POSSIBLE ARRIVAL TIMES FOR EARLY MAN IN THE NEW WORLD

A thesis submitted in partial satisfaction of the requirements for the degree of Master of Arts in Geography

by

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POSSIBLE ARRIVAL TIMES FOR EARLY MAN IN NORTH AMERICA

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The Bering land bridge is a broad platform connecting Alaska and Siberia, exposed by glacio-eustatic lowering of sea level 300 to 525 feet. The climate of Beringia is in dispute; this paper suggests either (1) the climate was mild, or (2) Early Man was culturally equipped to withstand arctic climates. Palynological studies indicate that trees were never present. Vegetation did support herds of grazing animals.

Man could have entered North America only during glaciation (lowered sea level) and could have moved south through Canada only during interglaciation (corridor through Canadian ice). These conditions were not contemporaneous and non-glaciated central Alaska was thus a "lock segment" for moving populations of animals and men, cut off at one end by ice or at the other by water.

North and South American archaeological sites show
Early Man in sub-glacial America during glaciation and the block segment passage requires that he enter Alaska during a previous glacial episode. Other archaeological evidence indicates that Early Man was culturally equipped to survive a polar climate.

Graphical presentation of the data demonstrates three major episodes of movement into North America herein called Calico, Sandia I and II, and Recent. These movements began in Asia 120,000; 65,000; and 25,000 years ago and left Alaska to cross Canada 90,000; 45,000; and 9,000 years ago. The average rate of movement was 2,250 miles in 10,000 years, making the theme of expansion of territory more logical than that of migration.
Archaeologists, anthropologists, geographers, and others have been puzzled and intrigued by the question of the arrival of the first humans into the New World. Argument has been long and often loud, but the present consensus is that Early Man walked across a Bering land bridge exposed by a glacially lowered sea level. No agreement exists, however, as to the possible times of arrival or routes of travel.

Archaeological sites of Early Man in the New World are scarce and not always completely accepted as to their authenticity. Sites are located in both North and South America and yield a wide range of cultural material and dates.

The objectives of this study were to demonstrate (1) that a logical interpretation of Pleistocene chronology and culture history permits the conclusion that Early Man in Asia was culturally and technologically equipped to move into North America across a Bering land bridge, (2) that an examination of the timing of the opening and closing of the land bridge and of the ice-free corridors south to central North America provides acceptable times for
arrival in and departure from the Alaskan lock segment, establishing logistic bases for movement to Early Man sites whose dates are currently accepted, (3) that a theme of expansion of territory is more logical than that of migration, and (4) that the application of a reasonable theoretical rate of movement can adequately account for currently known American archaeologic sites and produce the hypothesis of three major episodes of movement.

**Origin of American Aborigines**

When the first European explorers arrived in the New World they found a great diversity of native peoples inhabiting every environment, forming nearly 300 separate groups and speaking more languages than are spoken in the whole of Europe (Farb, 1964, p. 15). As soon as the explorers realized that they were not in India, immediate speculation as to the origins of these native peoples sprang up and has continued to the present. It was proposed that these aborigines were descendants of the inhabitants of the lost continent of Atlantis; that they were descended from the Canaanites who were expelled by Joshua; that they are in fact the lost tribes of Israel, a belief that is still held by many religious groups; and even that they were really autochthonous. One bizarre hypothesis held that the whole of mankind originated in South America and thence spread trans-atlantic to Africa, peopled the rest of the world, and arrived lately into North America...
Once it became clear that the aboriginal natives did not originate here, many diverse opinions arose to explain who they were, by which route and when the first peoples arrived. That a land route once existed in the North Atlantic and that a large land mass has since submerged was persistently proposed. Others contended that the first contacts were across the oceans, either the Atlantic from Africa, the Pacific from the South Pacific Islands, or the Orient via the North Pacific. Much current research is being done on early trans-Pacific contacts, although few propose that the first inhabitants came that way.

As early as 1590 it was suggested that the "heathen aborigines" came dry-shod across a land connection from Asia to North America in the unexplored far north, "... not with full deliberation, but changing their sites and lands little by little, some populating lands newly found, others seeking new lands..." (Jarcho, 1959, p. 432). This remarkably perceptive idea came from a Jesuit priest, Fray Joseph de Acosta, who explored South America and Mexico in the 1570's. He reasoned that the native Indians had no large boats, even in their legends, and therefore must not have had any in their ancestral past; that large animals were not found on the mainland; and concluded that

\[1\] For a brief history of early thinking on the subject, see Hrdlicka, 1912a, p. 6.
both the animals and their human predators, since they
could not have swam, came from the Old World on a land
bridge or across a very narrow strait. That the animals
or the men could have "sprung from the earth" was immedi-
ately ruled out as being against the laws of nature and
divine reason.

