



MAMMOTH TRUMPET

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Center for the Study of the First Americans
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DON ALAN HALL

Peopling of the Americas Symposium

Amateur and professional archaeologists packed the auditorium in Portland's Oregon Museum of Science and Industry to hear exciting new evidence that the first Americans traveled the Pacific Rim. Highlights of addresses by the experts at the CSFA-OMSI Symposium begin on **page 1**.

Following
the Pacific
Coast to
America

Mammoth Hunter



Scientist Ross MacPhee enjoys a brief burst of sun by the Itsivilitsky River on Wrangel Island, where he was leading a team seeking evidence that disease—not hunters or climate change—was responsible for driving mammoths and other Pleistocene megafauna to extinction. Our report begins on **page 14**.



CLARE FLEMING

The Center for the Study of the First Americans fosters research and public interest in the Peopling of the Americas. The **Center**, an integral part of **Oregon State University**, promotes interdisciplinary scholarly dialogue among physical, biological and social scientists. The **Mammoth Trumpet**, news magazine of the **Center**, seeks to involve you in the late Pleistocene by reporting on developments in all pertinent sciences.

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CHARTING THE WAY INTO THE AMERICAS

Scholars Link Theory with Reality during CSFA-OMSI Symposium



The Pacific Rim route has advanced to a predominant hypothesis that has passed significant tests. Scientists who have proposed, and who are testing, the theory that the Americas were initially settled by Pacific coastal people gathered in Portland, Oregon, last August for a lively day-long discussion.

They described revelations that included:

- Retrieving a stone tool from a 10,200-year-old shoreline painstakingly identified as a likely archaeological site on a lost landscape more than 50 meters under the sea off British Columbia.
- Finding skeletal remains of a man who lived in southeast Alaska more than 9,000 years ago and determining that his diet was almost exclusively marine foods.
- Discovering that before 12,000 years ago there was a great expanse of open tundra off the coast of British Columbia.

The occasion was a Peopling of the Americas Symposium, which drew more than 200 people. The event was sponsored by the **Center for the Study of the First**

Following the Pacific Coast to America

Americans and the Oregon Museum of Science and Industry. CSFA Director Robson Bonnicksen introduced seven visiting scientists who presented evidence that the first Americans had gradually followed the Asian Pacific coastline around into the New World.

"The idea that humans moved along the Pacific Rim to the Americas is not new," said Dr. Bonnicksen. "Almost 20 years ago Knut Fladmark of Simon Fraser University provided the most articulate case for the coastal migration hypothesis." It was Fladmark's proposal that humans could have moved along the Pacific Rim during full glacial times, probably using watercraft to advance from one unglaciated refugia to the next, living on fish and marine mammals. "Even though Fladmark's thesis was clearly articulated," said Bonnicksen, "many archaeologists would not readily endorse it." Dr. Fladmark himself presented his personal retrospective on the coastal hypothesis later in the symposium ("Fladmark," page 4), but the three initial presentations covered recent research that is proving that North America's Northwest Coast was a likely route from Beringia into the New World.

In introducing the symposium, Bonnicksen detailed archaeologists' changing perceptions of how the Americas were peopled. He reviewed the Clovis-first hypothesis *continued on page 3*

ICE AGE EXTINCTIONS

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Mammalogist Ross MacPhee and AIDS researcher Preston Marx think bones may hold the key to solving mystery

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23 Extinctions in industrial age are also puzzling

2 Wormington Award announced

CSFA Honors Dean Scanlan, Sandy & Larry Tradlener

Richard A. Scanlan, recently retired Dean of Research at Oregon State University, is 1998 recipient of the H. Marie Wormington Award. Given yearly by the **Center for the Study of the First Americans**, the award recognizes those who have advanced the cause of First American Studies.

Regarded as the highest award CSFA can present, the Wormington Award is named for H. Marie Wormington, long-time curator of archaeology at the Denver Museum of Natural History, who died in 1994. Dr. Wormington is remembered for the encouragement she gave to both avocational and professional archaeologists as well as for her influential books on Paleoindian studies that are still in use today. She often acted as an unofficial informational crossroads and helped to facilitate the exchange of ideas among the many Paleoindian archaeologists that she had contact with. The first Wormington Award was presented in 1989 to George and Helen Cremer of Melville, Montana, at the World Summit Conference on the Peopling of the Americas at the University of Maine.

Dean Scanlan, who for many years represented Oregon State University at meetings of the **CSFA** Advisory Board, was lauded for his remarkable service to **CSFA**, and for the great contribution he has made to **CSFA** with his common sense, his friendship and steadfast support. He was presented with a book of Native American myths and a framed print of a wise owl designed by Joanne Turner, a Board member and geologist from Boulder, Colorado.

Board Chairman Marvin Beatty said, "Dean Scanlan won the hearts of the advisory **CSFA** Advisory Board members over the years he met with us as the official representative of OSU. His warm Irish good humor, his knowledgeable comments, thoughtful advice and clear explanations of how OSU functions were enormously helpful to the Advisory Board members as we began our relationship with a new (to us) educational

institution." The **Center for the Study of the First Americans** moved to Oregon State University from the University of Maine in 1991.

Center Director Robson Bonnicksen observed that Scanlan "was a great person to work with because he's a good communicator, he's honest and he's fair."

Before becoming dean of research, Dr. Scanlan was a food scientist at OSU, doing research in a variety of areas, but particularly food toxicology and flavor chemistry. He taught courses including food chemistry, food analysis, food fla-

vors and food toxicology. He continues to live in Corvallis, Oregon.

The **Center's** Honorary Mention of Outstanding Services Award was presented to Sandy and Larry Tradlener for their outstanding efforts in putting together the 1998 Gala and Auction benefit May 15 in Portland. The Advisory Board was enthusiastic in its praise for the Gala setting and the superb job the Tradleners did in organizing and executing the affair. The Tradleners were presented with a plaque and a mammoth statue bearing the inscription "For a Mammoth Job."

"Larry and Sandy Tradlener hit the ground running when they joined the board," said Chairman Beatty, a Madison, Wisconsin, soil scientist. "Sandy arranged for helpful donations of equipment. Larry led the 1998 Gala and Auc-

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Charting the Way into the Americas

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pothesis and described a number of archaeological sites, including Monte Verde, Chile; Chesrow and related sites, Wisconsin; LaSena, Nebraska; and Cactus Hill, Virginia, that contradict the Clovis-first model. He also reviewed physical anthropological evidence that suggests that the early colonization of the Americas was more complex than the long-popular model of a single population of mammoth hunters passing between continental glaciers to populate North America starting from the Great Plains.

Paleoecologist Rolf W. Mathewes of Simon Fraser University continued the symposium by describing the "lost world" that existed along the west coast of Canada after the last glacial maximum. He showed pictures of what that lost world probably looked like. In what is now Hecate Strait between the Queen Charlotte Islands and the British Columbia mainland about 14,000 years ago, Dr. Mathewes said, "you would see something like this." His slide depicted a vast treeless plain with a background of snowy mountains. It was a photograph of a valley in the Yukon, but 14,000 years ago the sea floor under Hecate Strait might have been the treeless plain and the Queen Charlotte Islands the glaciated mountains beyond.

"This is the landscape that early colonizers would have seen had they traveled along the coast." Now, of course, the area is under at least a hundred meters of water, he added, "but that landscape *was* there—we *know* it was there."

Mathewes explained how scientists use pollen analysis—"nature's fingerprints"—to understand the paleoecology of that lost world. A retreating glacier will leave lakes and ponds. The first plants to colonize the area will immediately start releasing pollen, some of which will blow into a lake and sink to the bottom. Showing a picture of a glacial lake, Mathewes explained that sediments accumulating on the bottom of such a lake provide a continuous pollen record from the time of the lake's formation to the present. "When you take a core or sample of the sediment, you can microscopically analyze, count, and identify the pollen grains, and really reconstruct in detail the vegetation around any site like this."

Showing an example of a pollen diagram from Cape Ball on the east side of Graham Island in the Queen Charlottes, he said that the technique has been used in many places along British Columbia's coast. The diagram, he explained, shows the main pollen types and their relative abundance. From such information, paleoecologists can reconstruct vegetation communities and know that between 15,000 and 12,000 years ago the area was treeless, unglaciated terrain. "It looked very much like what you find in Alaska and the Yukon—a so-called herb zone with dwarf shrubs such as willows, which shows no evidence of any significant number of trees," Mathewes said. "This is a good window on what that coastal landscape was like at the probable time of entry."

While not ruling out the possibility that the first Americans came along the coast before the last glacial maximum, Mathewes regards the period being mentioned by many ar-

chaeologists—between 15,000 and 12,000 radiocarbon years ago—as the most likely. But he sees the possibility that it could have been relatively early in that era of deglaciation. "Even if there were some ice tongues sticking out on the continental shelf, in theory people could have used skin boats or other such devices to get around," he said.


Asked to describe the coastal environment before 15,000 years ago, Mathewes stressed that little is known about the previous 10 millennia. Evidence is limited for the period between 50 and 30 thousand years ago, which was before the buildup of the last glacial maximum. In that earlier period, he said, the Queen Charlotte Islands were definitely forested. "In fact there is evidence of true fir trees on the Queen Charlottes,

Coastal Route?



**Following
the Pacific
Coast to
America**

It's no wonder that most American archaeologists long chose to ignore the Pacific Rim as a likely route for the first Americans to have entered the New World. They were well aware that:

- Sea level had risen more than enough to drown the evidence.
- Rain-soaked soils of deeply forested coastal mountains would make unsubmerged sites poorly preserved and difficult to find.
- Maps of the glacial maxima depicted Cordilleran glaciers pushing into the ocean everywhere from the Puget Sound northward.
- The same maps indicated the possibility of a convenient mid-continent corridor of entry.
- Evidence of humans in the Americas before 11,500 radiocarbon years ago was controversial.
- Scientific wisdom dictated that the earliest Americans were terrestrial big-game hunters. 

which are now not there at all, so the forest was maybe even more diverse." Information from dates of around 47,000 and 30,000 years ago, he said, indicates temperatures cooler than today. "But it was not nearly as severe then as it was during the late glacial period between 15,000 and 12,000 years ago."

The period before 30,000 years ago would have had a great diversity of plants available, said Mathewes, "and by analogy, probably lots of mammals as well. It certainly would have been a human-friendly environment by any modern comparison."

He called the period of between 25,000 and 15,000 "the big question mark." It's a scientific question he has been working on because it involves trying to understand how the various species of trees survived the glacial extremes. Were there refugia along the coast of British Columbia and Alaska that offered a habitable environment before 15,000 years ago? "I've never found a site where I've been comfortable with the dates that show some continuous habitable environment between 15,000 and 20,000," he told the symposium audience. Caves on Alaska's Prince of Wales Island, he suggested, may supply that missing evidence.

"I'm going to do some work on the Queen Charlotte Islands

Fladmark, Still a Coast-Route Champion,

KNUT R. FLADMARK, the archaeologist perhaps most often associated with the hypothesis that people first entered North America along the Pacific coast, still is a strong champion of the theory. However, although the coastal route hypothesis is now being seen as the most likely scenario by many scientists, he believes many archaeologists still have it wrong because of their natural terrestrial bias.

Dr. Fladmark concluded the CSFA-OMSI Peopling of the Americas Symposium with a retrospective look at the theory. "While my name seems to be fairly commonly associated with the coastal route hypothesis, I certainly cannot take credit or blame for its invention." He said the idea may go back as far as Aleš Hrdlička in 1932, but certainly to Calvin J. Heusser, who presented evidence for a series of glacial refugia along the Northwest coast in his doctoral dissertation published in 1960. "As a graduate student in the late '60s and early '70s," Fladmark recalled, "I spent many hours poring over Heusser's book, and a week's food money Xeroxing a copy."

