	—	—	—	X
Broad whitefish (*Coregonus nasus*)	—	—	—	X
Inconnu (*Stenodus leucicthys*)	—	—	—	cf.
Arctic grayling (*Thymallus arcticus*)	—	—	—	X
Pike (*Esox* sp.)	X	—	—	X
Sucker (*Catostomus* sp.)	—	—	—	X
Burbot (*Lota lota*)	—	—	—	X
Birds	—	—	X	X
Ducks and geese (Anatidae)	—	—	—	X
Oldsquaw (*Clangula hyemalis*)	—	—	—	X
American Widgeon (*Anas americana*)	—	—	—	cf.
Goose (*Chen sp.*)	—	—	—	cf.
Ptarmigan and grouse (Tetraonidae)	—	—	—	X
Spruce Grouse (*Canachites* sp.)	—	—	X	—
Ruffed Grouse (*Bonasa umbellus*)	X	—	—	—
Shorebirds (*Charadriiformes*)	—	—	—	cf.
Perching birds (Passeriformes)	—	—	—	X
Hawk (*Buteo* sp.)	—	—	cf.	—
Mammals	X	X	X	X
Shrews (Soricidae)	—	—	—	X
**Ground sloth (*Megalonyx* sp.)	—	X	cf.	—
**Giant pika (*Ochotona whartoni*)	—	—	—	cf.
Pika (*Ochotona princeps*)	—	—	—	X
Hare or rabbit (Leporidae)	X	X	X	X
Eastern cottontail (*Sylvilagus floridanus*)	—	—	X	—
Hare (*Lepus* sp.)	—	X	X	X
Snowshoe hare (*Lepus americanus*)	—	cf.	—	X
Townsend hare (*Lepus* cf. *townsendii*)	—	—	X	—
Arctic hare (*Lepus arcticus*)	—	—	—	X
Rodent (Rodentia)	X	X	X	X
White-tailed prairie dog (*Cynomys leucurus*)	—	—	cf.	—
Black-tailed prairie dog (*Cynomys* cf. *ludovicianus*)	—	X	—	—
Arctic ground squirrel (*Spermophilus parryii*)	—	cf.	—	X
Richardson's ground squirrel (*Spermophilus richardsonii*)	—	X	X	—
Northern pocket gopher (*Thomomys talpoides*)	—	X	X	—
Beaver (*Castor canadensis*)	—	X	—	X
**Giant beaver (*Castoroides ohioensis*)	—	—	—	X
Collared lemming (*Dicrostonyx* sp.)	—	—	—	X
Brown lemming (*Lemmus sibiricus*)	—	—	—	X
Red-backed vole (*Clethrionomys rutilus*)	—	—	—	X
Gapper's red-backed vole (*Clethrionomys gapperi*)	—	X	—	—
Muskrat (*Ondatra zibethicus*)	—	X	X	X
Heather vole (*Phenacomys intermedius*)	—	X	—	—
Vole (*Microtus* sp.)	—	X	X	X
Singing vole (*Microtus miurus*)	—	—	—	X
Meadow vole (*Microtus pennsylvanicus*)	—	cf.	—	—
Tundra vole (*Microtus oeconomus*)	—	—	—	cf.
Yellow-cheeked vole (*Microtus xanthognathus*)	—	—	—	cf.
Sagebrush vole (*Lagurus curtatus*)	—	X	—	—
Porcupine (*Erethizon dorsatum*)	—	—	X	—
Coyote (*Canis latrans*)	—	cf.	—	—
Wolf (*Canis lupus*)	cf.	—	X	X
Arctic fox (*Alopex lagopus*)	—	—	—	X
Red fox (*Vulpes vulpes*)	—	cf.	X	—

Vertebrate Taxa	SASKATCHEWAN Fort Qu'appelle	SASKATCHEWAN Saskatoon	ALBERTA Medicine Hat	YUKON Old Crow Loc. 44
**Short-faced bear (*Arctodus simus*)	X	—	—	—
Raccoon (*Procyon lotor*)	—	—	X	—
Fisher (*Martes pennanti*)	—	—	—	X
Wolverine (*Gulo gulo*)	—	—	—	X
Badger (*Taxidea taxus*)	X	X	—	—
**Short-faced skunk (*Brachyprotoma obtusata*)	—	—	—	X
Black-footed ferret (*Mustela nigripes*)	—	—	X	—
Lynx (*Felis canadensis*)	—	—	X	—
**American lion (*Panthera leo atrox*)	—	—	X	—
**American mastodon (*Mammut americanum*)	—	—	—	X
**Columbian mammoth (*Mammuthus columbi*)	X	X	X	—
**Woolly mammoth (*Mammuthus primigenius*)	—	—	—	X
**Scott's horse (*Equus scotti*)	X	X	X	—
**Large horse (*Equus verae*)	—	—	—	X
**Small horse (*Equus conversidens*)	—	X	X	—
**Neogene horse (*Amerhippus* sp.)	—	—	X	—
**Llama (*Hemiauchenia* sp.)	—	—	X	—
**Largeheaded llama (*Hemiauchenia macrocephala*)	—	X	—	—
**Large camel (Camelini)	—	—	—	X
**Western camel (*Camelops hesternus*)	cf.	cf.	X	—
Caribou (*Rangifer tarandus*)	—	—	X	X
White-tailed deer (*Odocoileus virginianus*)	—	X	cf.	—
Wapiti (*Cervus canadensis*)	—	X	X	—
**Stag-moose (*Cervalces* sp.)	X	—	?	—
Pronghorn (Antilocapridae)	X	X	X	—
Prongbuck (*Antilocapra americana*)	—	cf.	cf.	—
Bison (*Bison* sp.)	X	X	X	X
**Giant bison (*Bison latifrons*)	X	cf.	cf.	—
Muskoxen (Ovibovini)	X	X	—	X
**Helmeted muskox (*Symbos cavifrons*)	X	X	—	—
Mountain sheep (*Ovis canadensis*)	—	—	X	—

* Fort Qu'Appelle data from Khan (1970) and this paper; Saskatoon data from Lammers (1968), Harington (1978), Skwara Woolf (1981) and Skwara and Walker (1989); Medicine Hat data from Stalker and Churcher (1982), Churcher (1985); Old Crow data from Harington (1989a).

** Extinct.

(Prest, 1970). In 1979, I examined and identified postcranial remains of an individual subadult beaver (*Castor canadensis*; Nova Scotia Museum 980GF721.1; Fig. 2) from this locality. The bones consist of: *Forelimb* — left scapula, left ulna; *Vertebrae* — atlas, seventh? cervical, third? thoracic, last four lumbar; *Ribs* — four posterior right, second left and three others; *Hindlimb* — left femur, right femur (ball), left tibia, left fibula (distal half), right fibula (proximal half); *Wrist or Ankle* — left astragalus, left calcaneum, nine podials (carpals or tarsals); *Foot* — three central metatarsals, seven phalanges (including two third phalanges or "claws"). Wood at the base of a 12 m-thick till unit at the site yielded a radiocarbon date of >33,800 years BP (GSC-33), and tamarack (*Larix*) wood underlying till and filling karst depressions gave a date >50,000 years BP (GSC-1642) (Dyck and Fyles, 1963; Lowdon and Blake, 1973). Pollen analysis of samples from the fossiliferous unit (R. J. Mott, Geological Survey of Canada Palynological Report 71-15) suggests conditions similar to the southern boreal forest today. Stea and Hemsworth (1979) suggest that the organic beds at East Milford and correlative deposits at Miller Creek [R. Granthom is studying a proboscidean (*Mammut americanum?*) tusk from this site, and I identified a beaver-cut stick from the organic layer while visiting the site in 1990.] and Addington Forks, Nova Scotia were deposited during parts of the Sangamon Interglaciation. Thus, beaver remains, and beaver-cut sticks along with the fossil pollen are indicative of wetlands in a cool, boreal forest during the last interglacial interval.