By the beginning of this century it was becoming clear
that the migration probably was by way of the Bering Strait
area, although there still were some serious detractors
(Gidley, 1912, p. 20; Dall, 1912, p. 18). Some would not
exclude the possibility of a land connection with Europe by
way of Greenland, or that the first migrants came by way of
the Bering Strait, not necessarily on land, but across the
ice or in boats (Fisher, 1935, p. 51-56). Oceanographers
contributed important data (Shepard, 1958, p. 676) and by
1948 began to realize the full extent of Pleistocene sea-
level lowerings and thus the enormous size of the exposed
Bering land bridge. As late as 1951 there was still some
hesitancy to commit oneself to the flat statement that
American aborigines came from Asia (Solecki, 1951, p. 11),
but every sign was pointing to the Bering connection.

Soon geographers and others became intrigued with the
idea of a dry path from the Old World to the New, and as
the Bering area was studied with fresh approaches, new
ideas developed. Several different routes were proposed:
across the Bering Strait in boats, across the sea in boats
from Kamchatka to the Aleutians, or across the ice or land on a bridge north of the Strait (Bryan, 1941, p. 505).

Early discussions of the physical geography of the exposed platform yielded no consensus, but gradually the hypothesis developed that the land bridge was a broad grassy plain, ice-free throughout all seasons, and that human migration proceeded at a very slow rate. Hunting populations moved after the animals, following the plants onto the newly exposed land. Most workers believed that man was not equipped culturally to survive a crossing at that latitude until very recently in his technological history. Many proposed, and some still maintain, that the migrants would have required boats, sophisticated weapons and tools, tailored clothing, and sound dwellings. Only recently have geographers been able to escape from the idea that early man must have been culturally similar to the Eskimo to survive in the climate of an ice age land bridge. The early migrants are most often pictured as travelling along the edge of ice floes in hooded parkas, on the ice or in kayaks, chasing walrus and seal with harpoons.

**Antiquity of Early Man in America**

It has been a long and difficult battle to convince even a few workers in the field of Early Man studies of the evidence for a respectable antiquity for Early Man in America. Principal proponents of this thesis have included George Carter and Carl Sauer, with supporting research from
such workers as Phil Orr and Louis Leakey. Archaeologists have feebly and sporadically claimed antiquity, but these claims generally have been met with hostility (Carter, 1957, p. 366). Somehow the first pronouncements of the earliest workers in American archaeology and the opinions of early religious leaders have led to a rigid doctrine that discouraged discovery and denied evidence (Sauer, 1956, p. 9). There is an ingrained habit of requiring recency. "If we knew nothing of European archaeology, an estimate of these folk as going back at least twenty or twenty-five thousand years . . . would meet with no opposition." (Sauer, 1944, p. 205). No archaeological framework seems to work in this hemisphere. We are required by precedent to work from find to find and from earliest date to earliest date. "The earliest accepted culture becomes the earliest culture" (Carter, 1951, p. 297). All that should really be required is that the earliest known date is simply the earliest date found and file it in the framework that we have as our hypothesis. Chamberlin's (1890) marvelous "Method of Multiple Working Hypotheses" seems to have been overlooked in the study of New World archaeology or Early Man in America. The consensus is that man is an Old World animal who migrated to the New World after attaining modern, i.e., Homo sapiens form, but that is where agreement ends. Orr (1968, p. 49) and Carter (1966, p. 18) have shown that it is not necessary to find a pre-Sapiens hominid in the New World.
to have Pleistocene or Glacial man here, or that because all
the fossil bones found are of a modern form this necessi-
tates recency.

As early as 1930 Albrecht Penck (MacGowan, 1950, p. 121) realized intuitively that man must have had a long
history in the New World. He reasoned that the time for
adjustments to several climatic zones, i.e., from arctic
to temperate to tropical to temperate to arctic, for humans
going from Alaska to Tierra del Fuego simply was not suffi-
cient from the end of the last glaciation—then thought to
be 25,000 years ago—to the present. His argument carries
even more weight now, because recent data have established
the last major change in climate and the end of the last
 glaciation at approximately 11,000 years ago. He also
argued that man migrates most easily within a single cli-
mate zone and would be reluctant to change to a different
environment. Therefore, he most likely entered America in
an arctic zone and moved south only as that zone moved
south, i.e., at the beginning of a glacial stage. He
would not have gone south against the tide of climate
belts moving northward during a deglaciation. He "... must have arrived in North America during one of those
retreats of the Wisconsin glaciation which preceded its
final growth and decline" (MacGowan, 1950, p. 222).

By mid-century an appreciation of the physical environ-
ment of the Bering land bridge was becoming known and early
crossings were tentatively proposed. Leechman (1949, p. 189) realized the habitability of the Yukon basin and the central Alaskan basin during periods of glaciation and proposed that it was occupied very early, even though there were immense ice sheets to the north, east, and south. Grudgingly, others began to accept at least the possibility that man may have been in North America several tens of thousands of years, but certainly no longer than that (Haag, 1962, p. 112; Butzer, 1966, p. 394; Anderson, 1968, p. 24). Such a conservative as R. F. Flint saw some glimmering of a reason for further research. "The prehistory of man in the Americas seems to have been so short as to be hardly more than an addendum to the long prehistory of man in the Old World. Nevertheless, the peopling of two continents within a comparatively short time is a process of no small interest" (Flint, 1971, p. 784).