In the 1960s, Fladmark's first experience at field archaeology was in the Queen Charlotte Islands, which he said was then "unknown territory" to archaeologists. He chose the area for the first field project he directed, and it turned out to be a stimulating experience. His site on the northern end of the Charlottes yielded two successive assemblages of simple flaked-stone tools. These, he said, seemed to be separated and deeply buried in a series of deposits that a visiting geologist identified as glacial outwash.

"So here I was—a graduate student stuck in unknown territory—who had discovered two simple flaked-stone tool assemblages with no known parallels at that time on the Northwest coast. And they both seemed to be in interglacial contexts," he told the symposium. The experience made him very interested in the possible ways that very early people might have been able to move along the coast.

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He eventually realized the "glacial outwash" was simply the raised beach deposits, which Daryl Fedje had described earlier in the symposium. Ideas of early coastal inhabitants were further discouraged by the dominant geological opinion of the time that glacial ice completely covered the continent to the continental shelf.

Fladmark reiterated descriptions of coastal refugia offered by the symposium's previous speakers. "In terms of their inhabitability, one factor that has to be remembered is that even very small refugia—basically nothing more than a rocky headland or a small offshore island—fronted unfrozen Pacific ocean, at least seasonally unfrozen. And any inhabitants—anybody that was able to reach such a location—would have had access to all the riches of the north Pacific."

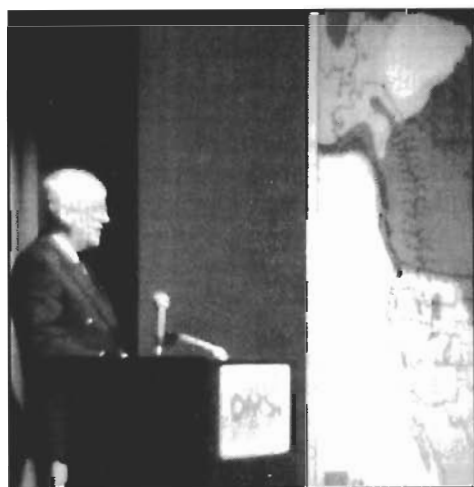
Still, said Fladmark, archaeologists are reluctant to see the first Americans as maritime people. They tend to have, he said, "an instinctive reaction against the possibility of maritime-adapted Paleoindians or proto-Paleoindians operating any kind of efficient ocean-going water craft in late-

North America has lost late-Pleistocene coastal plain half again as big as Texas

Pleistocene environments." He stressed that archaeology is a very terrestrial adaptation, except for some underwater investigations. "We require sites on land, we dig in land, we walk on land." Because of the terrestrial contexts for their sites, he said that archaeologists often deny or ignore the possibility of early maritime adaptations in almost all parts of the world.

And he sees an obvious reason. "In many parts of the world one simply can't get access to the shorelines much older than 10 or 11 thousand years." In the context of initial settlements of

Symposium speaker Rolf W. Mathewes shows a map of Pleistocene glaciation.



where there is evidence that between 30,000 and about 21,000 years ago there was a slow cooling taking place. You lose your trees and by 21,000 you're into a willow-tundra environment—treeless. Then you get to glaciation." After 15,000, he added, the willow-tundra environment resumes and continues until about 12,000 years ago when the trees invade.

Coastal environment at the height of the last glaciation, he said, requires more study. "Other people argue that there probably were continuous refugia," Mathewes said. "I still think it's a hypothesis, but not proven."

Recent work by geologists has altered earlier views that the coast was totally covered by ice throughout the last Ice Age. They suggest the glaciers were in tongues that left a large amount of the coast unglaciated. Unglaciated places would have been available as refugia for plants and animals and they could have served as "stepping stones to allow people to island-hop

Decries Archaeology's Terrestrial Bias

North America, the amount of territory lost to dry-land archaeologists is considerable. He calculated that by using a rise in sea level of 100 meters, North America has lost approximately 860,000 square kilometers of late-Pleistocene coastal plain.

"That's close to a million square kilometers of very desirable, very inhabitable range that is now under water around this continent alone. That's a land area approximately equal to one-and-a-half times the size of Texas, to use a term of measurement familiar to Americans," Fladmark said.

Thus, he said, there is a very simple reason that there are so few coastal sites in the world older than 8,000 or 9,000 years. "I've said it before, and everybody else in this symposium has said it, but it is not being absorbed. Late-Pleistocene and early-Holocene rise in sea levels simply drowned or washed away evidence of nearly all earlier coastal adaptations everywhere around the world—including northern Pacific coast of North America."

It is "completely unjustified," he stressed, to interpret the scarcity of early sites in coastal areas as an indication that marine-maritime adaptations are a fairly late development in human history.

"One possibility that we haven't talked much about in this symposium," said Fladmark, is that the drowned coastal areas "may actually have been focal points for cultural innovation and cultural evolution." Perhaps the workshops where American flintknappers originally developed and perfected tools like Clovis points are somewhere off the coast, underwater. Perhaps an originally maritime people carried new ideas into the continent as people became adapted to life in the interior.


Though not taking issue with symposium participants, including C. Loring Brace, who suggested that "migration" into the Americas was no doubt nothing more than populations expanding generationally into open territory, Fladmark also raised the possibility that maritime people can, if they wish, move fast. He said that people paddling skin boats like those used by Point Barrow Eskimo whalers could travel at least two

kilometers an hour, and calculating six hours of travel a day, they could make the approximately 20,000 kilometers from the Aleutian Islands to Chile in about four and a half years. They could reach the Columbia River in less than a year, and, theoretically, also could move inland.

Fladmark emphasized that such spans of time are consider-



During a break in the proceedings, Ruth Gruhn, co-organizer of the symposium, speaks with Knut Fladmark.

ably less than standard deviations of radiocarbon dates, and thus quick, coastal migrations "would be completely indistinguishable in our radiocarbon chronologies." And unfortunately for archaeology, people traveling by boat would leave few, if any traces. They might be archaeologically invisible. "That may be something we should think about a little more." 

-DAH

from Beringia all the way down the coast—even during fairly early phases of deglaciation."

Biologists, not archaeologists or geologists, have been the leading supporters of the theory that there were glacial refugia along the coast. Mathewes said the Queen Charlotte Islands have been called the Galapagos of Canada because of the endemic subspecies of plants and animals they harbor, suggesting long isolation.

"As this ice sheet started to retreat locally around 15 to 14 thousand years ago," he said, showing a map of British Columbia buried under the cordilleran ice, "these refugia expanded rapidly, and by 14 thousand years ago we find evidence of extensive ice-free areas down the outer coast." The coast, he emphasized, thus offered a much earlier route of entry for human migration than the so-called ice-free corridor, "which we know was blocked until about 12,000 years ago."

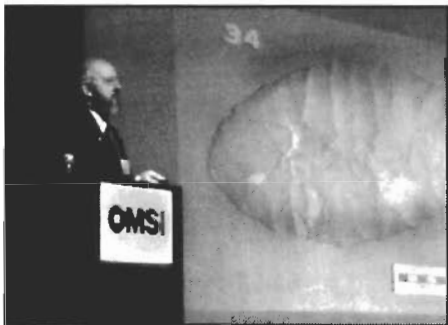
Mathewes showed the audience other slides of what he believes British Columbia's great coastal plain looked like before 12,000 years ago. One photograph depicted coastal tundra in the Aleutian Islands. The treeless area now deep under Hecate Strait supported diverse vegetation made up of members of the parsley family, grasses, sedges and a diversity of other herbs and plants. Similar plant communities still occur on the Aleutian Islands and in coastal Alaska, he said.

Still other slides depicted pollen grains, evidence of food plants available 14,000 to 12,000 years ago: crowberry, a common plant at a number of sites he has studied and a food resource available in summer; different fireweeds and docks, "all highly edible as greens"; bistort, "Northern tribes today use the highly starchy roots as a food resource"; and chocolate lily, "very important starchy vegetable for modern Indian tribes."

Food plants, then, were definitely available. "And where

there are plants, there are almost certainly animals." He cited paleontological evidence of terrestrial mammals, including both brown and black bears, as well as sea mammals along the coast of the Alaskan panhandle late in the last Ice Age.

"Wherever you have animals as large as grizzlies and black bears, there has to be a lot of food around for them to even survive, said Mathewes. "Having food enough for bears certainly means that



Robson Bonnicksen shows a slide of a stone tool as he reviews archaeological theories.

there's going to be food around for humans as well." After 15,000 years ago the opportunity for human migration along the coast increases dramatically, with an optimum "window" between 14,000 and 12,000 years ago. "It is now up to the archaeologists to find the decisive evidence of human presence at that time."

E. James Dixon, curator of archaeology at the Denver Museum of Natural History and an archaeologist with many years of experience in Alaska, continued

the program by presenting archaeological evidence from Prince of Wales Island, in Alaska's Alexander Archipelago north of the Queen Charlottes. It was there that proof was found that bears and other mammals wintered the Ice Age on the coast during a continuing research effort of the area's limestone caves ("Ancient Alaskan Bones May Help Prove Coast Migration Theory," **Mammoth Trumpet** 12:4).

Dr. Dixon explained the difficulty involved in challenging the paradigm for explaining how humans first reached the Americas. Though he long believed that coastal Alaska held undiscovered clues, his proposals for testing the coastal hypothesis were treated with a great deal of skepticism. He said that his 1993 book (**Suggested Readings**), which suggested that Fladmark had been right to propose a coastal migration route, "met with a lot of controversy." He credited Mathewes's paleoenvironmental work and the work of other scientists including Timothy Heaton, paleontologist at the University of South Dakota, for providing solid evidence that has encouraged further research.

It was Dr. Heaton who discovered animal bones, dating back to more than 40,000 years in caves, including site 49-PET-408, on Prince of Wales Island. And at that archaeological site, Dixon and colleagues have excavated an extensive deposit bearing evidence that people were there at least 9,200 years ago. Portions of the skeleton of one of those people, identified as a man in his early 20s, were found in the cave. His scattered bones

may represent the result of an unfortunate bear-hunting episode, or they may be a burial disrupted by scavengers.

Though he possibly was no more than a distant descendant of the first people who came along the Alaskan coast, and though the skeleton was fragmentary, the bones spoke volumes to the scientists who analyzed them. One revelation came from carbon isotope analysis, which Dixon illustrated with a slide of isotopic data showing how the diet of the ancient Alaskan compared with a variety of animals.

"It looks like this individual is truly adapted to a maritime diet," he said. He definitely was not a terrestrial or mixed feeder like a fox or bear. The isotopic signature, in fact, resembles that of the ringed seal. "This is very important," said Dixon, because it had been speculated that even though archaeological sites were near the coast, the people may not have been maritime adapted—they may have been inland people. "I think this is really very strong evidence. This is the oldest human skeletal material ever found in Alaska or Canada and very important to this discussion."

Dixon described other information the bones yielded, and he acknowledged the support of local tribal governments, which have been supportive of the research. The man's age at death was determined by the eruption pattern of the teeth and the degree of maturity apparent in the pelvis. Notches worn in a tooth indicated that he frequently had engaged in an activity such as holding fishing line or splitting sinew.



Six of the symposium participants take part in a noontime press conference. From the left are Rolf W. Mathewes, E. James Dixon, Daryl Fedje, Michael J. Moratto, C. Loring Brace, and Knut R. Fladmark. Co-organizers Robson Bonnicksen and Ruth Gruhn were on Mathewes's right.

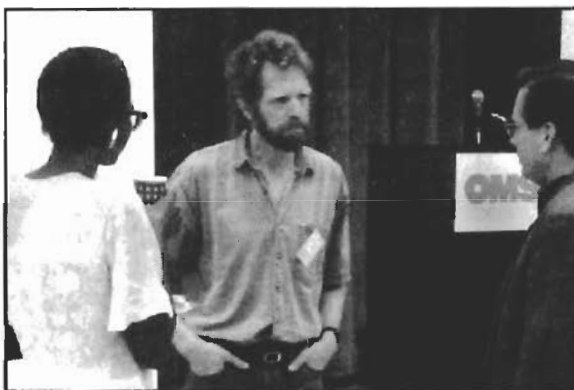


Discussing the symposium are participants Rolf W. Mathewes, left, Knut R. Fladmark, Ruth Gruhn, Robson Bonnicksen and Nancy Stueber, vice president of exhibits at the Oregon Museum of Science and Industry.

