AGE AND ENVIRONMENT OF LATE PLEISTOCENE MASTODONT AND MAMMOTH IN SOUTHERN ONTARIO

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ABSTRACT—Of 113 fossil proboscidean reports, 61 mastodont sites and 27 mammoth sites were assignable to postglacial time—the past 15,000 years. A map of these 88 sites shows that most mastodont sites are found in the south on poorly drained proglacial lake plains, suggesting wetland habitat, whereas mammoth sites mostly occur northward on well drained upland terrain and especially on proglacial lake beaches. However, fossil pollen analysis of 13 mastodont and two mammoth sites does not indicate distinctive habitats. Twelve C-14 dates on five mastodont sites and two mammoth sites range from 4,300 to 12,000 years B.P., but the fossil pollen chronology of the sites indicates none is younger than 10,000 years B.P., which is the end of zone 1, the spruce (Picea) zone. At the Rostock mammoth site detailed analysis identified subzones 1p, 1a, and 1b which, respectively, reflect periglacial desert (14,500–13,000 years B.P.), tundra-woodland (13,000–12,000 years B.P.), and boreal woodland (12,000–10,000 years B.P.). Tusk fragments in subzone 1b were C-14 dated at 10,790 years B.P. The cause of extinction is unclear: fluted-point hunters were contemporaneous, but direct association has not been demonstrated. Extinction was, however, accompanied by a change to warmer and drier climate that reduced wetland area and eliminated boreal-type habitat.

DEDICATION
This paper is dedicated to the memory of our friend and colleague, the late Walter E. Kenyon, a fine human being.

INTRODUCTION
In southern Ontario (south of the Precambrian Shield) and adjacent areas of the United States once covered by late Wisconsinan ice, mastodont (Mammuthus americanus) and mammoth (Mammuthus spp.) have been C-14 dated to as young as 5,000 years B.P. Although most dates fall within the late Pleistocene, 12,000–10,000 years B.P., a few younger dates suggest that these animals persisted, at least locally, into the Holocene (later than 10,000 years B.P.). Dreimanis (1967) and Winn (1977) suggested that some Holocene mastodont dates in southern Ontario could be explained by the persistence of relict wetland spruce habitat on proglacial lake plains and that the scarcity of Holocene mastodont sites to the north was due to unsuitable habitat of pine and hardwoods. We will show that widespread persistence of relict spruce is unlikely and that young dates for mastodont (and mammoth) can be explained by the time-transgressive nature of sediment enclosing the bones and by contamination of the dated material by younger carbon. Although we cannot demonstrate that mammoth habitat differed from that of the mastodont, we believe a similar chronology of extinction applies. We agree with Dreimanis (1967) that climatic drying, closing of spruce woodland to form forest, and succession to jack pine forest paralleled the ultimate demise of proboscideans in Ontario. We differ in viewing this as a rapid process complete by 10,000 years B.P. without relict proboscidean survivals.

DISTRIBUTION, STRATIGRAPHY, AND CHRONOLOGY
Mastodont and mammoth sites in Ontario are confined to areas south of the Precambrian Shield with two exceptions from northeastern Ontario (Bell, 1898; Sternberg, 1963); both finds lack stratigraphic detail and thus are beyond the scope of this paper. There are no sites in eastern Ontario (Fig. 1) or Quebec.

In Ontario and adjacent parts of the United States, postglacial proboscidean bones are almost always enclosed by sediment of the Picea (spruce) pollen zone (zone 1) of the late Pleistocene (Whitehead et al., 1982; Kapp, 1986), which was succeeded in Ontario by the Holocene Pinus (pine) zone (zone 2).
(McAndrews, 1981). Not all sites are easily datable and suitable for pollen analysis because skeletal remains are usually fragmentary, with decay-resistant teeth most frequently recovered. Excavation has seldom yielded a substantial part of the skeleton. This is probably due to immediate post-mortem scavenging and scattering, subaerial decay of bones, and sedimentary recycling. Table 1 shows the available pollen analyses and C-14 dates for Ontario sites.