Pollen analysis and U-Th age determinations on an organic deposit discovered subsequently suggest that the waning phase following the thermal maximum of the last interglaciation, or a younger interval with climate similar to the present, is represented (Mott *et al.*, 1982; Mott and Grant, 1985; Causse and Hillaire-Marcel, 1986; Mott, 1990). However, whether or not all the organic units are correlative is not known.

NEW BRUNSWICK

Hillsborough

A partial skeleton of an American mastodon (*Mammut americanum*) was found in blue clay beneath till in gypsum karst near Hillsborough in 1936 (Squires, 1966; Harington *et al.*, in preparation). The geological age of the Hillsborough mastodon is controversial. A sample of bone, likely contaminated by an organic preservative, yielded a radiocarbon date of 13,600 ± 200 years BP (GSC-1222). Organic debris in asso-

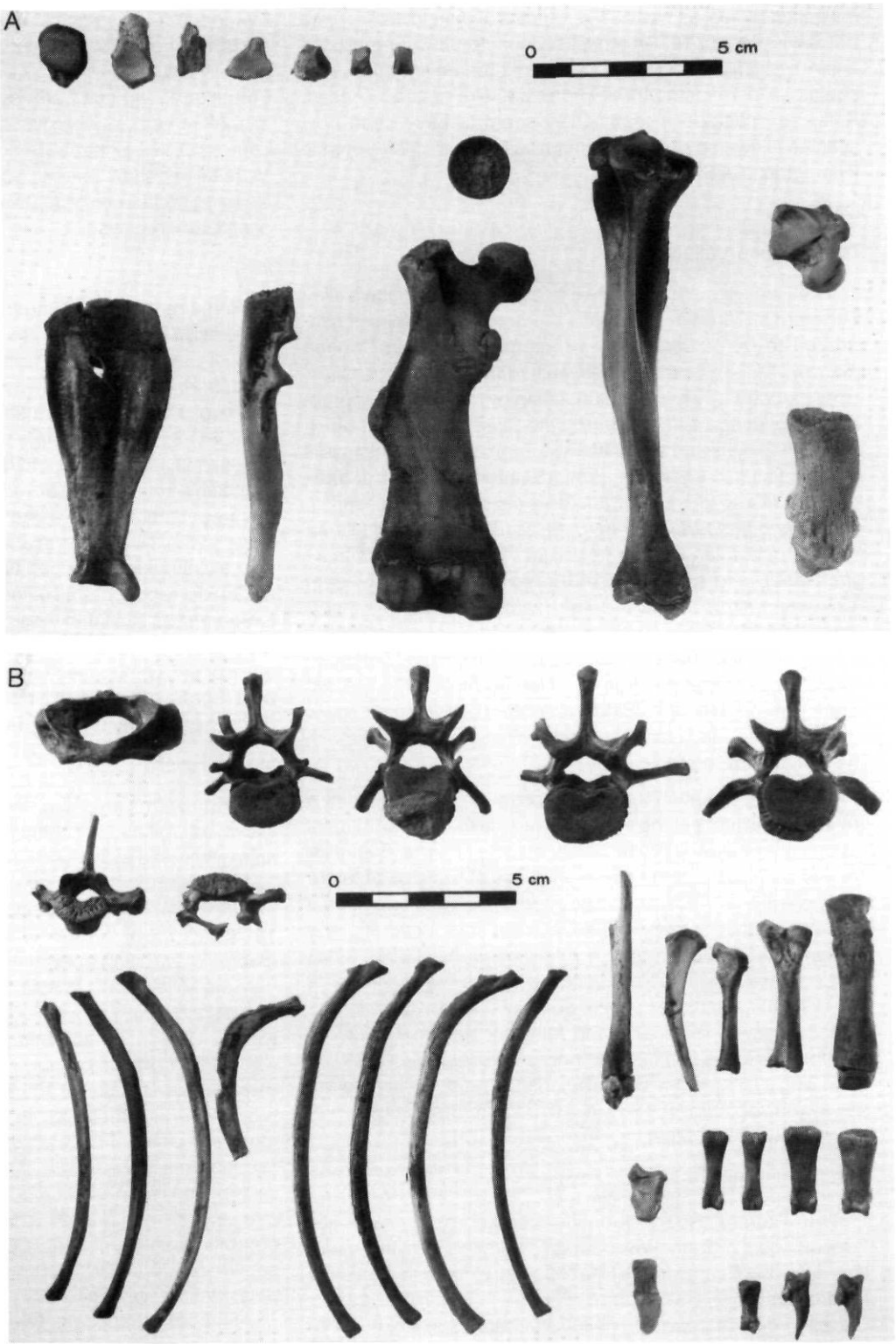

FIGURE 2. Bones of an individual subadult beaver (*Castor canadensis*; NSM 980GF721.1) from East Milford, Nova Scotia. A) Bottom (left to right): left scapula, left ulna, left femur, right femur (ball), left tibia, left astragalus, left calcaneum; upper left; podials. B) Upper two rows: atlas and six vertebrae; lower left; eight ribs or rib fragments; lower right: left fibula (distal half), metapodials and phalanges (including third phalanges or "claws" at bottom right).

Os d'un castor (Castor canadensis; *NSM 980GF721.1) trouvé à East Milford, en Nouvelle-Écosse. A) En bas (de gauche à droite): omoplate gauche, cubitus gauche, fémur gauche, fémur droit (emboîtement), tibia gauche, astragale gauche, calcanéum gauche; en haut à gauche: carpes. B) Deux premières rangées: atlas and six vertèbres; troisième rangée à gauche: huit côtes et fragments de côtes; partie inférieure droite: péroné gauche (moitié distale), métacarpes et phalanges (incluant les troisièmes phalanges ou «pinces» partie inférieure droite).*

ciated coprolites gave a date of 37,200 ± 1310 years BP (GSC-2469); whereas carbonate cementing the coprolites gave a date of 51,500 ± 1270 years BP (GSC-2467), and peat associated with the bones yielded a date of >43,000 years BP (GSC-1680). The finite dates could be minimal, rather than Middle Wisconsinan as once supposed (D. R. Grant *in* Blake, 1983). Because the pollen assemblages correlate well with several last interglacial organic deposits in the Maritime Provinces, and not with two suspected Middle Wisconsinan deposits, a Late Sangamonian age for the mastodon is favoured (Harington *et al.*, in preparation). Analysis of pollen in associated clay balls (considered to be mastodon coprolites) containing wood fragments, as well as associated peat, indicates a boreal forest environment. The blue clay enclosing the

mastodon bones, as well as the remains of dung-dwelling fungi (Pirozynski *et al.*, 1988), moss, sedges, freshwater molluscs and a beaver-cut stick all suggest that the environment was aquatic — perhaps near the shore of a lake or pond. Indeed, American mastodons themselves seem to have been best adapted to swampy areas or stream valleys with nearby spruce (Harington, 1986).

ONTARIO

Toronto (Don Valley)

The Don Formation, where it is exposed at the Don Valley Brickyard in Toronto, is perhaps the best known deposit considered to be of Sangamonian interglacial age in Canada (Karrow, 1990). Fossils are from an 8 m-thick layer of stratified, cross-bedded clay and sand underlain by the York Till of probable Illinoian age and overlain by the Scarborough Formation of Early Wisconsinan age. The Don Formation contains fossils of: whitefish (Coregoninae), trout (Salmoninae), pike or muskellunge (*Esox* sp.), shiner (cf. *Notropis* sp.), channel catfish (*Ictalurus punctatus*), burbot (*Lota lota*), yellow perch (*Perca flavescens*), a fish like the freshwater drum (cf. *Aplodinotus grunniens*), and a member of the sculpin family (Cottidae) (Crossman and Harington, 1970; mainly S. L. Cumbaa, personal communication, 1987); as well as woodchuck (*Marmota monax*) and giant beaver (*Castoroides ohioensis*) (Coleman, 1933). Organic material from the Don Formation has yielded a radiocarbon date of >46,000 years BP (L-409), and Karrow (1984) has reported amino-acid determinations compatible with the Sangamon Interglaciation.