This information was recovered because of an explicit strategy initiated nearly a decade ago by Dixon and colleagues to look for environmental and archaeological clues in limestone caves on Alaska's southeast coast. The result was the Tongass Cave Project, a large project involving the U.S. Forest Service and American Speleological Society, and especially that society's local affiliate, Glacier Grotto. He said that volunteer cavers from all over the world—Russia, Japan, and Germany as well as the United States—have taken part. "They explore these limestone formations," he said. "They do incredible feats of exploration, rappelling down black holes and swimming under water through caves to find their openings. In the process, they have a very good ethic. They map these caves, they report them. Anything they see that might be of archaeological interest, or paleontological interest is reported to us. So we follow up on their leads, and this has led to several discoveries." PET-408 was discovered during a survey for an environmental impact statement by a private contractor working for the Forest Service. The find was then investigated by a member of the Tongass Cave Project.

Dixon gave a progress report of the archaeological investigation of this site,

which extends into the cave from outside its mouth, and includes components dating to 5,700 as well as 9,200 years ago. In 1998 they found evidence of bear hunting. The 9,200-year-old level included microblades among its many artifacts, and a still-lower unit may have a smattering of other archaeological material. "For the first time we have the complete stratigraphic sequence," he said, noting that excavation has extended to bedrock. A



Daryl Fedje answers questions about his research put to him by reporters from the *Seattle Times* and *U.S. News and World Report*.

bone tool from the cave has been dated to 10,300 years B.P., suggesting even earlier occupation at the site.

PET-408 also yielded large projectile points, and such "heavy artillery," he said, is unusual in microblade sites. Illustrating how microblades are presumed to have been fitted into slotted shafts—arrows—he said that such weapons have

been used up to recent times by Bering Strait people. If PET-408 microblades were used to arm arrows, as archaeologists presume microblades were, he said they represent, "as far as I know, the earliest introduction of the bow and arrow to North America."

PET-408's microblades provide evidence for coastal migration. Dixon called the symposium audience's attention to a slide depicting blades of quartz crystal and of obsidian. "These are rock types that do not occur on Prince of Wales Island," he said, but they do occur on other islands and obviously were transported, possibly by traders.

Dixon sees a pattern emerging in sites along the Northwest Coast that supports coastal migration. The trading of obsidian and quartz crystals 9,200 years ago, a time when sea levels were higher than those today, necessitated some kind of watercraft. "There's very little doubt that by 9 to 10 thousand years ago along this vast area of the Northwest Coast from the Queen Charlotte Islands all the way up to southeast Alaska, people were adapted to a marine environment. They were ca-

pable of intercoastal navigation, and many of their settlements were along the coast."

Evidence of that antiquity suggests to Dixon that the first people must have come considerably earlier. "These kinds of established trade networks, subsistence patterns, and navigational skills, just didn't happen overnight."

THE EIGHT scientists making presentations to the Peopling of the Americas Symposium at Portland's Oregon Museum of Science and Industry late last summer all believe the first humans to enter the Americas from Beringia probably came along the coast. The actual timing of those initial settlers was not part of the day's focus, but it was clear from their presentations that the six archaeologists, one paleobiologist, and one human biologist have a range of opinions about the timing of the Americas' earliest migrations.

Robson Bonnicksen, in his introductory presentation, declared the end of old paradigms. "The Clovis-first model is dead," he said, after reviewing evidence from many archaeological sites as well as a variety of other evidence indicating human presence much older than the culture that left the beautiful stone projectiles named for Clovis, New

Mexico. Dr. Bonnicksen, Oregon State University archaeologist and director of the CSFA, called Clovis tools "an elephant-butcherer kit."

As Old Paradigms Fade,

"Many of these artifacts are absolutely exquisite," he said, and because they appeared suddenly, without evident precursor, people took them to represent a migration that spread quickly into the Americas through a hypothetical unglaciated strip thought to have existed between the continent's two great glaciers about 12,000 radiocarbon years ago. Bonnicksen, Rolf W. Mathewes, and E. James Dixon, each in turn, refuted the long-accepted idea of an ice-free corridor leading Beringians into the American heartland.

Dr. Dixon summarized scientific thinking expressed at a Beringia conference he had recently attended: "The consensus of primary researchers on this hypothetical ice-free corridor during this last major glaciation," he told the symposium, was that "there really was no corridor." Ice blocked the way from about 30,000 to 12,000 years B.P.

The symposium's death knells for the ice-free corridor and Clovis first, however, did not mean that participants were in full agreement as to when humans most likely arrived in the Americas. Bonnicksen told reporters at a lunchtime news conference that the archaeological record is suggesting people were here at least by full-glacial times. Some authorities would argue about humans earlier than 30,000 years, he said, but "more and more evidence is coming out that we do have older sites." He said that artifacts from near Chile's

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Following Dixon's presentation, Parks Canada archaeologist **Daryl Fedje** vividly illustrated the daunting difficulties and the potential achievements of research on the early archaeology of the Northwest Coast.

Fedje has spent the last several years working on the Queen Charlotte Islands, home of the Haida people, who call the islands Haida Gwaii. As an employee for Canada's national parks system, he has worked closely with the Haida in Gwaii Haanas, a wilderness park in the southern part of the Charlottes, and elsewhere in the area.

Searching for archaeological sites led Fedje to study paleoecology to determine the precise times that sea level changed. He found the time of higher sea level by taking cores from lake sediments and dating the horizons that indicated transition from fresh to salt water. He radiocarbon dated small pieces of organic matter, such as needles and twigs, to get precise age of the transitions. As a result he found that between 9,000 and 6,000 years ago sea level in part of Haida Gwaii was 15 meters higher than it is today.

"Diatoms are one of the best indicators of changes in water chemistry,"

Fedje explained. "They're very sensitive to salinity changes and they're also very well preserved. Fedje learned that while he was determining the time of higher sea level on land, the Geologic Survey of Canada was doing the same underwater just offshore in Hecate Strait. Eventually he was able to start working with marine geologist Heiner Josenhans examining evidence of the drowned landscape—the coastal tundra Mathewes had described earlier in the symposium.

They determined that before 9,400 years ago, sea level was much lower. It had risen rapidly starting about 13,000 years ago. But in four years of work aboard rolling Coast Guard research vessels they learned much more, thanks to instrumentation of the Canadian Hydrographic Service. They were able to conduct a highly detailed survey of the sea floor in the particular area they chose, in Juan Perez Sound on the east side of Moresby Island.

"Like mowing the lawn," Fedje said, their ship took swath after swath across the sound, gathering detailed sonar data on about 10 square kilometers of the sea floor into computers. "It's really quite incredible," he said; "immense, immense



DOY ALAN HALL

Ruth Gruhn, the University of Alberta archaeologist who has long championed the coastal-entry hypothesis and the importance of early sites in South America, answers questions after her presentation.

Timing Isn't the Issue

Monte Verde site dated to about 30,000 years ago look as convincing as those from 12,500-year-old Monte Verde itself. Other symposium speakers, notably Dixon and C. Loring Brace, a biological anthropologist, expressed a more conservative outlook.


Knut Fladmark made a point of withholding judgment on the veracity of Monte Verde as a pre-Clovis site, and he suggested that some of the new popularity of the coastal hypothesis might be the result of misguided attempts to explain early sites in South America rather than being based on the real merits of the Northwest coast route. In answer to a question from the symposium audience, he said that the coastal-route hypothesis could readily explain Clovis people arriving 12,000 years ago.

Dixon, who readily accepts Monte Verde as evidence of a pre-Clovis site, stressed his own conservatism regarding the timing of human entry into the New World, and suggested that the earliest date was 14,000 or perhaps 15,000 years ago—the time-frame used by paleobiologist Mathewes. “I think we should be a little bit cautious,” said Dixon. Referring to several presumed pre-Clovis sites mentioned at the symposium, he said, “Consensus really has not emerged on the age and nature of many of these sites, but there’s enough of them around to sort of make us suspicious that humans were here prior to the Clovis people.”

Dr. Brace, in response to a member of the audience who asked about the possibility of people in the New World as long as 50,000 years ago, said Americans

that old would have been Neanderthals rather than modern humans.

Opening his presentation on his Alaskan discoveries, Dixon noted the “overwhelming evidence” that humans didn’t evolve in the New World, but in Africa, later spreading elsewhere. “The way the archaeological evidence looks now is that the Americas were the last major continental land mass on the planet to be colonized.”

Further explaining his perspective, Dixon said, “The fact that we haven’t found human skeletal material in the Americas that’s really much older than about 11,000 thousand years is very troubling to me.” If humans had been in the New World 25,000, 50,000, or even 200,000 years ago, he said, there ought to be skeletal remains. Though he may disagree with Bonnicksen and others on the timing of the initial settlement, Dixon does agree that research should continue. “We should keep our minds open to the possibility that there may be much earlier material.” 

amounts of data. What it gives us is a picture of the sea floor accurate to about one meter horizontal and five or 10 centimeters vertical.”

The result, a huge set of data, allowed the researchers to produce a variety of contour maps and three-dimensional reproductions of a landscape that had been lost to the sea more than 11,000 years ago. “By using a combination of these different products, we were able to get ideas of where we might find archaeological features on the landscape.” Fedje showed the symposium audience slides

depicting some of the images, which offered accuracy as good as or better than aerial photographs.

“We were able to pick out, on this imagery, old river channels, old terrace features, deltas, plains, and lakes.” He showed a slide depicting a river channel where it meandered, and he pointed out scarps along the river channel and small tributary creeks. “These were the kinds of areas that we thought would be good targets for trying to find archaeological sites,” said Fedje. He could say, “Look at the confluence of the creek and that

larger terrace and river system there,” or, “Look at that sand bar down here.” The team could then pick out the coordinates from the imagery and go directly over the spot. Navigational instruments allowed the research ship to get within four or five meters of the precise target. Then the team would lower a large grab sampler to reach bottom.

The tool brings up between half and three quarters of a cubic meter of material at each bite, and the team screened all the material on the deck of the ship. After four days of screening, they were re-



The auditorium in Portland's Oregon Museum of Science and Industry was filled for the Peopling of the Americas Symposium. Many archaeologists—amateur and professional—attended the day-long event.



The museum sponsored a press luncheon for science writers. Facing the reporters are Ruth Gruhn and Robson Bonnicksen.

warded with an artifact, pictures of which Fedje displayed for the symposium audience. It was a basalt flake about 10 cm in length. He suggested that it had been made by billet-flaking or soft-hammered percussion flaking, and said it was unquestionably an artifact.

It came from beneath 53 meters of water from a bird's-foot delta associated with the shoreline of about 10,200 years ago. Fedje pointed out the location of the site on a slide and noted that two other archaeological sites are on the same drainage system—upstream and on dry land. One dates to about 9,200–9,300 years ago and the other dates to between 8,000 and 5,000 years ago.

Besides the artifact, the researchers found shorelines dating to more than 11,000 years, with many intertidal shellfish shells. It was, he acknowledged, "a good, solid bit of science."

Though an undersea archaeological survey might seem daunting, Fedje's surveys of the above-water wilderness were also extremely difficult. His lake-sediment coring told him that sites dating earlier than 9,500 would be drowned, but that between 9,000 and 5,000 years ago there was a period of stable shorelines 15 meters higher than today's. He concentrated on those higher terraces.

"We used modern air photography which we had digitized into extremely accurate and detailed contour maps of the shoreline," he explained. Then he adjusted the modern shoreline to where it would have been between 9,000 and 5,000 years ago.

With maps to help, they could decide where they should look. Then the hard work began, for it is much more difficult to do archaeology in the rain forest than it is along the present shoreline. For example, Fedje said he can do many soil samples of shoreline middens in the time that it takes to do one in the forest. With the computer-generated maps showing one-meter contour intervals, altimeters accurate to within one meter, compasses, levels, and other hand instruments, his crew set out into the heavy vegetation. Gwaii Haanas is wilderness, a national heritage site without road cuts or cleared land, so they tried to find natural exposures such as tree throws to aid the search.