Proboscidean persistence into the Holocene Pinus or later zones is indicated by C-14 dates on tusk. The best-known examples of apparent persistence are the dating of two Michigan mastodons and one mammoth to the early mid-Holocene (Crane & Griffin, 1958, 1959, 1965). Seven late Quaternary Ontario proboscidean sites have been C-14 dated (Table 1). Meltzer and Mead (1985) evaluate six dates from five Ontario mastodont sites in a comprehensive review of Late Pleistocene extinctions. Only the date on wood from the Verbeke Site is rated optimal. However, with addition of three mastodont dates omitted from their list (Verbeke, Perry) and three new dates on two mammoth sites (Rostock, Muirkirk), a C-14 span of 12,000 to 10,000 years B.P. for Ontario proboscideans is better documented.

It is usually impossible to determine and date the precise stratigraphic horizon deposited at the time when a fossil proboscidean lived. The bones have a thickness that may encompass many years of sedimentation even if redeposition is ruled out. Bones, except those found in gravel pits, are usually preserved in waterlogged lacustrine clastic, mali, or gyttja deposits, or in ill-defined "muck" or "peat" deposits. In most cases they appear to be in pond sediment that is overlain by marsh muck or peat. It is likely that the animal either died in the pond and sank or died on the shore of the pond, after which the carcass drifted into open water where the bones fell into sediment or were covered by beach sand. In soft offshore sediment the bones may have sunk to an older level or more likely were interspersed with and covered by younger sediment, which, if dated,
<table>
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<th>Laboratory number</th>
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<td>1</td>
<td>bone collagen</td>
<td>4,290 ± 120</td>
<td>WAT-945</td>
<td>Pilny et al. (1987)</td>
<td>1b and 2</td>
<td>This paper</td>
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<td>tusk collagen</td>
<td>10,790 ± 150</td>
<td>WAT-999</td>
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<td>8,310 ± 200</td>
<td>Beta-17869</td>
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<td>1p or 1b</td>
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<td>1a</td>
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<td>S-30</td>
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<td>J. McAndrews, unpublished</td>
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<td>6</td>
<td>plant in skull</td>
<td>6,250 ± 240</td>
<td>S-16</td>
<td>McCallum and Dyck (1960)</td>
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<td>18</td>
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<td></td>
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<td></td>
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<td>Point Edward mastodont</td>
<td>19</td>
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<td></td>
<td></td>
<td></td>
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<td>Winn (1977)</td>
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Figure 2—Pollen diagram from the Rostock mammoth site. Miscellaneous pollen and spores are in Table 2. Spectra A–E are from sediment taken from skull cavities.

would result in an apparent age younger than the bone itself.

Another source of "young dates" is the position of the dated material, usually within a meter of the modern surface. Such shallow deposits are subject to contamination by groundwater and modern rootlets. Land et al. (1980) compared the isotopic taphonomy of modern and fossil deer bones and noted that fossils can rapidly lose their isotopic integrity and change toward equilibrium with carbonate in groundwater. Others have drawn attention to difficulties in evaluating dates on fossil bone (Tamers & Pearson, 1965; Haynes, 1968; Taylor, 1980). We argue that in many cases pollen dating is better than C-14 dating for late Pleistocene mammoth and mastodont remains, if enclosing and penetrating sediments are carefully evaluated.

Stratigraphic associations remove chronological outliers such as the Ferguson Farm Site where gyttja in a mastodont skull dates 6,250 years B.P. and collagen from the same animal dates 8,910 years B.P. Probable bone contamination by penetrating younger sediments leads to rejection of this date. Two other spuriously young dates, both on mammoth, will be discussed. Pollen evidence confirms that the Ontario proboscidean dates are consistent with Meltzer and Mead's (1985) observation that extinctions were complete by 10,000 years B.P.

PALAEOECOLOGY OF PROBOSCIDEANS

The Rostock Mammoth Site provides an example of pollen dating in conjunction with radiocarbon dating. It also serves as a late Pleistocene fossil pollen reference section. Mammoth bones, now in the Department of Vertebrate Palaeontology, Royal Ontario Museum (catalog no. 29753) were found on the cultivated surface of a peaty swale in 1981. They were a skull fragment with upper left second molar in place, a cervical vertebra, a scapula fragment, and part of a limb bone. Excavation yielded only tusk fragments at 27 cm depth, which is taken as the level on which the mammoth lived. Collagen from the scapula was dated at 4,290 ± 120 years B.P., but tusk collagen was dated at 10,790 ± 150 years B.P.