The Don Formation appears to have been deposited in a freshwater estuary at the edge of a large lake that was at least 18 m higher than the present level of Lake Ontario. Evidence for this conclusion comes from analyses of remains of freshwater ostracodes, mollusc shells, wood, leaves, pollen, diatoms and insects that became buried in sediments. Several of the fishes represented suggest a relatively warm, turbid, slow-moving stream with weedy spots, whereas the presence of woodchucks and giant beavers suggests nearby open forest, with patches of grassland and lakes or ponds (Harington, 1989b). The lower part of the deposits includes pollen of a flora indicating a climate 2-3°C warmer than at present (Terasmae, 1960; and see Karrow, 1989, p. 1079 for further discussion of the paleoenvironments).

Toronto (Pottery Road)

The Pottery Road deposits consist of fluvial Late Sangamonian or Early Wisconsinan sediments occupying valleys cut in the Scarborough Formation at Toronto that are correlated with the Saint-Pierre Sediments (Karrow, 1984). Enclosed mammalian remains include bear (Ursidae, possibly brown bear *Ursus arctos*), mammoth or mastodon, white-tailed deer (*Odocoileus virginianus*), stag-moose (*Cervalces* sp.) and bison (*Bison* sp.) (Bensley, 1913; Coleman, 1913, 1933; Harington, 1978). A problematic muskox (*Ovibos moschatus*) bone from Scarborough Bluffs may also belong with this fauna (Churcher and Karrow, 1977). Ferland *et al.* (1988) consider that the 75,000 years BP Saint-Pierre Sediments were deposited during the last phases of the Sangamon interglaciation (marine oxygen isotope stage 5). However, Eyles (1987) suggests that the Pottery Road deposits are the most proximal and glacially-influenced facies of the prograding delta (Scarborough Formation), and that perhaps the incised channels were due to melt-stream discharges from "... an Early Wisconsinan Laurentide Ice Sheet". He notes that pollen studies by J. H. McAndrews show that the cooling trend evident in the upper Don sediments continues without a break into the overlying Scarborough clays.

Innerkip

Remains of vole (*Microtus* sp.), muskrat (*Ondatra* sp.), white-tailed deer (*Odocoileus virginianus*) and plates from the shell of Blandings's turtle (*Emydoidea blandingi*) were recovered from peat beneath two Late Wisconsinan tills near Innerkip. The deposit is radiocarbon-dated to >50,000 years BP (GSC-2010-2). The large numbers of plant-dependent beetles, seeds of emergent and floating aquatic plants, as well as Blanding's turtle (its present northern limit is in mixed and deciduous woodlands south of the boreal forest coinciding approximately with the 4°C mean annual isotherm) and muskrat suggest a well-vegetated pond environment. Modern ranges and ecological requirements of fossil insects from the site suggest temperatures similar to those found in southern Ontario today (July average temperature of 18-21°C; mean annual temperature of 6-7°C). On these grounds, the fossil-bearing Innerkip peat represents either a last interglacial or very warm interstadial deposit (Pilny and Morgan, 1987; Churcher *et al.*, 1990).

Moose River Crossing

Minnow or carp (Cyprinidae) remains, beaver-gnawed sticks, as well as an American mastodon (*Mammut americanum*) jaw with a molar tooth have been identified from the intertill Missinaibi Formation near Moose River Crossing and the bed of Moose River in the same vicinity, respectively (Skinner, 1973; Bell 1898). Stuiver *et al.* (1978) tried to obtain a radiocarbon date (using special enrichment techniques) on wood from the Missinaibi type section. As with previous attempts, the age (>72,500 BP) was beyond the range of radiocarbon dating (Shilts, 1984). The fish and beaver-gnawed sticks are from compact silty muck (evidently the remainder of an oligotrophic semi-permanent pond or small lake) containing remains of beetles, freshwater molluscs, sponge spicules, diatoms, seeds, moss and pollen. Fossil pollen evidence suggests that boreal forest occupied the Moose River Basin during the last interglaciation, and that climate was probably similar to that of today, or even warmer (Skinner, 1973). The palynological, paleogeographical and sedimentological data presented by Skinner confirm McDonald's (1969) belief that the Missinaibi beds are of last interglacial age. Wet-screening of these deposits, and others of similar age [*e.g.* Owl Creek Beds near Timmins (Mott and DiLabio, 1988; DiLabio *et al.*, 1988)] for microvertebrate remains are a paleobiological priority.

MANITOBA

Minnedosa

A partial skeleton of a ground squirrel (*Spermophilus* sp.; Fig. 3) and some vole (*Microtus* sp.) bones were recovered

from an ancient burrow in a 1.5 m-thick silt bed underlain by about 5 m of till and overlain by nearly 19 m of sediment (including three tills) north of Minnedosa. Grass associated with the bones yielded a radiocarbon date of >31,300 years BP (GSC-297) (Klassen *et al.*, 1967). It is worth noting that Klassen *et al.* (1967) suggested that the Minnedosa fossiliferous unit was correlative with the Roaring River Clay, considered by Tyrrell (1892) and Fenton (1984) to be of a last interglacial age.

FIGURE 3. Some of the better preserved bones of an individual ground squirrel (*Spermophilus* sp.; NMC 10476) from a burrow buried between glacial tills near Minnedosa, Manitoba. From left centre clockwise: left and right ulnae fragments, maxillary fragment with cheek teeth, upper canine, pelvic fragment, proximal end of a femur, tibia, calcaneum and astragalus, metapodial and phalanges.

*Les quelques os les mieux conservés d'un écureuil (*Sphermophilus *sp.; NMC 10476) recueillis dans un terrier enfoui entre des tills glaciaires, près de Minnedosa, au Manitoba. De gauche à droite, dans le sens des aiguilles d'une montre: fragments gauche et droit de cubitus, fragment de maxillaire et os de la joue, canine supérieure, fragment de l'os pelvien, extrémité proximale du fémur, tibia, calcanéum et astragale, métapode et phalanges.*

Bird

A left upper molar tooth of a primitive form of the woolly mammoth (*Mammuthus primigenius*) from near Bird in northeastern Manitoba is worth mentioning. It was probably washed out of sediments of Sangamonian or Early Wisconsinan age. Nielsen *et al.* (1988, Fig. 2) indicate that it most likely came from Late Sangamonian Nelson River sediments (silt and clay containing wood and peat). A radiocarbon date on wood from the Nelson River sediments (Henday section) is >49,000 years BP (GSC-4420, HP). Analyses of fossil pollen and insects in this unit, correlated with the Missinaibi Formation of northern Ontario, indicate an environment close to the treeline. The fossil insect fauna suggests tundra conditions, which would fit with the discovery of the woolly mammoth tooth.

SASKATCHEWAN

Deposits containing vertebrate fossils from Fort Qu'Appelle and Saskatoon are considered to be of probable Sangamonian or possible Wisconsinan interstadial age (Khan, 1970; Christiansen, 1972; Harington, 1978). Fenton (1984) includes these fossil-bearing deposits in the Osler Nonglacial Interval of Sangamonian age.