After much "judgmental shovel testing," Fedje and his crew managed to locate 17 archaeological sites near the old 15-meter shoreline terraces. He conducted more extensive excavations at four of them. The most interesting was on Richardson Island, where a small creek flowed through the 15-meter terrace leaving an excellent exposure of stratified alluvial sediments, which



DON ALAN HALL



BOTH: DON ALAN HALL

contained many artifacts. He said 20 or 30 stone tools were visible right in the face of these stratified layers. After testing the extent of the site with bucket augers, they put in an excavation down through five meters of alluvial sediments—and it

revealed 30 to 40 cultural layers. "There were lots of artifacts," he said, showing a slide of the excavation in progress, "about 8,000–9,000 artifacts from this one-meter square." The excavation also produced a series of about a dozen consistent radiocarbon dates that extended from about 8,500 at the top to 9,300 at the base. In the upper part, he said, between 8,500 and 8,900, there was a lot of evidence of microblade technology as well as bifacially flaked tools. Microblade technology evidently arrived in southern Haida Gwaii about 8,900 radiocarbon years ago because there is no evidence of microblades from earlier strata, although there are many other stone tools.

With archaeological evidence from the era of higher shorelines in the Queen Charlottes firmly established, Fedje is looking ahead to additional studies of more ancient shorelines now under the sea. Though the 1998 testing produced an artifact presumed to be about 10,200 years old, the undersea maps are pointing to a great many more potential sites, and the deeper ones obviously are considerably older.

"It is only one artifact," said Fedje, "and we ought to find more before we can be sure. But it appears to be in good context and shows that people were on the landscape—on this drowned landscape." The evidence thus represents an extension of the terrestrial record, which ends before 9,500 years ago. He concedes that the 10,200-year-old date is not especially early if viewed within the overall coastal entry hypothesis. But, he adds,



(above) C. Loring Brace, University of Michigan biological anthropologist.

(left) Daryl Fedje, Parks Canada archaeologist.

the date of this first underwater evidence is good in a way, because it does not "push the envelope too far too fast," and is thus not so easy to discount as if it had been an earlier one.

However, there are more obstacles than 50 or 100 meters of seawater. "There's been a lot of sedimentation that has occurred over the last 10,000 years or so," Fedje told the symposium. In some cases, sediment has covered undersea features by more than the depth that the research ship's bucket auger can reach. Rather than sample the target landform, then, the auger brings up only modern marine sediments.

Fedje and Josenhans hope to return to the area in 1999, perhaps with remote-controlled submarines that can survey and sample likely places on the lost landscape, but the work is expensive and they must find adequate funding.



DON ALAN HALL

Scientists, amateur archaeologists and students continue the symposium discussions outside the museum auditorium.

SUGGESTED READINGS

ON Coast Hypothesis

Gruhn, Ruth 1994 The Pacific Coast Route of Initial Entry: An Overview. In *Method and Theory for Investigating the Peopling of the Americas*, edited by Robson Bonnicksen and D. Gentry Steele. Center for the Study of the First Americans, Corvallis.

Fladmark, K. R. 1979 Routes: Alternative Migration Corridors for early Man in North America, *American Antiquity* 44(1):55-69.


——— 1990 Possible Early Human Occupation of the Queen Charlotte Islands, British Columbia, *Canadian Journal of Archaeology* 14:183-194.

Dixon, E. James 1993 *The Quest for the Origins of the First Americans*. University of New Mexico Press, Albuquerque.

Moratto, Michael J., and David Fredrickson 1984 *California Archaeology*. Academic Press, Orlando.

C. Loring Brace, biological anthropologist at the University of Michigan, suggested likely origins of those maritime people who passed along British Columbia's coast at the end of the Pleistocene. He reported to the symposium on his continuing analysis of physical appearances of prehistoric Asian people, some of whom constitute the ancestors and relatives of Native Americans past and present. His data, compiled from cranial measurements, suggest certain links between present-day people. He cautioned that similarity in appearance does not necessarily mean genetic relatedness.

Brace believes that Japan's Jomon culture, which was fully adapted to maritime resources by about 13,000 years ago, is important for understanding the coastal migration hypothesis for a number of reasons. In his model, the Jomon people, who were ancestors to the Ainu of north Japan, spread around the Pacific starting about 12,500 years ago. Technologically, the Jomon people had canoes and fishing harpoons. His cranial and facial analyses suggest that the Jomon population is related to modern-day Polynesians, as well as to peoples of Tierra del Fuego of the southern tip of South America and some local populations of North America.

Other ties between various populations of Asia and contemporary North American tribal groups are evident from Brace's analysis of skull and facial features. For instance, Athapaskan-speaking peoples of the Americas and Tibeto-Chinese speakers from East Asia, share similar features. Mongol people, he has found, do not share attributes with North Americans, contrary to common assumptions that stem from use of the word "Mongoloid" to refer to populations of northeast Asia and North America. 

—Don Alan Hall

Petit, Charles W. 1998 Rediscovering America: The New World May Be 20,000 Years Older than Experts Thought, *U.S. News & World Report* Oct. 12:56-64.

ON Pleistocene Extinctions

MacPhee, Ross D. E., and Preston A. Marx 1997 The 40,000-Year Plague: Humans, Hyperdisease, and First-Contact Extinctions. In *Natural Change and Human Impact in Madagascar*, edited by Steven M. Goodman and Bruce D. Patterson. Smithsonian Press, Washington.


Martin, P. S., and R. G. Klein (editors) 1984 *Quaternary Extinctions: A Prehistoric Revolution*. University of Arizona Press, Tucson.

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Flannery, T. F. 1994 *The Future Eaters*. George Brazillier, New York.

Krantz, Grover S. 1970 Human Activities and Megafaunal Extinctions, *American Scientist*, 58:164-170.

Preston, Richard 1994 *The Hot Zone*. Random House.

Vartanyan, S. L., V. E. Garutt, and A. V. Sher 1993 Holocene Dwarf Mammoths from Wrangel Island in the Siberian Arctic, *Nature* 362:337-340. 

PEOPLE ENTERING THE AMERICAS by way of the north Pacific coast may have followed the coast to what is now California, and on to South America. Of course archaeologists are very interested in evidence of early maritime adaptations they might have left along the way. The search for that evidence was described for the CSFA-OMSI coast symposium by Michael J. Moratto of California State University-Fresno and Ruth Gruhn of the University of Alberta.

Dr. Moratto, author of *California Archaeology*, reviewed California sites that may indicate the presence of Pleistocene people. "California has produced a larger number of sensational claims regarding the peopling of the New World than any area of comparable size on the face of the Earth," he told reporters at a noontime press conference. "So I view it as my task today to sort through some of the claims."

He presented the symposium audience a map depicting sites that have been said to prove human presence before Holocene time, and he reviewed evidence that has caused most archaeologists to dismiss many of them. However, there are some sites that may meet the test by being both authentically cultural and dating to the Pleistocene. "One of these is Santa Rosa Island, where since the 1940s investigators have called attention to the remains of pygmy mammoth or dwarf mammoth." Some of these remains, he said, have been reportedly associated with artifacts or hearths. Some of the bones were "blackened. I hesitate to say that they were burned, but they were blackened, and they produced a radiocarbon date of 29,650 years, uncalibrated, uncorrected." Remains of dwarf mammoth continue to be discovered.



Michael J.
Moratto

Another Santa Rosa Island site, Arlington Springs, revealed human remains Moratto says were reliably dated to around 10,000 years. "So we know that people were on the islands 10,000 years ago." He said another site on the island contains areas of reddish earth, said to be hearths, that have been radiocarbon dated variously to between 15,820 and 40,000 years ago. "Whether or not they're definitively archaeological remains to be seen."

Characterizing several potential Ice Age archaeological sites in California, Moratto said that poor field methods and inadequate control "have contributed to the fact that as of this day I cannot stand here and tell you as an archaeologist that any one site is acceptable to me. But they sure are intriguing."

California has some obviously early sites that present special difficulties for archaeologists. Moratto described problems at a few including Lake Manix, a Pleistocene lake bed east of Barstow, on the margins of which are extensive deposits of high-quality chalcedony—"some of the prettiest stone you've ever seen." The site, he added, would have been highly visible from the time that the first people arrived. "The problem we have here is that the specimens themselves, although definitely artifacts, cannot be dated easily because they're mostly on the desert surface. My speculation is that this

**Following
the Pacific
Coast to
America**

On to California—

quarry has been used as a source of chalcedony ever since human beings have been in the area. Maybe 15,000 years ago—maybe 10,000. We just don't know."

"If there were some way to tease out the older components from the younger, and to date these materials, Manix Lake may turn out to be one of our older sites," Moratto told the symposium.

Other candidate sites include Rancho La Brea in downtown Los Angeles, where human remains have been dated to 9,000 years ago. There, too, three long bones of a saber-toothed cat suggest a much earlier human presence. The three bones bear marks that seem to be knife cuts, and one of those bones was dated to 15,200 ± 200 years B.P. Another candidate is the Farmington Reservoir area, which includes 40 different sites on the eastern edge of the Central Valley where artifacts are eroding from gravels known to be 8,000–12,000 years old. The artifacts are in secondary context, having washed down from quarries or workshops upstream. "Farmington, like so many sites, needs further work."

"Saving the best for last," Moratto said, he concluded his presentation with a description of Daisy Cave on San Miguel Island where Jon Erlandson, a University of Oregon archaeologist, has discovered "tantalizing evidence" of a maritime-oriented culture at least 11,600 calibrated radiocarbon years ago. Dr. Erlandson been conducting a painstaking investigation of the cave 10 meters above the surf ("Living on the Rim: California Island Cave Offers Tantalizing Clues to Paleoindian Life," *Mammoth Trumpet* 13:2). He has unearthed much evidence of basketry dating to 8,500 and 9,000 years ago.

Moratto said that Erlandson has reported a radiocarbon



After his presentation, California State-Fresno archaeologist Michael Moratto is questioned by a member of the symposium audience.

CREDIT BOTH: DON ALAN HALL

and South America

date of $15,780 \pm 120$ years B.P. on charcoal from a deep layer that may contain hearth features. The features, Moratto said, contain burned rock, welded sediments, burned bone, occasional wood fragments and a flake of unquestioned cultural origin found in situ."

Daisy Cave, Moratto told the symposium, implies watercraft more than 11,000 years ago. The early islanders "were involved in a maritime-based economy."

Dr. Gruhn, who, like Knut Fladmark, is the author of several papers supporting the Pacific coastal entry route for the initial settlement of the New World, continued the symposium by reviewing the archaeological record of the coastal area southward from California. Her presentation, "Early Cultures of the Pacific Coast of South America," focused chiefly on the coastal zones of Ecuador, Peru, and northern Chile.

"The earliest human populations known in the archaeological record of this area all made ample uses of the abundant resources of the sea," she said, after explaining that cold, upwelling ocean currents that result in deserts on land support a wealth of fish, shellfish, sea mammals, and sea birds in plankton-rich waters offshore. "The earliest human populations known in the archaeological record of this area all made ample use of these abundant resources of the sea."

Gruhn's presentation began in Ecuador with sites representing the Las Vegas culture, dating from 11,000 to 6,000 radiocarbon years ago. The area has experienced slow tectonic uplift that has kept pace with rising sea level. In late-Pleistocene and early-Holocene times the area supported rich mangrove swamps on the coast. Gruhn said that approximately 40 Las Vegas sites, mostly on ancient estuaries and lagoons, provide evidence of a diversified economy. "By the end of the Pleistocene," she told the symposium, "a population utilizing coastal marine and estuarine resources was successfully established in the coastal zone of southwest Ecuador." The area is known through the research of Karen Stothert of the University of Texas, San Antonio.