A trench was dug to expose the stratigraphy down to the basal glacial till, and samples for pollen and plant macrofossils were collected. The basal Elsa Till below 195 cm (Fig. 2) was deposited during the Port Bruce Stadial 14,500–14,000 years B.P. (Pilny et al., 1987). The overlying lacustrine silt is the surficial deposit around the swale (Karrow, 1971) and represents a turbid pond fed by glacial meltwater or postglacial elastic-charged runoff. The gravel layer at 105–100 cm may represent slope erosion upon local melting of permafrost (A. Morgan, University of Wa-
<table>
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<th>Location or depth (cm)</th>
<th>Sum density ml⁻¹ (×10⁶)</th>
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<tr>
<td>Acer</td>
<td>1</td>
</tr>
<tr>
<td>Ostrya/Carpinus</td>
<td>2</td>
</tr>
<tr>
<td>Juglans</td>
<td>3</td>
</tr>
<tr>
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<td>4</td>
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<td>Unknown</td>
<td>14</td>
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<td>Other</td>
<td>15</td>
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</table>

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Table 2: Miscellaneous pollen and spores from mammoth skull samples (A-E) and section (1-200 cm depth).

PLEISTOCENE PROBOSCIDEANS IN ONTARIO

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redeposited from the surrounding till. We reject interstadial organic deposits as a source because of a lack of detrital organic matter. Instead the pollen was probably blown northward from southern forests (Bearss & Kapp, 1987) and deposited on the glacier surface before being incorporated into the ice (McAndrews, 1984) and glacial till. Our view that subzone 1p represents a periglacial desert is supported by 1) low pollen density (<2,000 per ml, Table 2), 2) absence of conifer macrofossils, and 3) small amounts of herb pollen (Gramineae, Artemisia, and Cyperaceae) relative to tree pollen. Such a sparsely vegetated landscape is an unlikely habitat for proboscides.

In contrast to subzone 1p silt, the marl containing subzones 1a and 1b has 1) high pollen density (17,000–77,000 per ml), 2) low Pinus, but high Picea, Cyperaceae, and aquatic-plant pollen, 3) virtually no pre-Quaternary spores, and 4) the presence of Picea needles and seeds. Subzone 1a is distinguished from 1b by relatively low Picea and high Salix (willow) and Cyperaceae (sedge family). Macrophossils and pollen data indicate a few spruce and tamarack (Larix) trees in a tundra community dominated by dwarf birch (Betula glandulosa), willow, arctic avens (Dryas integrifolia), and sedges. The assemblage indicates a tundra woodland that was more dense in 1b than 1a.

Five sediment samples taken from cavities in the Rostock Mammoth skull were analysed for pollen. Three are assignable to zone 2 and two to zone 1b, suggesting two different dates and environments. This shows that the skull was deposited near the end of zone 1b as the pond dried out and jack pine (Pinus banksiana) began to succeed spruce. The position and date of the tusk is several hundred years older than most C-14 dates for the boundary between zones 1 and 2 in southern Ontario (Karrow et al., 1975). Zone 2 peat was deposited around the skull—an example of bone thickness encompassing centuries of sedimentation. Because the younger date (from scapula collagen) was on porous bone subject to contamination by modern rootlets, we reject it and accept the date on the less porous tusk, but more importantly the older date accords with the age of the spruce zone sediment. We also reject the Muirkirk mammoth date of 8,310 years B.P. (Table 1) as being too young because the dated bone was contaminated with rootlets (J. Stipp, Beta Analytic, Inc., personal communication, 1986); the associated pollen assemblage is zone 1.