Fort Qu'Appelle

Vertebrate fossils at Fort Qu'Appelle are from Echo Lake Gravels overlain by sand and thick till of the Saskatoon Group (presumably of Wisconsinan age), and underlain by another thick till of the Sutherland Group (Christiansen, 1972). The gravels may be outwash laid down at the close of an interglacial interval by an advancing ice sheet — like the Pottery Road deposits in Ontario and the Saint-Pierre Sediments in Québec. Mollusc shells from sand overlying the fossiliferous gravels yielded a radiocarbon date of >30,000 years BP (GSC-987). The vertebrate fauna is listed in Table I: scientific names of vertebrate fossils mentioned hereafter for Fort Qu'Appelle, Saskatoon and Old Crow River are omitted because they are listed in that table. Remains of pike (personal communication T. Tokaryk, 1987) and Ruffed Grouse (Weigel, 1963) indicate the presence of woods and rather turbid water near the site. Most of the mammals represented — particularly the badger — suggest a grassland habitat with some shrubs. A previously unidentified partial tibia of a small adult pronghorn (Antilocapridae cf. ?*Capromeryx* sp., Fig. 4) from Fort Qu'Appelle supports this view.

Saskatoon

In the vicinity of Saskatoon (*e.g.* Saskatoon site, Riddell site), 6-9 m-thick sands containing a substantial vertebrate fauna (Riddell fauna) are enclosed by two tills of the Floral Formation. This formation is overlain by till of the Late Wisconsinan Battleford Formation as well as surficial stratified drift, and underlain by sand and till of the Sutherland Group. Stratigraphic studies and radiocarbon dates indicate that the Floral Formation at Saskatoon is >34,000 years old (S-426). Skwara Woolf's (1980, 1981) biostratigraphic work at the

Riddell site (across the river from the Saskatoon site) augments the mammalian fauna listed previously (Lammers, 1968; Harington, 1978) — particularly its rodent component. She considered the fauna to be of Illinoian to Wisconsinan age. Fenton (1984) points out that, because deposits containing the Riddell fauna are not likely older than Sangamonian yet stratigraphically underlie Middle Wisconsinan sediments, they are probably of last interglacial age. Skwara and Walker (1989) concluded that "... lithologic and stratigraphic relationships of tills and ecological requirements of the fauna limit the Riddell Member to the Sangamonian". The area in which the majority of living mammals in the Riddell fauna occurs together is at least 500 km south of Saskatoon. On this basis Skwara Woolf (1981) suggests the presence of a more equable climate with cooler summers and milder winters than presently occur at Saskatoon.

Similarities exist between the Fort Qu'Appelle and Saskatoon faunas. Each has fish, hare or rabbit, rodent, canid, badger, Columbian mammoth (Fig. 5), Scott's horse (Fig. 6), a camel like the western camel (Fig. 7), pronghorn, probably giant bison, and helmeted muskox (Table I).

ALBERTA

Medicine Hat

Surprise, Mitchell and Island bluffs near Medicine Hat have yielded a substantial fauna. Fossils are from Stalker and Churcher's (1982) Unit XIII — a 3 m-thick deposit near the base of a sequence of sediments laid down in stream floodplains and channels. This unit is overlain by dark grey, contorted till and underlain by black till. A radiocarbon date of ">38,000" years BP is provided for Early Wisconsinan deposits overlying this fossiliferous bed; apparently this is based on a date of 37,900 ±1100 years BP (GSC-1442) from "Mid Wisconsin" deposits (Stalker and Churcher, 1972; Table 2). Trial Uranium-series dates on Columbian mammoth and Scott's horse bones were 74,000 ±5000 years BP (MH-B-24) and 76,000 ±5000 years BP (MH-B-25), respectively (Szabo *et al.*, 1973). Some conclusions can be reached concerning the regional paleoenvironment by considering habitats commonly occupied by the various species represented. The hawk suggests woodland or open country, while the Spruce Grouse indicates the proximity of coniferous or mixed forest. Of nearly 30 mammalian species represented, about 40% are commonly found in open grassland habitats, 17% in parkland, 14% in woodland, 7% in coniferous forest or tundra; and the remainder are associated with alpine grassland, water, or they vary in their choice of habitat (Medicine Hat Fauna 7; Harington, 1978). The black-tailed prairie dog, which is not now found this far north indicates that Unit XIII was deposited under warmer conditions than those prevailing (Stalker and Churcher, 1982). Therefore, probably large tracts of open grassland with patches of trees and some ponds or lakes were present in the region during the Sangamon Interglaciation. Of the species listed, nearly one-third are extinct.

Medicine Hat and Saskatoon areas share the following mammalian taxa (those marked with an asterisk are also shared with Fort Qu'Appelle; Table I): ground sloth, hare or rabbit*, Richardson's ground squirrel, northern pocket gopher,

FIGURE 4. Partial right tibia (SMNH P1120.12) of a relatively small pronghorn (Antilocapridae cf. *?Capromeryx*) from Fort Qu'Appelle, Saskatchewan. Collected with mammoth and horse fossils from the Bliss Gravel Pit by Bruce McCorquodale in 1964.

Partie du tibia droit (SMNH P 1120.12) d'un relativement petit antilocarpe (Antilocapridée cf. ?Capromeryx) de Fort Qu'Appelle, en Saskatchewan. Recueilli avec des fossiles de mammouth et de cheval dans la carrière de Bliss par Bruce McCorquodale, en 1964.

FIGURE 5. Left three-quarter front view of restored partial mandible with near complete left lower third molar (LM_3) of a Columbian mammoth (*Mammuthus columbi*; MMMN 6815/MV 110) from the Saskatoon site, Saskatchewan. White areas are restored.

Vue frontale aux trois quarts gauche d'une partie de mandibule restaurée avec la presque totalité de la troisième molaire inférieure gauche d'un mammouth (Mammuthus columbi; *MMMN 6815/MV110) du site de Saskatoon, en Saskatchewan. Les parties restaurées sont en blanc.*

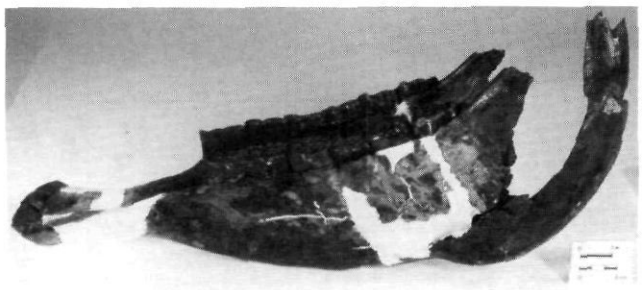

FIGURE 6. Left side view of a restored mandible with all teeth (except left second lower incisor, LI_2) of Scott's horse (*Equus scotti*; SMNH Field Nos: SM 9-12, 22, 34) from the Saskatoon site, Saskatchewan. White areas are restored.

Côté gauche d'une mandibule restaurée avec toutes les dents (sauf la deuxième incisive inférieure gauche) d'un cheval (Equus scotti; *SMNH n^{os} SM 9-12, 22, 34) du site de Saskatoon, en Saskatchewan. Les parties restaurées sont en blanc.*

FIGURE 7. Upper left: wapiti third phalanx (*Cervus canadensis*: ROM 5545) from north of Sutherland (N. E. Saskatoon); lower left: western camel first phalanx (*Camelops hesternus*; MMMN 6812/MV101) from the Saskatoon site; and right: a bison thoracic vertebra (*Bison* sp.; MMMN 6812/MV110) from the Saskatoon site, Saskatchewan.

En haut, à gauche: troisième phalange d'un Cervus canadensis *(ROM 5545) recueillie au nord de Sutherland, au NE de Saskatoon; en bas, à gauche: première phalange d'un spécimen de* Camelops hesternus *(MMMN 6812/MV101) du site de Saskatoon; à droite: vertèbre du thorax d'un bison* (Bison *sp.; MMMN 6812/MV110) du site de Saskatoon, en Saskatchewan.*

muskrat, vole, probably red fox, Columbian mammoth*, Scott's horse*, small horse, probably western camel*, probably white-tailed deer, pronghorn*, and probably giant bison*.