Moving southward, Gruhn described the Amotape com-

plex of northern Peru, first described by James B. Richardson III of the University of Pittsburgh. This culture, dating to 11,000 years ago, also relied on coastal mangrove swamps and estuarine environments, she said. Farther south on the north coast of Peru, the Paiján complex dates to about the same time ("Stone-tool Tradition Endures Radical Environmental Change," **Mammoth Trumpet** 10:3). "There were likely Paiján fishing settlements directly on the coast," said Gruhn, but because of higher sea levels, those sites would now be at least 10 kilometers offshore.

Farther south in Peru, the continental shelf is narrower, so early coastal sites are closer to the modern shore. "Three archaeological sites indicate that a maritime adaptation was well established on this coast by the end of the Pleistocene." Gruhn quoted archaeologist Daniel Sandweiss of the University of Maine, investigator of site QJ-280 on Quebrada Jaguay, as reporting that "a specialized maritime subsistence strategy was followed even by the earliest occupants of the site," which dates to about 11,000 years ago.

Archaeological evidence from these South American sites indicates that most of the tools, weapons, and utensils were made of perishable materials including wood, bark, reeds and bone, which have not been preserved, Gruhn told the symposium. Stone artifacts are generally very simple tools that she said would be useful for working such materials. These artifacts are so unimpressive that archaeologists may have overlooked sites.

"Questions remain unanswered," she said. "Do the known archaeological sites I have described represent the very earliest people in the Pacific coastal area of South America? Were their ancestors hunters and gatherers who descended from the Andes Mountains directly onto the coastal plain to become fisherfolk? Or did the very first population expand down the west coast of South America directly from the north, already successfully adapted to a coastal environment?"

Gruhn concluded her symposium presentation by suggesting that the best strategy for seeking additional information on early coastal sites in South America is to search places where tectonic uplift has kept pace with the post-Pleistocene rise in sea level. "The desert Pacific coastal areas of South America give promise of future discovery of such sites," she said. 

-DAH


CSFA Honors Scanlon & Tradleners

continued from page 2

tion with great distinction even when his work took him out of state unexpectedly as plans for the event were underway. Larry and Sandy assembled an outstanding array of art and craft objects for those who attended the auction to purchase."

CSFA Director Robson Bonnicksen praised the Tradleners for the "beautiful job" they did in organizing the Gala through efforts that extended over the better part of a year. "They did everything from making arrangements for the space to organizing the things that came (for the auction). Their work went beyond what could normally be expected, and this service

award is in honor of the enormous amount of effort that they made on behalf of the Center."

Larry Tradlener has done construction management and quality control in the telecommunications field since 1985. He has recently started his own archaeological surveying and mapping company. Sandy Tradlener has worked for Tektronix as a program manager for new product development since 1992. They both have a strong interest in archaeology, and, in addition to the Center, belong to a number of archaeological organizations. Larry and Sandy are past president and membership chairman, respectively, of the Denver Chapter of the Colorado Archaeological Society. They recently moved back to Colorado from Oregon. 

-Carol Ann Lysek

Explaining Pleistocene Extinctions



Mammalogist Testing New Theory Linked to First Contact with Humans

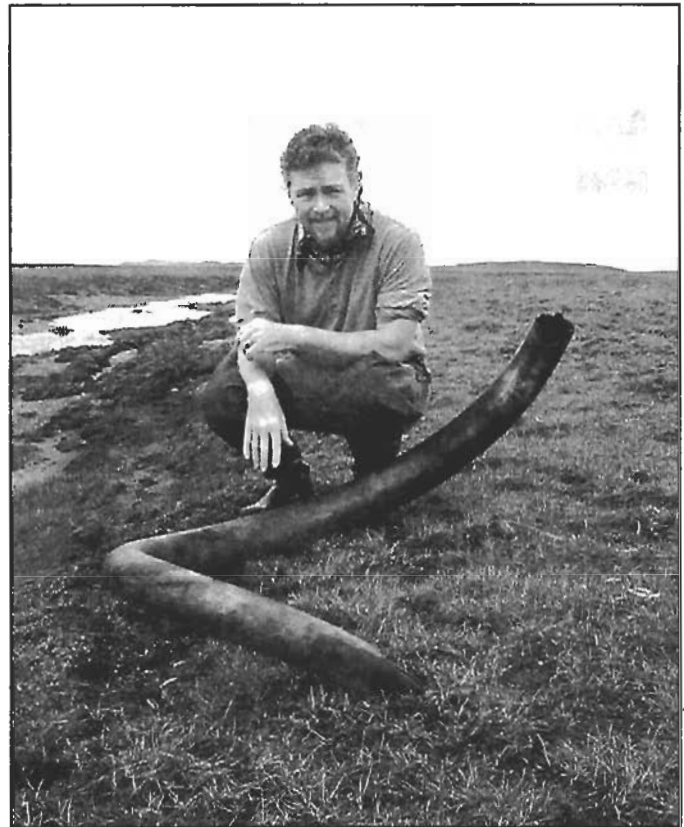
Ross D. E. MacPhee has a new theory for explaining Pleistocene extinctions, and if he is right, he may also help to solve the mystery of when people first came to the Americas. Dr. MacPhee, Chairman of the Department of Mammalogy at the American Museum of Natural History, is yet to find physical evidence that could prove his hypothesis, but he and colleagues are now focusing substantial scientific effort on the question, and he trusts that other scientists will be joining in his quest—if only to prove him wrong.

Finding both the climate-change and overkill hypotheses implausible, MacPhee believes the real cause for the mysterious disappearance of mammoths and scores of other species was disease, possibly virulent viruses that killed quickly and crossed species boundaries. “Hyperdisease,” a still-hypothetical plague, he argues, came to the New World with the first humans.

MacPhee, who has studied extinctions of mammals in many parts of the world, believes that the hyperdisease theory can explain extinctions, starting at least 40,000 years ago in Australia and continuing to extinctions at the end of the Pleistocene in the Americas. Except for one important difference, the disease theory is the same as the overkill, or blitzkrieg, hypothesis put forth by Paul Martin of the University of Arizona.

“Overkill, except for the final agency, is exactly what I’m talking about,” MacPhee said in a telephone interview from his office in New York. “This is evidence of people coming, interacting with the animals, and the animals disappearing soon after the people arrived. This is overkill. It’s just that Paul Martin’s explanation of the pattern puts people at the center with a direct impact, and mine puts people at the periphery. But they brought something that then took over to create the pattern we perceive.”

The search for evidence that disease was the culprit that did in an entire bestiary of mammals, animals that had been highly successful until the onset of the Holocene, is quite similar to much of the archaeological work that has often been reported on in the **Mammoth Trumpet**. First, it involves fieldwork similar to that required for the investigation of Paleoamerican



CLARE FLEMING

Ross MacPhee poses with the complete mammoth tusk that he and Jeff Saunders excavated from Wrangel Island’s Itsivilsky River, background. The specimen, weighing nearly 80 pounds, is a right tusk.

sites, although the quest is primarily for faunal remains rather than for cultural evidence. Chronology is crucial, because the evidence must necessarily be found in animal remains that represent the last or “terminal” populations of species affected by the hyperdisease agent.

After well-preserved mammal remains that date to the time of the terminal populations are found, MacPhee and his colleagues must turn to a whole series of the latest molecular biology techniques in the search for what would amount to the smoking gun of the hyperdisease hypothesis.

Much Circumstantial Evidence

Though this research may be even more complex than finding and dating the continent’s earliest evidence of humans, MacPhee says that such a large body of circumstantial evidence supports disease as the culprit in the extinctions that the studies are not only reasonable, but necessary. Among his arguments favoring hyperdisease are simply the problems many scientists have found in both the climate-change and the overkill theories. However, MacPhee is highly self-critical, readily noting the flaws he finds in his hyperdisease theory. That’s the way science works, he insists.

“One has to be that sort of balanced combination of being very sure that you’re onto something, and not so sure that you ignore any kind of contradictory evidence.” In this kind of science, he maintains, one must keep one’s eyes open to all

evidence. "You're never going to get a clear-cut answer that is something one can replicate in a lab," he continues. "What you're going to find is a pattern of occurrence that is consistent with an argument. It doesn't mean that it is even the only argument."

MacPhee's recent fieldwork on Wrangel Island (**"Mammoths' Last Stand,"** page 16), illustrates the difficulty of gathering scientific evidence to prove a theory. Mammoths survived on Wrangel until 3,700 years ago and existing archaeological evidence indicates that humans were there at least by around 3,100 or 3,200 years ago (**"Mammoths Outlived Pleistocene Epoch,"** **Mammoth Trumpet** 8:3). Yet in spite of an abundance of well-preserved mammoth remains, MacPhee says that there is a good chance he and his colleagues did not recover the kind of material they will need.

Wrangel Island and its mammoths do have an important role in MacPhee's scientific argument, however. "Even if you don't like hyperdisease or arguments of a similar sort," he said, "Wrangel does rule climate-change *completely* out of court." At the time the last mammoths lived, the world's climate was much as it is now. The argument that sudden climate changes at the end of the Pleistocene might be appropriate to explain extinctions in North America, says MacPhee, "but the notion that there were lasting effects that could have extended over five millennia and only at *that* point take out the last of the mammoths is just beyond reason now."

On Wrangel, paleobotanical work indicates that since about 8,000 years ago, vegetation was much as it is today, both in character and also in the kinds of species represented. "It is tundra-style vegetation. There's *nothing* out on the present tundra higher than five or six centimeters." And MacPhee says that from the distribution of mammoth fossils his expedition found, it is evident that the mammoths were living on the tundra.

Climate Theory Doesn't Explain Wrangel

"The fodder that they would have encountered back then would be very similar to the fodder that is available right now," he said.

Something other than climate change, he reasons, must have driven Wrangel's mammoths to extinction. In spite of the difficulties of doing fieldwork there, Wrangel Island was an obvious choice because of the mammoth remains. "Mammoths are the critical species for understanding these late Quaternary extinctions." Because they probably survived on Wrangel longer than anywhere else on Earth, the island provides scientists with a chance to analyze the habitat of these remarkable survivors. The Russian scientist Sergey Vartanyan of the Wrangel Island State Reserve has dated the remains of dozens of mammoths, and although many of the

youngest were quite small, some of the most recent dates are from animals that were as large as any mammoths known anywhere. MacPhee and his Russian colleagues view initial contact with humans as the most likely cause of their extinction.

"The notion that there could have been any substantial climate-induced effect that resulted in the kinds of plants that they preferentially wanted to eat not being there is just not plausible," said MacPhee.

Wrangel Island, he says, is evidence of the first-contact pattern of extinctions that began more than 40,000 years ago in Australia. He argues that the difference between the age of Wrangel Island's last known mammoths and date of its first-known people is close enough to support the hyperdisease theory. "A five- or six-hundred-year gap is to my mind basically nothing. That could be bridged by one important find."

Russian archaeologists who studied Wrangel's one archaeological site designated it a Paleo-Eskimo site. "Although there's only one site and you really don't have chronology to talk about, it looks like the convergence [of people and mammoths] was there." He notes that evidence of actual short-term overlap might be impossible to find. "The way I look at it is that the early date for humans and the last date for mammoths, in any kind of



Jeff Saunders and Clare Flemming (wearing their hip waders) examine a small mammoth molar found in the Itsvilitky River.

a statistical or probabilistic sense, are so close that there's essentially no difference."

Paul Martin's overkill and Ross MacPhee's hyperdisease hypotheses rely on the same first-contact pattern worldwide. While Wrangel Island evidence may present an obvious argument against the climate-change theory, MacPhee ob-

serves that it is not inconsistent with the overkill theory. Perhaps the earliest people simply killed all the island's mammoths and horses for food.

A longtime student of extinction, Quaternary extinctions in particular, MacPhee was contemplating the possible reasons long before he thought of disease as the plausible explanation. "The

thing that I've never been able to counter in Paul's arguments with me is the question, 'Well, if overkill has nothing to do with it—if direct human impact didn't have much to do with it, then why is it that again and again, all over the planet, I find the same story? That there's really nothing happening until people come. People come and the animals go down.'"