PROBOSCIDEAN DISTRIBUTION AND GEOCHRONOLOGY

We have compiled reports of 75 mastodont, 31 mammoth, and 7 unspecified proboscideans from Ontario based on Jackson (1978), Sternberg (1930, 1963), Dreimanis (1967), Winn (1977), and unpublished reports. Mastodont records not pertinent to postglacial study include seven with no locational information, three duplications, two interglacial records, and two finds from northern Ontario. The remaining 61 reports appear to be postglacial with 58 in southwestern and three in south-central Ontario, regions separated by the Niagara Escarpment (Fig. 1). One mastodont identification (No. 17) is based on tusk that might actually be mammoth. The 31 mammoth reports are reduced to 27 when two duplications, one interglacial specimen, and one find later identified as mastodont are disregarded. Of these 27 occurrences, 23 are in south-central and four in southwestern Ontario. The quality of contextual and descriptive data for mammoth is more variable than that for mastodont.

Southern Ontario has abundant datable ice-recessional features. Consequently, we can identify geochronological associations for most proboscidean sites. Because southwestern and south-central Ontario have divergent histories of ice lobe retreat (Chapman & Putnam, 1984), we will consider finds for the two regions separately (Fig. 1).

Of the 57 mastodont sites in southwestern Ontario, eight are on the upland associated with the initial retreat of Port Bruce ice and therefore have maximum ages of 14,500 years B.P. The remaining 49 mastodont sites lie at a lower elevation and are therefore younger than various proglacial Great Lake strandlines with specific ages. Seven are below Lake Whittlesey, 32 below Lake Warren, two below Lake Grassmere, three below Lake Lundy, three below Lake Rouge, one below Lake Dana, and one below Lake Algonquin. Max-
imum possible ages range from about 12,700 to younger than 10,400 years B.P. Because 85% of assignable locations are below the Lake Warren beach, the principal period of mastodont occupation is after 12,500 years B.P. At least 20% of the locations lie below various later proglacial strandlines. Persistence of mastodont in the area after 10,400 years B.P. is suggested by the Point Edward site below the Lake Algonquin beach, but this appears to be erroneous. This site yielded only an isolated tooth, which was probably recycled from an earlier deposit, because sediment from the tooth cavity contains the zone 1 pollen assemblage (Table 1).

Table 1 shows that acceptable radiocarbon dates for five southwestern Ontario mastodonts span the period 12,000 to 10,000 years B.P. All C-14 dates are younger (by 300 to 3,300 years) than those of associated geochronologically assignable features and appear definitely to postdate 12,000 years B.P. Pollen analysis shows that they can all be assigned to zone 1 and thus are older than 10,000 years B.P.

Of four southwestern Ontario mammoth locations, two near Muirkirk are on the Ridgetown Island Moraine, which was submerged by Lake Whittlesey but exposed above subsequent Lake Warren. Both finds probably date to after 12,700 years B.P. A mammoth from Dufferin County lies adjacent to the Orangeville Moraine just west of the Niagara Escarpment, and the Rostock mammoth is on the Elma Till plain; both must post-date Port Bruce ice retreat, 14,500-14,000 years B.P.

Only three mastodonts are recorded in south-central Ontario. The Hamilton locality appears to lie at or below the Lake Iroquois beach and may date no earlier than about 11,500 years B.P. A St. Catharines locality lacks specific provenience but lies below Lake Warren levels and may date no earlier than 12,500 years B.P. An interior location (site 17 on Fig. 1) is based on an unverified report of a tusk specimen that no longer exists (A. Dreimanis, University of Western Ontario, personal communication, 1986) and thus could be mammoth; the site surface was deglaciated about 11,500 years B.P.

Of 23 mammoths from south-central Ontario, all but four are associated with Lake Iroquois features. Contemporaneity with Lake Iroquois is indicated for most, but the provenience and contextual data suggest that at least some are recycled from older land surfaces eroded by the proglacial lake. For instance, Coleman (1899) noted that it is doubtful whether mammoth remains from an old railway cutting, covered over for the Hunter Street tunnel in Hamilton, are from Iroquois beach deposits; they could be from an old land surface of pre-Iroquois age. The partly decayed bones were found in the “blue Erie clay” at the base of the cutting. Coleman (1899) noted mammoth bones from the Desjardins canal a mile or two to the northeast. These bones were 70 feet above the present lake and 30 to 40 feet below the level of Lake Iroquois. A tusk and some bones from this location, originally described as belonging to mammoth, were also identified by Baker (1920) as mastodont, an identification adopted by Dreimanis (1967). Although all of these remains were found below the level of Lake Iroquois, they may have been reworked from surfaces of earlier age.