Bindloss

Sandy gravels at a locality near Bindloss, on a terrace 15 m above the Red Deer River, have produced remains of the American lion, Columbian mammoth (*Mammuthus columbi, sensu* Kurtén and Anderson, 1980, p. 351) and small horse (Harington, 1971a; Churcher, 1972). As the region was covered by ice during the maximum Wisconsinan advance, the fossils are probably of Sangamonian interglacial, or possibly of Wisconsin interstadial age (Churcher, 1983). All of the species reported are known from Sangamonian deposits at Medicine Hat (Table I).

Watino

Vertebrate fossils from the lower gravels exposed along the Smoky River near Watino include: ground squirrel (*Spermophilus* sp.), a proboscidean (probably a mammoth, *Mammuthus* sp.), small horse (*Equus* sp.) and bison. Ground squirrel and horse were reported by Reimchen (1968), whereas I identified probable mammoth, small horse and bison specimens for John Westgate (Westgate *et al.*, 1972) from this unit. Since overlying Middle Wisconsinan non-glacial beds have been radiocarbon dated to 43,500 ± 620 years BP (GX-1207), this fauna is probably of Sangamonian age (Churcher and Wilson, 1979; Fenton, 1984).

BRITISH COLUMBIA

Westwold

Remains of fish, rodent, small horse (*Equus* cf. *E. conversidens*) and bison have been excavated from a 20 cm-thick oxidized sand near the top of a 30 m unit of silt and sand overlying 16 m of well-sorted, stratified gravel (Westwold Sediments) covered by two tills near Westwold. The Westwold Sediments are considered to be of Sangamonian age (Harington, 1978; Fulton and Smith, 1978; Fulton *et al.*, 1984) because they underlie glacial deposits that are older than Middle Wisconsinan and seem to have been deposited under climatic conditions similar to, or warmer than, present based on identification of plant macrofossils within the fossiliferous unit. Freshwater mollusc shells (*Margaritifera margaritifera* and *Anodonta nuttaliana*) from the unit yielded a radiocarbon date of >35,500 years BP (GSC-413) (Dyck *et al.* 1966).

Quesnel Forks

A partial mountain goat (*Oreamnos* sp.) cranium was collected at a depth of about 84 m in a gold-bearing gravel unit at Bullion Mine near Quesnel Forks. Fortunately, the position of the fossil in relation to the stratigraphy at the site was recorded by W. E. Cockfield (Field Notebook, 1931; Cockfield and Walker, 1933). If my tentative correlation of the surface till (Fraser Glaciation), underlying fluvial deposits (Olympia Nonglacial Interval), underlying till (Semiahmoo Glaciation) and the underlying fluvial deposits (Highbury Interglaciation) bearing the mountain goat fossil is correct, then this specimen is of Sangamonian age (Harington, 1971b). However, the specimen could be older: it is the oldest known mountain goat fossil.

Quesnel

An ungual phalanx (claw) of a ground sloth (*Megalonyx* sp.) from stream gravels near Quesnel, although not found in place, could also be of Sangamonian age (Harington, 1977).

YUKON TERRITORY

Old Crow River Locality 44

A substantial vertebrate fauna of possible Sangamonian age from Old Crow River Locality 44 (Table I; Fig. 8) was excavated from about 0.5 m of fine grey gravel, with *in situ* mollusc shells, that grades upward through gravel with rooted logs and ancient point-bar detritus to brownish clay silt. The top of this unit (lower Interlake beds) is best defined by a change in pollen assemblages that occurs some 9 m above its base. This unit is underlain by about 3.5 m of oxidized clay, occasionally containing organic detritus (reworked Lower Lake clay), and overlain by approximately 9 m of buff silt and clay (upper Interlake beds), 2 m of varved lacustrine clay (Upper Lake clay) of Late

FIGURE 8. Excavating microvertebrate remains from Old Crow River Locality 44, Yukon Territory. Note the presence of a large spruce log (arrow).

Fouille pour extraire les restes d'un microvertébré au site n° 44 de Old Crow, au Yukon. À noter la présence d'un gros tronçon d'épinette (flèche).

Wisconsinan age and 6 m of silty Holocene sediments (Harington, 1977).

The fossil-bearing unit is more than 54,000 years old. Five radiocarbon dates on specimens from the unit are non-finite: horse (*Equus* sp.) and mammoth (*Mammuthus* sp.) bones yielded dates of >39,900 years BP (I-4223, I-4228); a sample of unidentified wood gave the same reading (I-3572); spruce (*Picea* sp.) wood yielded radiocarbon dates of >44,000 years BP (GSC-1593) and >54,000 years BP (GSC-2066). In addition to the radiocarbon dates listed, the following evidence suggests that the vertebrate fossil-bearing unit is of Sangamonian age. Analysis of plant macrofossils and invertebrates indicates that the climate was at least as warm as present. A significant change in climate from cool (dwarf birch) to warmer (spruce-birch) is reflected in pollen assemblages extending upward from the reworked Lower Lake clay to the fossil-bearing unit (Lichti-Federovich, 1973). Large spruce (*Picea* sp.) logs up to about 1.5 m in circumference, in combination with a nearly equal number of tamarack (*Larix* sp.) logs (8 spruce: 7 tamarack in sample identified by J. S. Gonzalez, Forintek Canada Corp., 1986) indicate a period warmer than present — especially considering that the tamarack fossils are clearly north of the species' modern range (Little, 1971; Viereck and Little, 1975). The presence of short-faced skunks (*Brachyprotoma obtusata*) more than 4,300 km north of their known paleo-range (Youngman, 1986) — particularly if they had similar habitat requirements to their closest living relative the spotted skunks (*Spilogale putorius*) — may also indicate a warmer phase. Also, the fact that the fossiliferous unit lies between the widespread Upper Lake and Lower Lake beds, considered to be of Wisconsin and Illinoian ages respectively (Harington, 1977; Jopling *et al.*, 1981), suggests that it is of last interglacial age.

In 1986, an attempt was made to determine if Uranium-series analyses of wood samples from the logs previously mentioned could provide a clearer idea of the age of the vertebrate fossil-bearing unit. Instead of the "closed system" required for this dating method to produce reliable results, "... it seems that we have an almost 'overclosed' system" (C. Causse, personal communication, 1987). For five samples that appeared to be most useful, the "... slope equal to 0.296 (= 0.036) is indicative of an age ~40,000 years" — an age that I regard as highly doubtful because of older radiocarbon dates on wood (and probably bone) mentioned above.

Many species represented by plant and invertebrate macrofossils, as well as vertebrate remains (*e.g.* fish, duck, goose, shorebird, beaver, giant beaver, muskrat and American mastodon) have aquatic affinities, and suggest the former presence of ephemeral shallow ponds and lakes in a river floodplain with sandy margins in places, perhaps with spruce-tamarack forest (see above) nearby. Forest-tundra may best describe the vegetation that existed when the unit containing vertebrate fossils was deposited, but probably more grasses were present than in the contemporary forest-tundra of the region (Harington, 1971c, 1977, 1978; Lichti-Federovich, 1973; Matthews, 1975).

The Locality 44 fauna shares the following vertebrates with supposed last interglacial faunas of the Canadian Prairies (Table I): pike, grouse-like bird (Tetraonidae), hare, arctic ground squirrel, muskrat, vole, wolf, mammoth, horse, camel (Camelidae), caribou, bison and muskoxen.

Herschel Island

Two marine mammal specimens from Herschel Island may be of Sangamonian age (Harington, 1977). In 1970, M. Bouchard collected a heavily permineralized fragment, similar to mandibular bone of a large whale like the bowhead (*Balaena mysticetus*), *in situ* at Locality 2 in "preglacial marine sands" considered by Vern Rampton to be of pre-early Wisconsinan age. In 1973, at Herschel Island Locality 5, I collected the left scapula of a small seal like the ringed seal (*Phoca* cf. *P. hispida*) from an oxidized sandy organic layer containing marine mollusc shells and wood approximately 9 m above sea level. Sediments exposed in this lower half of the coastal exposure west of Pauline Cove are mainly sandy silt, and appear to be a sequence of coastal marine deposits. Although I suspect that the fossil-bearing sediments at both localities are of last interglacial age (equivalent to the Pelukian transgression of Hopkins, 1967), more stratigraphic work is required before sound conclusions can be reached.