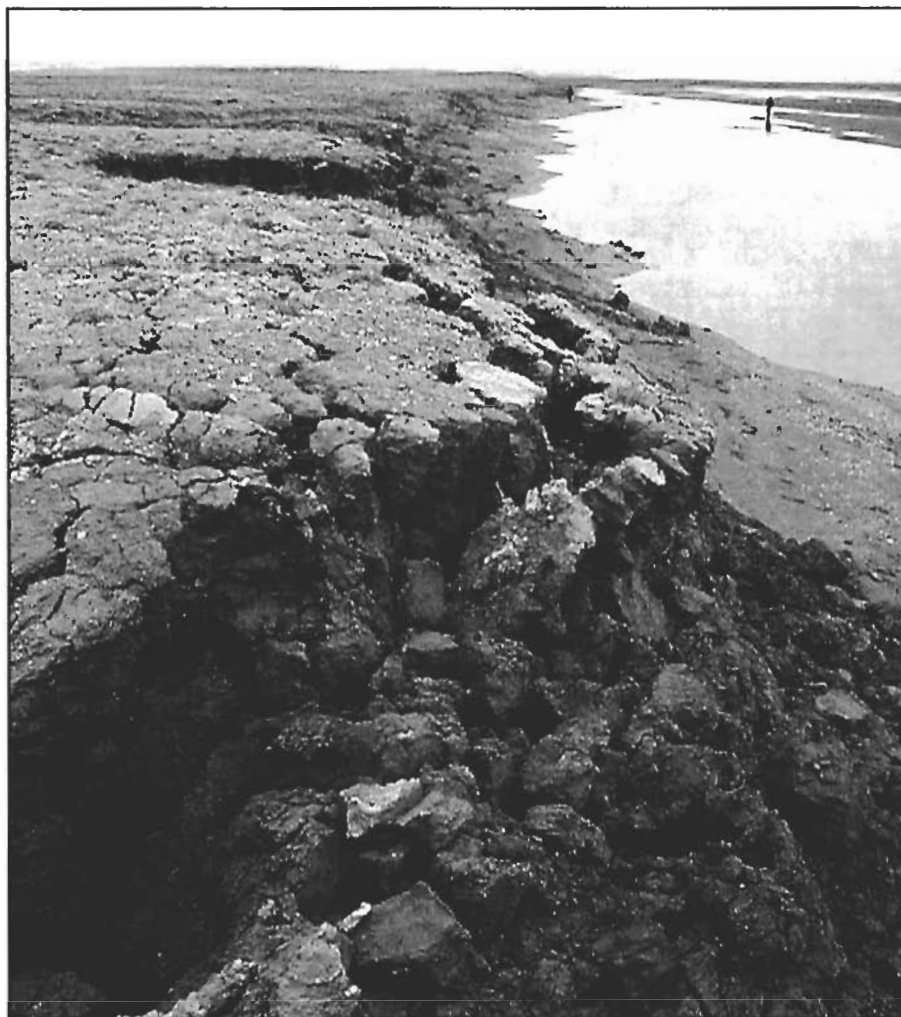
Mammoths' Last Stand



WRANGEL ISLAND is for mammoth lovers. It was on this remote outpost, nearly 50 kilometers north of the Arctic Circle between the Chukchi and East Siberian seas, that the woolly Pleistocene elephants lived more than 6,000 years into the Holocene. Across its bleak landscape, well-preserved mammoth remains are relatively plentiful, possibly offering clues to why they died. In short, Wrangel Island would seem the perfect place for mammologist Ross D. E. MacPhee of the American Museum of Natural History to collect evidence.

Beginning last July, Dr. MacPhee's expedition was to last five weeks, but as is often the case with fieldwork in far-away places, the time actually available for searching for specimens was considerably less. In addition to the challenges caused by Russia's failing economy, the weather was the worst seen in many years.

The expedition team, which included MacPhee's research assistant Clare Flemming and his colleague Jeff Saunders of the Illinois State Museum, as well as Alexei Tikhofov of the Zoological Institute of the Russian Academy of Sciences in St. Petersburg, was forced to spend four days in Mys Shmidta on Siberia's Arctic Coast awaiting weather that would allow the 250-km helicopter flight to the island. Lacking navigational aids, the pilots fly the route only when visibility is good at both the



On Wrangel Island tundra, the Naskhok River's bank shows typical slumping of polygonal ground. Upstream in the distance, Jeff Saunders and Ross MacPhee prospect for mammoth remains.

takeoff and the landing sites. Communication consisted of a single Teletype link between the Mys Shmidta airport and the polar research station on the island.

"The weather on different sides of the strait was often of the sort that there might be sunshine in Mys Shmidta, but overcast or even snowing on Wrangel," said Dr. MacPhee, "or vice versa." Nevertheless, he and his colleagues eventually

were camped on tundra where the mammoths had roamed. They worked on the northeast side of the island; Paleozoic rocks form mountainous and hilly terrain in the central and south portions, but the entire north side of the island is flat tundra.

The terrain may be flat, but tundra isn't for wimps. "Walking on the tundra is just killing," said MacPhee, "I don't

Until he thought of disease as an alternative, he had no explanation. Now he has the task of challenging overkill with another way of explaining the same evidence—something realistically as destructive or potentially population-destroying as human hunting. Disease, he is confident, fills the bill, although he admits that there's no disease now known

capable of bringing down population sizes over a wide area fast enough to prevent recovery. "If these collapses don't happen fast enough, then the evidence is that there will be a recovery," he says.

A Really Nasty Disease

"So you've got to have something that's

really nasty." The disease, he says, must very rapidly kill off at least the sexually active and reproductive part of the population. "You've got to have something that can travel quite independently of people. Once introduced by its vector, of course, an infectious disease is going to take off, depending entirely on the characteristics of the new population infected." Mac-

care what kind of shape you're in, it's just killing. It would be comparable to walking across a plowed field in the rain, with gale-force winds blowing at your back. It was hard work." And once off the helicopter, they were on foot.

Wrangel's mammoth fossils are so young, many are still on the tundra, and these are damaged by weathering. "Even though it's very cold, there's a lot of freezing and thawing over the course of a year," MacPhee explained, adding that bones in rivers seem to be in better shape. So the expedition's strategy was to don waders and follow rivers and creeks searching for mammoth bones, which seem to have worked themselves out of the tundra on the banks of the river or been torn out during spring breakup. He suspects that some of the perfect bones had emerged only a year or two earlier. There was never any doubt when the team encountered mammoth remains, because the bones are so large.

Though MacPhee was particularly keen to find complete long bones, all mammoth fossils were of interest. "We found seven virtually complete tusks that are as fresh looking as anything I've got in my mammal collection here at this museum. Perfect! Not even abraded." Though they didn't find a lot of complete bones, they found more than previous scientific mammoth hunting expeditions had found. Some bones were astoundingly well preserved.

"One ulna we found was greasy to the touch," said MacPhee, obviously indicating that the fatty marrow was leaking through. He compared this amazing discovery to "a poorly prepared bone in any osteological collection." There's no doubt that the bone is at least 3,700 years old, yet Wrangel's conditions of preservation are such that it has enough marrow to keep on leaking out.

After finding well-preserved long bones, MacPhee needed samples for DNA analysis. Wrangel Island is a protected area and the Russians don't allow fossils to leave the Wrangel Island State Reserve, but it was agreed that he could take samples.

"I took a big battery-powered drill with a bunch of batteries," he said, but the procedure didn't go well. "This bone was not only perfect, but it was also very very hard to drill." He soon exhausted his sup-



A large tusk fragment waits in near-freezing water of the Shumanaya River to be recovered.

CLARE FLEMING

ply of batteries and the charger failed. "I was left out there in the field with no corner store to go to get any more batteries or a new recharger."


The Russians were understanding, however, and allowed several of the bones to be removed to St. Petersburg for drilling. MacPhee was happy to be able to return to New York with the bone samples, each of which will have to be radiocarbon dated before it can be analyzed for DNA content. In the search for clues to extinction, only samples that represent the terminal population of animals are of interest to the researchers. As of this writing, MacPhee had not received radiocarbon dates on the samples.

Bones found on Wrangel Island's tundra or streams can't be assumed to be from the animals that died most recently.

Looks can be deceptive. MacPhee's colleague Sergey Vartanyan of the Wrangel Island State Reserve has dated more than 70 specimens of animal remains, mostly mammoth but some horse, and they range from 40,000 years B.P. right down to 3,700 B.P. He has 18 dates younger than 5,000 years B.P.

Size of the mammoths is no indication of their antiquity. In spite of misleading publicity that accompanied the initial announcement by Dr. Vartanyan

and colleagues back in 1993, Wrangel's last mammoths weren't a "dwarfed" island population. For one thing, Wrangel had only been an island for perhaps 5,000 years; previously it had been part of the Siberian mainland. Further, research has shown that mammoths everywhere actually had a rather large amount of variability in body size.

"We found animals that were, yes, incredibly small—and they were clearly adult because we were getting worn third molars that were just a third to a half the size of a typical large *primigenius* from North America. So clearly there were small adults." However, some of Vartanyan's most-recent dates are from quite large animals. Wrangel's last elephants weren't all dwarfs. 

Phee says it is essential for his theory to have a killing agent that, after initial introduction, is thereafter independent of people because the pattern of extinction in the Pleistocene in North and South America is best compared to a spreading wildfire.

Human hunters, he insists, couldn't have done it. "How are you going to get people going through the rain forest of South America rapidly enough to kill off all the hippidions and other horse species? And to kill off the glyptodonts and to kill off all the other kinds of megafauna that were likely distributed in South America at the time? Let alone the proboscideans. You had gomphotheres all over the place in South America at the end of the Pleistocene."

MacPhee emphasizes that an independent and very rapidly transmitted force is required to explain why the extinctions occurred when they did. "A disease, an infectious disease, is the one thing in nature that comes closest, in my mind, to having that kind of characteristic."

He remembers, almost to the moment, when it first occurred to him that disease was the likely reason for late-Quaternary extinctions. After having been an proponent of overkill, serious doubts developed. While in Madagascar working on that island's endemic mammals, he started to disbelieve in over-hunting as the cause for extinctions there. "Then one day I was thinking blankly, just daydreaming, essentially, about these extinctions and chewing over ideas that never seemed to get very far, or to work, or to make much sense."

Origins of a Theory

"I just happened to pick up a *New Yorker* magazine. In the *New Yorker* was a short version of the book *The Hot Zone*, by Richard Preston, which is about the ebola disease and emerging diseases in general." Of course MacPhee was already conscious of the AIDS epidemic and the evidence that the AIDS virus had crossed the species boundary from monkeys to have a devastating effect on humans, and he was impressed by the sudden impact the ebola virus had on people. The disease came out of

(below) Prize specimen: leaning into a Wrangel Island gale, Ross MacPhee admires the mammoth ulna he found in the Lower Naskhok River. (right) Team member Clare Fleming enjoys the 24-hour daylight of the Arctic summer.