Two mammoths from the Simcoe Lowlands to the north lie just east of the Niagara Escarpment and may date no earlier than about 12,300 years B.P., when the Port Huron ice withdrew from the Escarpment. A probable mammoth near Egypt, Ontario, came from the Lake Algonquin beach deposit and thus lived between 11,500 and 10,400 years B.P.

PHYSIOGRAPHIC REGIONS OF OCCURRENCE

Most mastodonts are found in the southwestern Ontario lowland bordering Lake Erie (Fig. 1). We believe that scarcity of mastodont in the upland regions of southwestern Ontario suggests unfavorable habitat and/or conditions for preservation. Almost 90% of the mastodont occur on lowland sand and clay plains typically developed on abandoned proglacial lake beds; 80% are below Lake Warren and more recent strandlines with 60% on the Warren plain (Jackson, 1978).

Mammoths are mostly found along the west end of the Lake Ontario basin with about 14 associated with Lake Iroquois shoreline deposits. Although several may be recycled from older deposits, most appear to be contem-
poraneous with Lake Iroquois. Three are known from the uplands of southwestern Ontario, including the Rostock mammoth, a fourth from just east of the Niagara Escarpment in the Simcoe Lowlands, and a fifth from the Lake Algonquin strand. Two are reported from the Ridgetown Island Moraine in the lowland southwest.

The nearly exclusive distributions and contemporaneity of mastodont and mammoth suggest occupation of different habitats, with mastodonts favoring the wetlands of the Lake Warren plain and mammoths preferring the better drained uplands and the strands of Lake Iroquois and Lake Algonquin. Coleman (1941) suggested that the beaches of Lake Iroquois, exposed to cool lake breezes, provided relief from insects. The landscape several kilometers inland from the strand may have been treeless tundra with wooded areas farther inland much like the southern shore of modern Hudson Bay. Detailed pollen and macrofossil analysis is needed to test this hypothesis.

**HABITAT DIFFERENTIATION**

The differential distribution of mastodont and mammoth in the late Wisconsinan of the Great Lakes area probably reflects their preferred environments and food sources. Skeels (1962) suggested that the mastodont was a forest dweller that browsed on vegetation along bogs and streams, while the mammoth was a grazer adapted to grasslands. Bunodont molars of the mastodont and high-crowned teeth of the mammoth suggest different diets. Martin and Guilday (1967) interpreted the forest-associated distribution of mastodont in the American Southwest (montane forest "islands" in the Sandia Mountains, New Mexico) as indicating they were more strictly browsers than mammoth. Winn (1977) hypothesized that an association with open water such as a lake or pond, as well as spruce-dominated vegetation, was crucial to mastodont survival in southern Ontario.

Dreimanis (1968) suggested that imperfectly drained lowlands in the Great Lakes area, which favored spruce-dominated vegetation, were a preferred mastodont habitat. He noted the coniferous aspect of plant remains interpreted as stomach contents from seven mastodont sites in eastern North America, associations of conifer macrofossils at twelve C-14 dated eastern mastodont sites, and dominance of spruce pollen at 17 of 18 eastern sites where pollen analysis was undertaken. The exception showed *Pinus* dominance but with *Picea* and *Quercus* pollen; we suspect that this assemblage correlates with the older subzone 1p rather than Holocene zone 2.

The fact that late Pleistocene mastodonts ranged over much of the North American continent suggests adaptation to more than strictly spruce-dominated environments. Mastodonts occurred in Florida beyond the southern limit of spruce forest during the Wisconsinan glacial maximum (Martin & Guilday, 1967). Near Port Charlotte, Florida, a late Wisconsinan deposit C-14 dated at 12,600 years B.P. contained mastodont as well as mammoth; pollen analysis of the enclosing sediment showed no *Picea* pollen (J. McAndrews, unpublished). King (1973) showed Middle Wisconsinan mastodonts in Missouri to have lived in an open jack pine parkland.