It is worth mentioning marine mammal remains from adjacent Alaska [walrus (*Odobenus* sp.), sea lion (*Eumetopias* sp.) and Steller's sea cow (*Hydrodamalis gigas*; Th^{230}/Pa^{231} dates: 135,000 ±12,000 years and >122,000 years)] that are considered to be of Sangamonian age (Gard *et al.*, 1972; Harington, 1978).

NORTHWEST TERRITORIES

Lower Carp Lake

Pleistocene vertebrate remains are seldom found in heavily-glaciated areas of the Canadian Shield. An interesting exception was the discovery of a cheek tooth of Jefferson's ground sloth (*Megalonyx* cf. *M. jeffersonii*) and fragments of an

American mastodon (*Mammut americanum*) tooth at Lower Carp Lake north of Yellowknife (Stock and Richards, 1949). The stratigraphic range of Jefferson's ground sloth extends from Illinoian to Late Wisconsinan time (Kurtén and Anderson, 1980), and I consider it most likely that these fossils are of Sangamonian age. The broad, blunt ground sloth caniniform teeth suggest a leaf-stripping adaptation, and *Megalonyx jeffersonii* is associated in more southerly regions of North America with forest faunas, which is interesting in light of the fact that the American mastodon (also represented at this site) evidently preferred marshy, open spruce forest.

Rat River

At Rat River a beaver-gnawed stick from the base of a 12 m-thick layer of organic silt overlying an older till yielded a radiocarbon date of >38,000 years BP (GSC-120), so beavers may have lived in the Mackenzie River valley during the last, or an earlier, interglacial interval (Harington, 1978).

CONCLUSIONS

Presuming the vertebrates and vertebrate faunas mentioned previously are approximately coeval and of last interglacial age, what conclusions can be drawn regarding highlights of species distribution and dispersal routes from south to north as the Illinoian ice sheet melted back?

Fishes are best represented in faunas from Toronto, and Old Crow River. Whitefish (Toronto, Old Crow River) and pike (Toronto, Fort Qu'Appelle, Old Crow River) seem to have had a wide distribution — one similar to their present ranges.

Amphibians have not been reported so far, but a reptile, Blanding's turtle, is known from Innerkip in southern Ontario.

Birds are poorly known from last interglacial deposits across the country except for grouse-like birds (*e.g.* ptarmigan and grouse from Old Crow River, Spruce Grouse from Medicine Hat and Ruffed Grouse from Fort Qu'Appelle). A hawk is reported from Medicine Hat. However, approximately seven species are reported from Old Crow River, where remains of ducks and geese, as well as grouse-like birds are most common in the fauna.

Mammal remains are rather well represented across the country. Hares or rabbits were widespread in western Canada (Fort Qu'Appelle, Saskatoon, Medicine Hat, Old Crow). Ground sloths (*Megalonyx* sp.) are known from several western localities (Saskatoon, Medicine Hat, Quesnel, Lower Carp Lake). Considered together, with a specimen from near Fairbanks, Alaska (Stock, 1942), these fossils suggest that *Megalonyx* occupied a rather broad range in western North America during the Sangamon Interglaciation. The fact that the Old Crow specimens appear to be smaller than most Wisconsinan age fossils of *Megalonyx* may indicate that the species reached northwestern North America during the Sangamonian, or possibly an earlier interglacial interval (Harington, 1977). According to the sparse evidence available, the ground sloth most likely spread into Yukon and Alaska by a corridor east of the Cordillera (*e.g.* Medicine Hat — Saskatoon — Lower Carp Lake — Old Crow — Fairbanks), however an alternative route via the interior of British Columbia (Quesnel) is possible. Indeed, both routes may have been used.

Ground squirrels were widespread in western Canada (Minnedosa, Saskatoon, Medicine Hat, Watino, Old Crow), suggesting the presence of well-drained areas and a fairly deep active layer in the soil.

As in the Holocene, Sangamonian beavers (Castoridae) occupied wooded wetlands in eastern and western Canada. Thus, beavers and giant beavers were widespread (East Milford, Miller Creek, Hillsborough, Toronto, Moose River Crossing, Old Crow). Furthermore, both species lived together at about the same time according to evidence from Old Crow River Locality 44. Apart from Old Crow and Bluefish basins in the Yukon, the only other locality producing remains of the giant beaver in northern North America is Toronto. Perhaps giant beavers were able to disperse rather rapidly northward into the Yukon from more southerly areas through chains of lakes which evidently tend to form along the southern margin of the Canadian Shield during interglacial intervals (*e.g.* the present interglacial interval). A likely time for this northward radiation would have been the beginning of the Sangamon Interglaciation, when the Illinoian ice sheet was melting back (Harington, 1977). Another aquatic-adapted rodent, the muskrat, was widespread too (Innerkip, Saskatoon, Medicine Hat, Old Crow). Although voles (*Microtus* sp.) apparently had a broad distribution (Innerkip, Minnedosa, Saskatoon, Medicine Hat, Old Crow), probably the red-backed and singing voles, and the lemmings occupied mainly northern habitats (Old Crow).

Canids were widespread in the West (Fort Qu'Appelle, Saskatoon, Medicine Hat, Old Crow). Badgers occupied the Prairies (Fort Qu'Appelle, Saskatoon), perhaps reaching the Yukon (Dawson) and Alaska (Fairbanks) when large tracts of grassland extended northward during a relatively warm period of the Wisconsinan (Middle Wisconsinan?). Dawson is now about 2,000 km northwest of the present northern limit of badgers in Alberta. American lions occupied western Canada (Medicine Hat, Bindloss).

American mastodons are known from eastern (Lower Middle River, Miller Creek, Hillsborough, Toronto?, Moose River Crossing) and northwestern Canada (Lower Carp Lake, Old Crow). Woolly mammoths occupied northern Manitoba and the Yukon (Bird, Old Crow), while Columbian mammoths seem to have held sway in southern Canada (?Toronto, Fort Qu'Appelle, Saskatoon, Medicine Hat, Bindloss). Medium and small horses (*Equus scotti, Equus conversidens*) dominated the western grasslands (Fort Qu'Appelle, Saskatoon, Medicine Hat, Watino, Westwold), while larger horses (*Equus verae*) seem to have been most common farther north (Old Crow). Similarly, western camels were most common on the western plains (Fort Qu'Appelle, Saskatoon, Medicine Hat), while larger camels lived farther north (Old Crow).

White-tailed deer (*Odocoileus virginianus*) and stag-moose (*Cervalces* sp.) are known from southern Canada (Toronto, Innerkip, Saskatoon, Medicine Hat; and Toronto, Fort Qu'Appelle, Medicine Hat, respectively). Pronghorns were common on the western plains (Fort Qu'Appelle, Saskatoon, Medicine Hat), whereas bison [perhaps mainly giant bison

(*Bison latifrons*)] had a broader distribution (Toronto, Fort Qu'Appelle, Saskatoon, Medicine Hat, Watino, Westwold, Old Crow). Muskoxen are known from Toronto to Old Crow: helmeted muskoxen (*Symbos cavifrons*) apparently dominated the western plains.

ACKNOWLEDGEMENTS

I am grateful to Charles A. Repenning (U.S. Geological Survey, Denver) and R. J. Mott (Geological Survey of Canada, Ottawa) for their constructive comments on a draft of this paper.

REFERENCES

Bell, R., 1898. On the occurrence of mammoth and mastodon remains around Hudson Bay. Geological Society of America Bulletin, 9: 369-390.