CLARE FLEMING

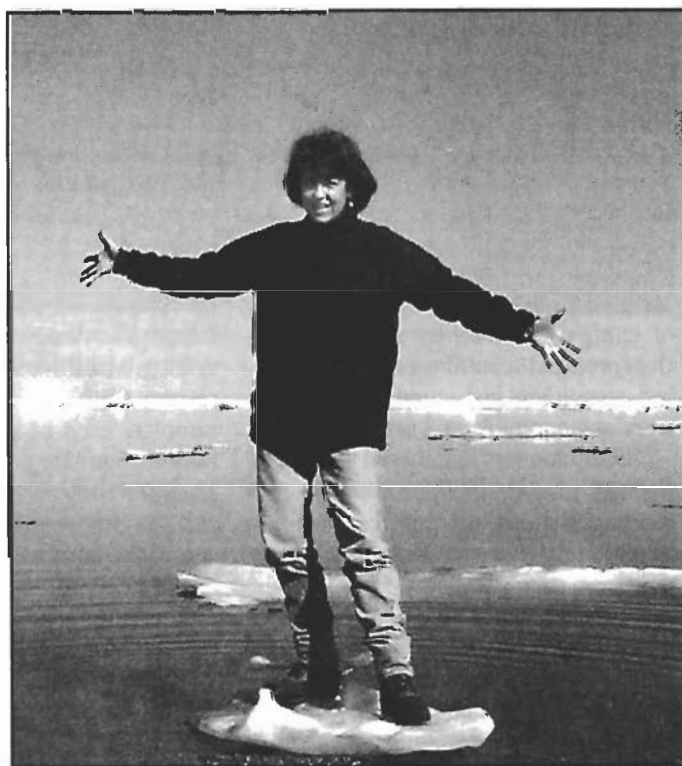
Theory Infers Late Entry of Humans



The hyperdisease hypothesis infers the relatively late entry of humans into the Americas. Because the theory links extinctions to the first contact with humans, archaeological sites dating to more than 13,000–14,000 calendar years ago would clearly challenge it. "In view of the probable transmission method—first contact with humans—we are forced, willy nilly, to hew to 'Martin's Limit,' that people are only 13,000–14,000 calendar years old in the New World," says Dr. MacPhee, who watches with great interest for any evidence that humans have been here longer.

"I am agnostic about earlier humans in the New World. Scientifically, proof of same would be one of the most important archaeological discoveries of this or any millennium. But there is nothing—yet—that undoubtedly puts *Homo sapiens* in place in the New World earlier than a couple of millennia antecedent to the big die-off. Whether one goes for conventional overkill or hyperdiseases, this is all basically still within the frame of Martin's Limit and does not constitute a refutation of either hypothesis."

Why couldn't the hypothetical disease have been brought by a second wave of human migrants to the New World? MacPhee rejects such an argument as analogous to arguing that the first Paleoamericans were not big game hunters and only turned to slaughtering Pleistocene megafauna after arriving in the New World. "I view such devices as salvage efforts to save hypotheses in apparent trouble." 



ROSS MACPHEE

apparently nowhere and caused mortality in humans of 80 and 90 percent. "Just to touch a victim, to get any kind of bodily fluid on you, was the same as getting the death sentence," said MacPhee.

"I thought that's got to be IT! That's the *only* thing that could have happened that could have resulted in levels of mortality that you'd need to see in order to force extinction of the sort that we have evidence of in the late Quaternary record all over the planet. It has to be something that is disease-like."

That line of reasoning soon led MacPhee to Preston A. Marx, a well-known AIDS researcher and one of the people who discovered that green monkeys had been living with a similar immuno-deficiency virus, or AIDS. Dr. Marx, virologist at the Aaron Diamond AIDS Research Center in New York and a faculty member of Tulane University in New Orleans, has a particular interest in diseases that can jump from one species to another and the whole process of emerging disease. Together, Marx and MacPhee worked out the disease hypothesis.

Marx knew that to bring about extinction, a species would have to contract an especially lethal pathogen totally unknown to the immune system. It would have had to kill rapidly, infect adults as well as young, and affect many species without having much impact on humans, and have a host that arrived with humans.

They carefully constructed arguments for, as well as against, the disease theory and examined them alongside arguments for and against climate-change and overkill. They published a detailed discussion of their thinking, "The 40,000-Year Plague," in a 1997 paper (*Suggested Readings*).

Not Conventional Paleopathology

Now, to test the disease hypothesis, they're studying remains of Pleistocene animals in search of some evidence of disease. MacPhee says that people ask him: "'Can't you just look at the bones and tell whether the animal died of disease, because there's paleopathology to look at, right?' And the response to that is, 'No. We're not talking about diseases like



ALEXEI TIKHONOV

In Mys Shmidta, Clare Flemming, Ross MacPhee, and Jeff Saunders reflect on changing Soviet times: Lenin—face bashed in with a hammer—looms above.

A Species That Should Not Have Gone Extinct

Mammoths are critical to the understanding of Pleistocene extinctions. "They should have NOT have gone down," mammalogist Ross D.E. MacPhee said in a recent telephone interview. They had no natural predators other than people. He said there was nothing that could have had any substantial impact on mammoths any more than there are predators today that can have a substantial impact on Asian or African elephants.

"Of course there are animals that will take out older individuals or infants, but we're talking about taking out a species, and there isn't anything that would give sufficient predator pressure on any kind of proboscidean to result in that, in my opinion."

MacPhee said another reason that mammoths shouldn't have gone extinct is their broad range. "Mammoths were practically everywhere in the Holarctic.

They were all the way from Western Europe to northern Asia into North America—deeply down into North America." Further, they inhabited almost every conceivable kind of environmental setting, including highlands and lowlands, and frigid places and hot places. "They were clearly a very successful entity."


MacPhee scoffs at arguments that they died out because they were adapted to steppe vegetation. "These animals, like elephantids in general, could eat anything." He has no doubt that with their kind of dental pattern, which he says is virtually indistinguishable from that of Indian elephants, they could have browsed, grazed and, if necessary, eaten the bark off trees.

"They're built like tanks and are able to eat practically anything." Today's elephants, and presumably mammoths,

have a social structure that emphasizes the protection of young and related individuals with very strong ties between generations—at least in the female line. "Mammoths are not much different from elephants in morphological ways, so my strong suspicion is that they weren't very different in many of these aspects of social behavior."

Yet they went extinct. How can that be?

MacPhee argues that if climate-related arguments are ruled out, then the only other obvious things are overkill and hyperdisease. And he has a hard time accepting overkill.

"If you have to have people do something in a direct kind of way in order to achieve extinction of the megafaunal species, then we have to contemplate the fact that with mammoth populations being spread over most of the habitable part of the Northern Hemisphere in the late Quaternary, you'd have to have an equivalent number of people engaged in bringing them down all over the place at roughly the same instant in time." 

—DAH



arthritis that leave an impression on bone.'” He points out that it takes a long time for chronic diseases to leave their marks on bone.

“What I’m talking about are acute, seriously acute infections that kill in a matter of days or weeks.” The types of diseases that MacPhee and Marx are considering include the bacterium leptospirosis, and the rabies and distemper viruses. “And you’re not going to find an imprint on bone for an animal dying of a disease like distemper. The lethality comes so rapidly that any pathological effect that you might expect to find on bone just does not occur. The animal’s death is too early in the process.”

But their fieldwork does involve bones. MacPhee explains that many viruses after replication exist for a while in the animal’s bloodstream. And since blood tissue is formed on the inside of the long bones in all mammals, and since long bones have to have their own blood supply, he and Marx are confident that long bones should be a likely place to look for evidence of disease.

The source of such information, then, will be “osteosites”—paleontological and archaeological sites containing animal bones. The best sites will be in locations that are likely to have the best preservation of DNA (**“Analysis of Ancient DNA,”** page 22). But MacPhee is interested in investigating bone bed sites of the right age. “If there’s any kind of mass mortality context, that’s something that would be worth investigating from



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(upper) To increase its working radius, the Wrangel Island crew relocated from its warm wooden cabin to tents about 12 kilometers away. For four days, the crew prospected in and around the Shumanaya River (in distance). The island’s central mountain range can be seen behind Sergey Vartanyan and Ross MacPhee. (lower) Sergey Vartanyan and Alexei Tikhonov paddle the portable canoe down the Naskhok River. This canoe, which folded up into its own backpack, facilitated the relocation of camp via the sea coast, allowing the team the chance to explore territories far from base camp. (left) Midnight sun “sets” behind team members Alexei Tikhonov, Ross MacPhee, Sergey Vartanyan, and Jeff Saunders.

the hyperdisease point of view." He is very interested in working with archaeologists studying such sites because he needs numerous samples for his investigations.

After they have taken samples from the bones of animals that died around the time their species went extinct, the researchers' strategy turns to the search for DNA from those animals. A recent addition to the team that includes Marx, MacPhee, and research assistant Clare Flemming, is Alex Greenwood, who has been working on isolating ancient DNA in the Munich, Germany, laboratory of Svante Pääbo. Dr. Pääbo is a pioneer researcher in the use of polymerase chain reaction (PCR) to magnify ancient DNA so it can be studied ("Studying Ancient American DNA," *Mammoth Trumpet* 6:1).

The first step will be to find the host DNA of the Pleistocene animal. Once that obstacle is crossed, the search can begin for foreign DNA that might be that of a pathogen. "If in a given sample we can't get a signal from the host DNA, then we'll just throw the stuff in the waste basket," says MacPhee. "If we're successful at that step and the DNA is good, then of course we're going to go on to see whether there is any hope of amplifying the pathogen."

Initially they will be looking for evidence of several well-characterized viral families that are known to produce serious disease in all kinds of mammals. "If we're successful there, then we'll sequence out what we get and if what we get accords with something that's believable, then that becomes the search image for future tests," MacPhee says.

"If we can get one successful hit, then we will try it out on a whole range of things." If the evidence of a pathogen occurs again and again in animals they think were part of terminal populations, then they will have solid evidence that disease could have caused Pleistocene extinctions.

"What we will have *not* proven, obviously, is that the animals died of this particular pathogen," MacPhee emphasizes, but a pattern of potential disease will, itself, require explanation. The process is complex. "It cannot be assumed that we would find



Ulna in the pack: Ross MacPhee transports the best find of the season, a mammoth ulna whose tip protruding from his pack resembles a teddy bear. He found this incredibly well preserved bone on the bottom of the Lower Naskhok River.

Now, Three Theories




Ever since people first realized that the Americas once harbored animals the likes of mammoths, mastodons, giant sloths, and stag-moose, they have sought to understand why such marvelous beasts disappeared.

The oldest hypothesis, changing climate, probably is the current favorite among archaeologists. It holds that abrupt fluctuations in climate that resulted in melting of the last continental glaciers also disrupted the animals' habitats to the extent that they were unable to survive. Recent research on paleoclimatic conditions has added support to the hypothesis by confirming changes more abrupt and catastrophic than scientists previously had believed.

A second hypothesis, that human hunters drove the megafauna to extinction, gained popularity in the 1960s and 1970s along with the ascendancy of evidence that Clovis hunters, with their spectacularly crafted stone-tipped projectiles, were the first Americans. It holds that animals that did not evolve with humans lacked fear of the hunters and were easily slaughtered. Overkill is supported by worldwide evidence that the initial arrival of modern humans has had devastating impacts on island ecosystems.

A third hypothesis, disease, proposes that lethal epizootics introduced inadvertently by humans, their companions, or parasites, suddenly overwhelmed the animals. The theory was proposed in the 1990s after the emergence of "new" diseases such as AIDS and ebola, and after research indicating that disease can and does cross species boundaries.

Proponents whom we associate with these theories are Russell Graham of the Denver Museum of Natural History, climate change; Paul S. Martin of the University of Arizona, overkill; and Ross D. E. MacPhee of the American Museum of Natural History, disease. In the tradition of scientific inquiry, advocates of a hypothesis must attempt to defend their chosen explanation and to refute all alternate theories. However, scientists not associated with a single theory of Pleistocene extinctions may accept all of them to some varying degree, even to the extent of proposing hybrid theories.

The complexity of the extinctions problem leaves room for considerable creativity. For example, both anthropologists Grover Krantz and Elin Whitney-Smith have offered theories relating to imbalances in population dynamics. Dr. Krantz, of Washington State University, proposed in 1970 that America's first human hunters wrecked the existing predator-prey relationships by outcompeting predators in a way that eventually led to many extinctions. Dr. Whitney-Smith, of George Washington University, presented an explanation of her "second-order overkill" model at the 1998 meeting of the Society for American Archaeology and urged colleagues to experiment with it ("Computer Model Offers New Twist to Explain Pleistocene Extinctions," *Mammoth Trumpet* 13:4). Her theory requires a slight decrease in predator populations shortly after the arrival of the first humans. 