Pollen and C-14 evidence for the postglacial period strongly suggest that mastodonts lived in the Northeast during the time of the *Picea* pollen zone. Winn's (1977) suggestion of a preference for pond borders and marshes, together with the inexact data on stomach contents, indicates that spruce may not have been sought as food. Northeastern mastodont finds are conspicuously less abundant in well-drained, sandy areas and absent or rare in mountainous terrain (Dreimanis, 1968). Spruce vegetation did occur in these areas, but swamps and bogs were less abundant.

Late Wisconsinan mammoth remains in eastern North America are distributed from the glacial margins at 44°N south to Florida. A few hundred mammoths are known from Late Wisconsinan contexts, principally in the Great Lakes area (Hay, 1923; Skeels, 1962; Drumm, 1963; Wilson, 1967; Griffin, 1968; Agrenbroad, 1984). Mastodont fossils, however, are much more numerous. In southern Ontario, for instance, nearly three times as many mastodonts as mammoths are reported. Harrington and Ashworth (1986) and Maglio (1973) note that specialized molar structure may have enabled woolly mammoths to graze on coarse, tundra-like vegetation. Based
on this, on other morphological and dietary evidence, and on continental distribution patterns, they suggest that woolly mammoth indicates tundra-like habitats. They cite Russian studies of frozen mammoth gut contents as indicating a diet of herbs (sedges, grasses) and mosses together with twigs of shrub willow, alder, and birch.

Mammoth dung analyses from the Colorado Plateau show that diet was dominated by grasses and sedges but that twigs of saltbush, sagebrush, water birch, and blue spruce were also eaten (Mead et al., 1986). This suggests that mammoth preferred non-forest habitats dominated by graminoids and shrubs and indicates that tundra, steppe, and woodland would be a better habitat than dense forest. In contrast, direct evidence of mastodont diet is vague, with a more densely forested landscape indicated, although not one necessarily dominated by spruce. As yet, pollen analyses of sites in southern Ontario have shown no distinction in habitat.

REGIONALITY AND TIMING OF ONTARIO PROBOSCIDEAN EXTINCTION

Dreimanis (1967, 1968) advanced a climatic/environmental theory relating mastodont disappearance in northeastern North America to increasingly warm and dry conditions after 11,000 years B.P., which eventually caused disappearance of spruce-dominated habitats. He hypothesized that mastodonts could not migrate from local relic spruce enclaves toward the northward-retracting spruce habitat because these areas were separated by a rapidly expanding belt of pine and hardwood forests on the well-drained morainic, kame, and dune areas. We agree that increasing dryness resulted in rapid dwindling of the critical wet areas in spruce forest openings and that northward migration was not a viable alternative because mastodont habitat had ceased to exist. The shrinkage of surface water and shoreline vegetation rather than simply the decline of regional spruce vegetation (Whitehead et al., 1982) may have contributed to the decline of the mastodont. Lake-induced precipitation was probably reduced with the draining of proglacial Lake Algonquin. Thinning of the Laurentide ice sheet would have permitted increased southward flow of cold and dry arctic air into southern Ontario. These changes likely contributed to a radical drying of the land surface and a marked decline of aquatic vegetation that may have been critical to mastodont survival. Dreimanis (1967) suggested that the paucity of mastodonts along shorelines later than that of Lake Warren is partly explained by more rapid draining and absence of swampy conditions on these abandoned lake plains.

Similarly, mammoth habitat must have been severely affected by the warming that favored encroachment of pine into the well-drained upland spruce woodland. Northeastern mammoth extinction, like that of the mastodont, may be related to climatic and environmental changes accompanying final retreat of Laurentide ice. Replacement of upland grasses and sedges by forest at the end of the zone I spruce period could have had drastic effects on mammoth populations. Mammoth and mastodont may have briefly persisted in localized habitats after 10,000 years B.P., but good evidence for this is lacking.

PROBOSCIDEANS AND PALAEO-INDIANS

The presence of proboscideans 12,000 to 10,000 years B.P. coincides with the presence of Palaeo-Indian fluted-point hunters in southern Ontario at the time of main Lake Algonquin (Jackson, 1983). Did these early Palaeo-Indians exploit mammoth and/or mastodont in southern Ontario between about 11,500 and 10,400 years B.P.?