Bensley, B. A., 1913. A *Cervalces* antler from the Toronto interglacial. University of Toronto Studies, 8: 1-3.

Blake, W., Jr., 1983. Geological Survey of Canada Radiocarbon Dates XXIII. Geological Survey of Canada, Paper 83-7: 1-34.

——— 1984. Geological Survey of Canada Radiocarbon Dates XXIV. Geological Survey of Canada, Paper 84-7: 1-35.

Causse, C. and Hillaire-Marcel, C., 1986. Géochimie des familles U et Th dans la matière organique fossile dans des dépôts interglaciaires et interstadiaires de l'est et du nord du Canada: potentiel radiochronologique, p. 11-18. *In* Recherches en cours, Partie B. Commission géologique du Canada, Étude 86-1B.

Christiansen, E. A., 1972. Stratigraphy of the Fort Qu'Appelle vertebrate fossil locality, Saskatchewan. Canadian Journal of Earth Sciences, 9: 212-218.

Churcher, C. S., 1972. Imperial mammoth and Mexican half-ass from near Bindloss, Alberta. Canadian Journal of Earth Sciences, 9: 1562-1567.

——— 1983. Faunal correlations of Pleistocene deposits in Western Canada p. 145-158. *In* W. C. Mahaney, ed., Correlation of Quaternary Chronologies. Geo Books, Norwich.

——— 1985. Equids (Genus *Amerhippus*) from the Sangamon at Medicine Hat, Alberta. Fourth International Theriological Congress (Edmonton, August 13-20, 1985), Abstracts of Papers and Posters, No. 92.

Churcher, C. S. and Karrow, P. F., 1977. Late Pleistocene muskox (*Ovibos*) from the Early Wisconsin at Scarborough Bluffs, Ontario, Canada. Canadian Journal of Earth Sciences, 14: 326-331.

Churcher, C. S. and Wilson, M., 1979. Quaternary mammals from the eastern Peace River District, Alberta. Journal of Paleontology, 53: 71-76.

Churcher, C. S., Pilny, J. J. and Morgan, A. V., 1990. Vertebrate, plant and insect remains from Innerkip site, southwestern Ontario. Géographie physique et Quaternaire, 44: 299-308.

Cockfield, W. E. and Walker, J. F., 1933. Geology and placer deposits of Quesnel Forks area, Cariboo District, British Columbia. Geological Survey of Canada, Summary Report 1932, Part A1: 76-143.

Coleman, A. P., 1913. Excursion B2 Toronto and vicinity. *In* Excursions in Vicinity of Toronto and to Muskoka and Madoc. Ontario Bureau of Mines, Guide Book 6: 6-34.

——— 1933. The Pleistocene of the Toronto region (including the Toronto interglacial formation). Ontario Department of Mines, Annual Report 41(T): 1-55.

Crossman, E. J. and Harington, C. R., 1970. Pleistocene pike, *Esox lucius*, and *Esox* sp., from the Yukon Territory and Ontario. Canadian Journal of Earth Sciences, 7: 1130-1138.

Dawson, J. W., 1868. Acadian geology. MacMillan and Co., London, 694 p.

DiLabio, R. N. W., Miller, R. F., Mott, R. J. and Coker, W. B., 1988. The Quaternary stratigraphy of the Timmins area, Ontario, as an aid to mineral exploration by drift prospecting. Geological Survey of Canada, Paper 88-1C: 61-65.

Dyck, W. and Fyles, J. G., 1963. Geological Survey of Canada Radiocarbon Dates II. Geological Survey of Canada, Paper 63-21: 1-31.

Dyck, W., Lowdon, J. A., Fyles, J. G. and Blake, W., Jr., 1966. Geological Survey of Canada Radiocarbon Dates V. Geological Survey of Canada, Paper 66-48: 1-32.

Eyles, N., 1987. Late Pleistocene depositional systems of Metropolitan Toronto and their engineering and glacial geological significance. Canadian Journal of Earth Sciences, 24: 1009-1021.

Fenton, M. M., 1984. Quaternary stratigraphy of the Canadian Prairies. *In* R. J. Fulton, ed., Quaternary Stratigraphy of Canada — A Canadian Contribution to IGCP Project 24. Geological Survey of Canada, Paper 84-10: 58-68.

Ferland, P., Occhietti, S. and Clet, M., 1988. Revision du stratotype des sédiments de Saint-Pierre et unités pléistocènes non-glaciaires sous-jacentes. Climatic Fluctuations & Man, 3: 16-17.

Fulton, R. J. and Smith, G. W., 1978. Late Pleistocene stratigraphy of south-central British Columbia. Canadian Journal of Earth Sciences,15: 971-980.

Fulton, R. J., Fenton, M. M. and Rutter, N. W., 1984. Summary of Quaternary stratigraphy and history, Western Canada. *In* R. J. Fulton, ed., Quaternary Stratigraphy of Canada — A Canadian Contribution to IGCP Project 24. Geological Survey of Canada, Paper 84-10: 69-83.

Gard, J. M., Jr., Lewis, G. E. and Whitmore, F. C., Jr., 1972. Steller's sea cow in Pleistocene interglacial beach deposits of Amchitka, Aleutian Islands. Geological Society of America Bulletin, 83: 867-870.

Harington, C. R., 1971a. A Pleistocene lion-like cat (*Panthera atrox*) from Alberta. Canadian Journal of Earth Sciences, 8: 170-174.

——— 1971b. A Pleistocene mountain goat from British Columbia and comments on the dispersal history of *Oreamnos*. Canadian Journal of Earth Sciences, 8: 1081-1093.

——— 1971c. Ice age mammals in Canada. Arctic Circular, 22: 66-89.

——— 1977. Pleistocene mammals of the Yukon Territory. Ph.D. thesis, University of Alberta, Edmonton, 1060 p.

——— 1978. Quaternary vertebrate faunas of Canada and Alaska and their suggested chronological sequence. Syllogeus, 15: 1-105.

——— 1986. The American mastodon. Neotoma, 19: 1-3.

——— 1989a. Pleistocene vertebrate localities in the Yukon. *In* L. D. Carter, T. D. Hamilton and J. P. Galloway, eds. Proceedings of the American-Canadian Workshop on the Late Cenozoic History of the Interior Basins of Alaska and the Yukon. U.S. Geological Survey, Circular 1026: 93-98.

——— 1989b. Ice age fossils and vanished vertebrates, p. 156-164. *In* J. Theberge, ed., Legacy: The Natural History of Ontario. McClelland and Stewart, Toronto.

Harington, C. R., Grant, D. R. and Mott, R. J., (in preparation). The Hillsborough, New Brunswick mastodon and other Pleistocene proboscidean fossils from Nova Scotia.

Hopkins, D. M., 1967. Quaternary marine transgressions in Alaska, p. 47-90. *In* D. M. Hopkins, ed., The Bering Land Bridge. Stanford University Press, Stanford, California, 495 p.

Jopling, A. V., Irving, W. N. and Beebe, B. F., 1981. Stratigraphic, sedimentological and faunal evidence for the occurrence of pre-Sangamonian artefacts in northern Yukon. Arctic, 34(1): 3-33.

Karrow, P. F., 1984. Quaternary stratigraphy and history, Great Lakes-St. Lawrence region. *In* R. J. Fulton, ed., Quaternary Stratigraphy of Canada — A Canadian Contribution to IGCP Project 24. Geological Survey of Canada, Paper 84-10: 137-154.

——— 1989. Last interglacial sediments of the Don Valley Brickyard, Toronto, Canada, and their paleoenvironmental significance: Discussion. Canadian Journal of Earth Sciences, 26: 1078-1082.

——— 1990. Interglacial beds at Toronto, Ontario. Géographie physique et Quaternaire, 44: 289-297.