Analysis of Ancient DNA— Essential to Disease Theory

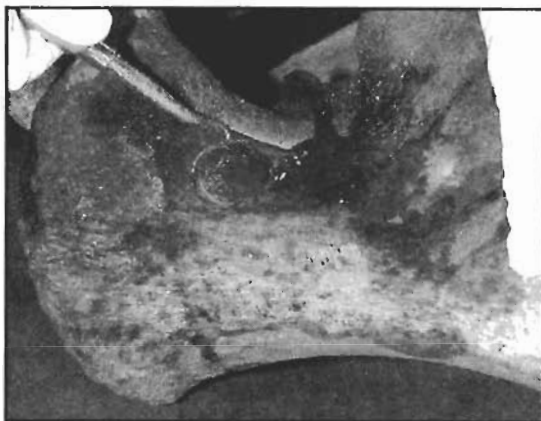


EVIDENCE of hyper-virulent, hyper-lethal diseases will necessarily come only from the analysis of ancient DNA, a fragile, but sometimes enduring, commodity. Bone seems to be the ideal medium for preserving it. DNA is apparently damaged by sunlight, warm temperatures, and moisture. In considering the most likely sites to find useful specimens of bone, Dr. MacPhee relies on the experience of a pioneer in the study of ancient DNA, Svante Pääbo. For example, when Pääbo's lab, in Munich, Germany, sought to isolate DNA from the remains of Neanderthals, researchers tried a variety of Neanderthal material. However, their only success came from the Neander Valley skeleton, which is the type specimen for Neanderthals.

"Svante's opinion of this," MacPhee explains, "is that it's because it was from northern Europe." They couldn't get DNA from Neanderthal specimens from warmer places such as Palestine and Italy. In the search for ancient DNA, he says they can pretty well forget material from temperate or tropical contexts. "It's just too tough on the DNA and you're only going to get believable results from things that have been isolated from most factors that cause severe deterioration of the DNA molecule."

Where, then, are there likely to be bones that could hold the necessary clues?


Wrangel Island and other parts of the far north have beautifully preserved bone, but in spite of the cold temperatures and limited sunshine, these wet environments are very hard on the DNA. "The ancient-DNA people tell me that they've actually been quite unsuccessful in getting DNA from permafrost samples of mammoths and other kinds of beasts from Russia."



MacPhee thinks the ideal place to find ancient DNA is in bones from consistently dry, cool caves—perhaps like those in the desert Southwest. Those should be good for providing information for the time frame he's interested in, say, for the last 20,000 years. "I need to link up with people who are working in that kind of cave context, or museum collections that feature that kind of material," says MacPhee.

He is also quite interested in some bone bed sites that have been characterized by archaeologists as kill sites. Perhaps they might not represent evidence of human slaughtering. "If you've got mass mortality like that—very large numbers of animals dying in one place—and disease is a possible candidate for the cause, then you've got a lot of material you can sample from a single time zone, which is important,

and you've got a chance for trying out several different sorts of techniques for getting the DNA."

Alex Greenwood, the molecular biologist on MacPhee's team, undoubtedly will have plenty of extinct mammal bone samples from which to seek ancient DNA. 

—DAH



A diamond-studded core drill (*above*) bites into a juvenile mammoth tibia. MacPhee used the battery-powered drill to extract samples from bone. A cored sample is being extracted (*left*) from a long bone. The vial (*below*) may contain the key to MacPhee and Marx's hyperdisease hypothesis. It holds a sample of cancellous tissue extracted from the mammoth ulna found on Lower Naskhok River.



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the same kind of virus in case after case." So the search goes on.

Wild-eyed, but Exciting

"I know that it's a wild-eyed idea," he says, "but to me it's exciting because it offers possibilities that have never been tried."


Dr. Greenwood is now working on some of MacPhee's early samples in Munich, but soon he will be going to New York to pursue the quest full-time for the next couple of years. MacPhee is glad to have Greenwood on his team as a post-doctoral researcher. "This is a fellow who is an absolute whiz with ancient DNA. I'm really lucky to have snagged him."

Why hadn't anyone come up with the disease hypothesis before?

MacPhee says the idea wouldn't have come up in the 1960s or 1970s when Dr. Martin was actively arguing the overkill explanation. At that time, he says, epidemiologists and virologists really didn't consider that there could be "new" diseases. "By that I mean that the mindset was that everything that was around had been around for ages. Generally speaking, it was thought that human populations were always relatively well adapted to the parasite and pathogen load and it was assumed that other species would be relatively the same."

Although there are historical descriptions of syndromes that didn't accord well with any known diseases, MacPhee says that it was generally assumed that it was because the diseases were poorly characterized or because it was a particularly virulent strain of some other disease entity that was long gone, although it was one that had long had a relationship with humans. "What changed everything, in terms of that mindset, was the discovery of AIDS. People started thinking immediately about how many other diseases might have an origin similar to AIDS."

He says such diseases lay all around us hidden and potentially ready to spurt out as they do from time to time if the conditions are right. "Once the 'new' infectious organism is able to get its foothold, it does its job, which is to reproduce itself—and very often inadvertently kill its new host."

And maybe even an entire species of new hosts. 

—Don Alan Hall

Dearth of Industrial-age Extinctions as Puzzling As Pleistocene Die-offs



NOT ONLY do we *not* understand Quaternary extinctions in prehistoric times, we don't even understand extinctions that are going on now," says Dr. Ross D. E. MacPhee, a Quaternary paleontologist for more than 20 years.

Conservation biologists, he says, in their concern for species like the black rhinoceros and orangutan, create the impression that people are readily driving large mammals to extinction. "What is striking about the evidence of mammal extinction in the last few hundred years—and I'm talking about the last 500 years instead of the last 50,000—is that the pattern of loss does not accord with anything the conservation community tends to dwell on." Groups like rhinos and great apes, he says, have suffered no extinctions at the species level in the last 500 years.


Rodents, insectivores, bats, and marsupials are the mammals that have really suffered, accounting for close to 75 percent of all losses in the past 500 years. By contrast, there have been very few extinctions among large mammals. MacPhee notes the extinction of one seal, one sirenian, and one canid in the past five centuries, but he points out that in the same time bracket there have hardly been any extinctions among groups like *Artiodactyls* (pigs, camels, deer, cattle, antelope, sheep and buffalo) and *Perissodactyls* (horses and rhinos). What population biologists are really talking about when they speak of "three losses every hour," he says, are invertebrates, particularly arthropods.

The astounding thing about mammal extinctions in the continents of the New World is that, after 10,000 or 11,000 years ago, there were none. "I mean *NONE* that has been documented, right up to the present. After all these species disappearances in North America—all the mammals that Paul Martin and others have documented the losses of—there were no more extinctions at the species level."

The only species-level losses in the New World after 10,000 years B.P., he says, have occurred on islands. "Now tell me, how that can be, if it is true that the Paleoindians, when they came over, were so touched by blood lust that they had to kill everything in sight? How is it that they managed to do such a wonderfully destructive job on something like 45 or 50 genera of North American mammals in the space of maybe only a few hundred years, whereas after 11,000 years ago—no matter *what* their practices—there were no more extinctions?"

The conservation biology of living megafauna has taught us that species can survive even after populations are brought down to only a few tens of individuals. "If you conserve them thereafter—or leave them alone, even—they bounce back incredibly rapidly." MacPhee says the archetypical example is the bison, but there are others, including the pronghorn and a couple of species of seals.

And then there are whales. MacPhee says there have been no known cetacean extinctions in all Quaternary time, in spite of best efforts of the world's whaling industry. He argues that if there's any situation faced by today's mammals that mimics Paul Martin's Pleistocene overkill argument, it is surely the 200-year quest for great whales. "There was terrific hunting-style pressure on them, but despite a level of slaughter probably unprecedented in any other taxon, no whale species has gone extinct." Though he concedes that whales have benefited from conservation measures, MacPhee insists that if it were easy to drive species to extinction, "as it must be under Paul's argument," some whale species should have gone down. "Otherwise, there's something wrong with the logic of the argument."

"There's something missing," he concludes, "in the picture of how extinction occurs." 

—DAH

Expedition in May on Savannah River Continues Pre-Clovis Investigation

The Allendale Paleoindian Expedition, sponsored by the South Carolina Institute of Archaeology at the University of South Carolina, is scheduled to be back in the Savannah River Valley May 4 through 29. Director Al Goodyear says expedition volun-



Members of the 1998 Allendale Paleoindian Expedition pose at their site in the shady woodlands of the lower Savannah River Valley.

COMING CONFERENCES

March 24–28, 64th Annual Meeting of the Society for American Archaeology, Sheraton Chicago.

Contact: SAA, 900 Second Street NE No. 12, Washington, D.C. 20002-3557. 202-789-8200. Fax 202-789-0284. e-mail: meetings@saa.org.

April 8–10, Northwest Anthropology Conference, Holiday Inn, Newport, Ore.

Contact: Loretta Wardrip, Dept. of Anthropology, 238 Waldo, Oregon State University, Corvallis, OR 97331. 541-737-4515. e-mail: lwardrip@orst.edu.

April 20–May 1, 68th Annual Meeting, American Association of Physical Anthropologists, Columbus, Ohio.

Contact: Mark Teaford, Dept. of Cell Biology & Anatomy, Johns Hopkins University School of Medicine, 725 N Wolfe St., Baltimore, MD 21205. 410-955-7034. e-mail: mteaford@welchlink.welch.jhu.edu.

April 28–May 1, Canadian Archaeological Association, 32nd Annual Conference, Westmark Whitehorse Hotel, Whitehorse, Yukon.

Contact: Ruth Gotthardt, Programme Coordinator, 867-667-5983, Fax 867-667-5377. e-mail: Ruth.Gotthardt@gov.yk.ca. For information: www.canadianarchaeology.com.

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teers will be helping to investigate sites that include early-Archaic, Dalton, Clovis, and—apparently—pre-Clovis occupations. Volunteers may sign up for a week or more to help excavate the sites (“Update: Savannah River Quarry Site,” **Mammoth Trumpet** 12:2 and “Microblades Surprise South Carolina Team,” **MT** 11:1).

Dr. Goodyear will be continuing the investigation of one site that in 1998 yielded numerous artifacts well below the Clovis level. Long a supporter of the Clovis-first model, he told a reporter, “I had a paradigm crash right there in the woods” (**Readings: Petit 1998**).

The expedition team will train volunteers in excavation and artifact-identification techniques. Expedition provides free camping, lunches and evening meals, and evening programs. To sign up or to get information about costs and tax deductibility contact Goodyear at 803-777-8170 or goodyear@garnet.cla.sc.edu. 

May 16–20, 2nd International Mammoth Conference, Natuurmuseum Rotterdam, The Netherlands.

Contact: Natuurmuseum Rotterdam, P.O. Box 23452, NL-3001 KL Rotterdam, The Netherlands. Fax 31-10-436-43-99. e-mail: mammoth@nmr.nl.

Oct. 4–8, XIII Congreso Nacional de Arqueología Argentina, Córdoba, Argentina.

Contact: Casilla de Correo 1082, Correo Central 5000, Córdoba, Argentina. Fax 5451-68-0689. e-mail: 12cnaa@ffyh.unc.edu.ar. For information: www.filosofia.uncor.edu.

Oct. 20–24, 57th Annual Plains Anthropological Conference, Ramkota Inn, Sioux Falls, S.D.

Contact: Archaeology Laboratory, Augustana College, 2032 S. Grange Ave., Sioux Falls, SD 57105. 605-336-5493. e-mail: hannus@inst.augie.edu.

Oct. 28–Nov. 1, Conference: Clovis and Beyond, Santa Fe, NM. Sponsors: Center for the Study of the First Americans, Museum of Fine Arts, Laboratory of Anthropology of the Museum of New Mexico, and the Smithsonian Institution.

Contact: Clovis and Beyond Conference. 505-982-8520.

Send conference notices to **Mammoth Trumpet**, 620 Northwest Witham Drive, Corvallis, OR 97330. 