Chapman and Putnam (1984, Fig. 62) have divided southern Ontario into 52 minor physiographic regions. Significantly, 55% of assignable southern Ontario fluted-point locations occur in the same physiographic regions that account for over 90% of the mastodonts. Of eight physiographic regions where 5% or more of mastodont locations occur, all but two are also regions where 5% or more of southern Ontario fluted-point locations are found (Jackson, 1983). The spatial and temporal co-distribution of southern Ontario mastodonts and Palaeo-Indians suggests that at least occasional reliance was placed on mastodonts as a food source. This seems especially likely in view of growing evidence
for use of this animal in eastern North America (Graham et al., 1981; Fisher, 1984; Shipman et al., 1984).

Association of mastodonts with Palaeo-Indians has not been documented in southern Ontario. In the 1920's, however, a fluted point was reported in muck-silt beside a mastodont tusk and ribs in the Thames River valley (Garrad, 1971; E. Jury, University of Western Ontario, personal communication, 1978). Other tenuous co-occurrences of mastodonts and human artifacts have been reported in Ontario. Ami (1898) noted that deer bones and “arrow-heads” were found in the peat above a mastodont near Marburg. Dreimanis (1967) reported that mastodont molar fragments were found with “Indian relics,” and he later (1968) noted that a “possible skinning tool” was found with the Ferguson Farm mastodont. To our knowledge none of these tenuous associations has been described by archeologists, nor has there been an excavation at an Ontario proboscidean site specifically designed to recover archeological information. This oversight requires attention because, as Dreimanis (1968) suggested, human predation may have contributed to the final collapse of Ontario proboscidean populations.

The distribution of the less abundant mammoth does not coincide with areas of fluted-point abundance, although the occurrence of a few fluted-point sites along the Algonquin strand near Georgian Bay raises the possibility of mammoth exploitation, especially since mastodonts appear to be absent from this area.

Mastodont remains are absent from the two most important physiographic regions of Ontario fluted-point occurrence—the Huron Slope in southwestern Ontario and the Simcoe Lowlands in south-central Ontario. These two regions account for more than 30% of fluted-point locations in southern Ontario (Jackson, 1983). The major Parkhill site complex (Roosa, 1977) is located in the former, and the Fisher site complex (Storck, 1984) in the latter region. We suggest that this co-distributional anomaly might be explained by Deller and Ellis’s (1988) theory of time-sequential occupation of southern Ontario by at least three fluted-point-using cultures. The development of communal hunting organization over time in the American Southwest may be a useful analogy.

The caribou is the only large and gregarious herbivore present in the Ontario fossil record (Coleman, 1899) that was exploited in the bordering United States (Cleland, 1965; Spiess et al., 1985). Perhaps both the Parkhill and Fisher sites, with large activity area complexes, were associated with communal hunting of caribou. Fluted points from both sites are placed typologically late in the Ontario Palaeo-Indian time scale (Deller & Ellis, 1988). Deller (unpubl. manuscript, completed 1982) has suggested that these sites were located on the Lake Algonquin strandline because of reliance on migratory caribou traversing this feature. The dwindling of proboscidean populations after about 11,000 years B.P. in southern Ontario, therefore, appears to coincide with increased Palaeo-Indian site complexity, suggesting communal hunting of more gregarious species at late sites such as Parkhill and Fisher.

CONCLUSIONS

1) Postglacial fossil proboscidean sites are essentially confined in Ontario to south of 44°N and west of 79°W.

2) The 61 mastodont sites mostly occur in the south on poorly drained proglacial lake plains, whereas the 27 mammoth sites are mostly in the north and east on the well-drained upland and proglacial lake beaches, suggesting different regional habitats.

3) Dates on the proboscideans based on geological setting, C-14, and fossil pollen indicate that their time span was 12,500 to 10,000 years B.P.

4) This interval was a time of spruce-dominated tundra-woodland and forest, but plant-fossil analysis has not distinguished different habitats for the two species.

5) Although fluted-point hunters were contemporaneous with and geographically overlapped with the proboscideans, there is no good evidence for predation.

6) Extinction coincided with climatically induced succession to jack pine and hardwood forest and shrinkage of wetlands.

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