Khan, E., 1970. Biostratigraphy and palaeontology of a Sangamon deposit at Fort Qu'Appelle, Saskatchewan. National Museums of Canada, Publications in Palaeontology, 5: 1-82.

Klassen, R. W., Delorme, L. D. and Mott, R. J., 1967. Geology and paleontology of Pleistocene deposits in southwestern Manitoba. Canadian Journal of Earth Sciences, 4: 433-447.

Kurtén, B. and Anderson, E., 1980. Pleistocene mammals of North America. Columbia University Press, New York, 442 p.

Lammers, G. E., 1968. A note on the Saskatoon site, Saskatoon, Saskatchewan, and its contained paleofauna. Napao, 1: 32-33.

Lichti-Federovich, S., 1973. Palynology of six sections of late Quaternary sediments from the Old Crow River, Yukon Territory. Canadian Journal of Earth Sciences, 51: 553-564.

Little, E. L., Jr., 1971. Atlas of United States trees. Volume 1. Conifers and important hardwoods. U.S. Department of Agriculture, Forest Service, Miscellaneous Publication 1146: 1-9, and maps of 200 species.

Lowdon, J. A. and Blake, W., Jr., 1973. Geological Survey of Canada Radiocarbon Dates XIII. Geological Survey of Canada, Paper 73-7: 1-61.

Matthews, J. V., Jr., 1975. Insects and plant macrofossils from two Quaternary exposures in the Old Crow-Porcupine region, Yukon Territory, Canada. Arctic and Alpine Research, 7(3): 249-259.

——— 1988. The last interglacial in the Canadian Arctic Archipelago and northern mainland: true and false signals. Climatic Fluctuations & Man, 3: 28-30.

McDonald, B. C., 1969. Glacial and interglacial stratigraphy, Hudson Bay Lowlands. Geological Survey of Canada, Paper 68-53: 78-99.

Mott, R. J., 1990. Sangamonian forest history and climate in Atlantic Canada. Géographie physique et Quaternaire, 44: 257-270.

Mott, R. J. and DiLabio, R. N. W., 1988. The Sangamonian interglacial in northern Ontario. Climatic Fluctuations & Man, 3: 33.

Mott, R. J., Anderson, T. W. and Matthews, J. V., Jr., 1982. Pollen and macrofossils study of an interglacial deposit in Nova Scotia. Géographie physique et Quaternaire, 36: 197-208.

Mott, R. J. and Grant, D. R., 1985. Pre-Late Wisconsinan paleoenvironments in Atlantic Canada. Géographie physique et Quaternaire, 39: 239-254.

Nielsen, E., Churcher, C. S., and Lammers, G. E., 1988. A woolly mammoth (Proboscidea, *Mammuthus primigenius*) molar from the Hudson Bay Lowland of Manitoba. Canadian Journal of Earth Sciences, 25: 933-938.

Piers, H., 1912. Mastodon remains in Nova Scotia. Transactions of the Nova Scotian Institute of Science, 13: 163-174.

Pilny, J. J. and Morgan, A. V., 1987. Paleoentomology and paleoecology of a possible Sangamonian site near Innerkip, Ontario. Quaternary Research, 28: 157-174.

Pirozynski, K. A., Jarzen, D. M., Carter, A. and Day, R. G.. 1988. Palynology and mycology of organic clay balls accompanying mastodon bones, New Brunswick, Canada. Grana, 27: 123-129.

Prest, V. K., 1970. Quaternary geology of Canada, p. 676-764. *In* Geology and Economic Minerals of Canada, Economic Geology Report No. 1. 5th edition. Department of Energy, Mines and Resources, Ottawa.

Reimchen, T. H. F., 1968. Pleistocene mammals from the Saskatchewan Gravels in Alberta, Canada. M.Sc. thesis, University of Alberta, Edmonton, 92 p.

Shilts, W. W., 1984. Quaternary events — Hudson Bay Lowland and southern District of Keewatin, p. 117-126. *In* R. J. Fulton, ed., Quaternary Stratigraphy of Canada — A Canadian Contribution to IGCP Project 24. Geological Survey of Canada, Paper 84-10.

Skinner, R. G., 1973. Quaternary stratigraphy of the Moose River Basin, Ontario. Geological Survey of Canada, Bulletin 225: 1-77.

Skwara Woolf, T., 1980. Mammals of the Riddell Local Fauna (Floral Formation, Pleistocene, Late Rancholabrean) Saskatoon, Canada. Saskatchewan Museum of Natural History, Natural History Contributions No. 2: 1-129.

——— 1981. Biostratigraphy and paleoecology of Pleistocene deposits (Riddell Member, Floral Formation, Late Rancholabrean), Saskatoon, Canada. Canadian Journal of Earth Sciences, 18: 311-322.

Skwara, T. and Walker, E. G., 1989. Extinct muskox and other additions to the Late Pleistocene Riddell Local Fauna, Saskatoon, Canada. Canadian Journal of Earth Sciences, 26: 881-893.

Squires, W. A., 1966. The Hillsborough mastodon. Atlantic Advocate, 56: 29-32.

Stalker, A. M. and Churcher, C. S., 1972. Glacial stratigraphy of the southwestern Canadian Prairies; the Laurentide record. 24th International Geological Congress, 1972. Section 12: 110-119.

Stalker, A. M. and Churcher, C. S., 1982. Ice age deposits and animals from the southwestern part of the Great Plains of Canada. Geological Survey of Canada, Miscellaneous Report 31 (wall chart).

Stea, R. and Hemsworth, D., 1979. Pleistocene stratigraphy of the Miller Creek section, Hants County, Nova Scotia. Nova Scotia Department of Mines and Energy, Paper 79-5: 1-16.

Stock, C., 1942. A ground sloth in Alaska. Science, 95(2474): 552-553.

Stock, C. H. and Richards, H. G., 1949. A *Megalonyx* tooth from the Northwest Territories, Canada. Science, 110: 709-710.

Stuiver, M., Heusser, C. J., and Yang, I. C., 1978. North American glacial history extended to 75,000 years ago. Science, 200: 16-21.

Szabo, B. J., Stalker, A. M. and Churcher, C. S., 1973. Uranium-series ages of some Quaternary deposits near Medicine Hat, Alberta, Canada. Canadian Journal of Earth Sciences, 10: 1464-1469.

Terasmae, J., 1960. A palynological study of the Pleistocene interglacial beds at Toronto, Ontario. Geological Survey of Canada, Bulletin 56: 23-41.

Tyrrell, J. B., 1892. Report on northwestern Manitoba with portions of the adjacent districts of Assiniboia and Saskatchewan. Geological Survey of Canada, Annual Report 5, Part 1E.

Vernal, A. de, Causse, C., Hillaire-Marcel, C., Mott, R. J. and Occhietti, S., 1986. Palynostratigraphic and TH/U age of upper Pleistocene interglacial and interstadial deposits on Cape Breton Island, eastern Canada. Geology, 14: 554-557.

Viereck, L. A. and Little, E. L., Jr., 1975. Atlas of United States trees. Volume 2. Alaska trees and common shrubs. U.S. Department of Agriculture, Forest Service, Miscellaneous Publication 1293: 1-19, and 105 maps.

Weigel, R. D., 1963. Ruffed Grouse from the Pleistocene of Saskatchewan. Wilson Bulletin, 75(2): 206.

Westgate, J. A., Fritz, P., Matthews, J. V., Jr., Kalas, L., Delorme, L. D., Green, R. and Aario, R., 1972. Geochronology and palaeoecology of Mid-Wisconsin sediments in west-central Alberta, Canada. 24th International Geological Congress, 1972. Abstracts, p. 380.

Youngman, P. M., 1986. The extinct short-faced skunk *Brachyprotoma obtusata* (Mammalia, Carnivora): first records for Canada and Beringia. Canadian Journal of Earth Sciences, 23: 419-424.