Other disciplines have contributed to the indirect evidence that may some day confirm man's early presence. The physical anthropology of the North American natives and their ethnology are continuing to show a wide variety of peoples, languages, cultures, and environmental adaptations that must have taken a long time to produce (Bryan, 1941, p. 507; Roberts, 1951, p. 16; Farb, 1964, p. 15). Some of these differences have been attributed to separate waves of migration (Hopkins, 1967b, p. 479) and their separation by the Laurentian-Cordilleran ice sheet complex.
leaving one evolving group in Alaska and another in central United States below the ice. This evidence indicates contacts as early as 28,000 years ago, and "So far, there are no facts available that would rule out even earlier migration . . ." (Müller-Beck, 1967, p. 373). Speculation on the great Pleistocene extinctions lent support to the antiquity of man in America. Earlier times of rapid environmental change, such as other glacial to non-glacial transitions have not produced extinctions in Arctic and mammalian fauna on the order of those experienced at the end of the last major glaciation. "Some new factor must have been introduced at the end of Wisconsin time--probably the presence of human hunters" (Hopkins, 1967b, p. 476).

Direct evidence of archaeologists is more and more confirming this antiquity. Carter has long argued (1966, p. 18) that we should give serious attention to even greater antiquity. Why not, "... especially when bipolar flaking is at least of second interglacial age in adjacent Asia, whence our earliest Americans are popularly assumed to have come?" Recent discoveries in Peru add further relevance to Carter's queries. Tools 22,000 years old in the Andes give credence to some of his answers: "I wonder if any of my more conservative colleagues would care to venture the flat statement that no Core Tool Tradition parallel to the one in the Paccaicasa strata at Flea Cave [Peru] will ever be unearthed in North America? If it is
found, is it not likely that it will be from 40,000 to as much as 100,000 years old" (MacNeish, 1971, p. 46)? Core tools of just such age have been reported for San Diego (Carter, 1967), and at Calico (Leakey, 1970).

Early Man was living in Asia during Pleistocene glacial stages and was accustomed to hunting grazing mammals. Leakey (1969, p. 185; 1970, p. 10) suggested that it was highly unlikely that these early hunters would not follow those herds into Alaska. It is well known that certain representatives of extant American fauna, including bison, mountain sheep and mountain goat, and some now extinct forms such as the true elephant moved into America during the Pleistocene at times when there was a major land bridge between Siberia and Alaska. Sauer agreed and argued that periods of glaciation when the seas were lower and the land was well drained and not boggy, were the logical times for man to cross. "When woodlands of conifers and deciduous trees covered the Arctic and woodland animals lived there and moved across them, man too could have come, if he was available" (Sauer, 1956, p. 12).

Man was available in Asia throughout the glacial Pleistocene and the environment of the land bridge was suitable. This author thinks that it is absurd to deny that there must have been frequent, repeated early contact between Alaska and Asia.
II

PLEISTOCENE CHRONOLOGY

In discussions of Early Man or glaciations, the problem of Pleistocene chronology is one of the first important considerations. Too many papers are published where the time units are correlated with the "early Wisconsin" or a "Late Pleistocene" glacial interstade instead of in some absolute chronology that could remain consistent from one author to another.

To discuss properly the arrival of Early Man in America the Quaternary time scale must be considered, terms must be defined, and the standards of glacial absolute time that is used throughout this paper (Figure 1) must be set forth.

Each branch of science concerned with events of earth history during the last few million years has tried to establish the Quaternary Period and the Pleistocene Epoch based on relevant and significant events within the confines of that science (Hays and Berggen, 1971, p. 669). Each scientist working on this problem begins his presentation with the definition of the beginning of the Pleistocene Epoch. All these scientists agree that the Quaternary Period and the Pleistocene Epoch begin at the same time units are correlated with the "early Wisconsin" or a "Late Pleistocene" glacial interstade instead of in some absolute chronology that could remain consistent from one author to another.

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A complete discussion is in Hays and Berggen, 1971.
Figure 1
Late Cenozoic Chronology
(After Hays and Berggen, 1971; Flint, 1971; and others)
time and that the Quaternary comprises the Pleistocene and Recent, or Holocene, but there the agreement ends.

Anthropoligists are directly concerned with the history of man as an evolving cultural animal and naturally want to begin their relevant time scale with the first appearance of a tool-using, culturally equipped hominid. This has posed frequent problems because it requires re-definition of the beginning of their time scale with each new find of fossil hominid older than that found before. Some anthropologists sought to remedy this by cooperating with vertebrate paleontologists, calling for the base of the Pleistocene to be marked by the first appearance of the horse, camel, bovine, elephant faunal assemblage. This has not solved all problems because further research has shown that this classical assemblage, called Villafranchian, occurs in strata of different age at different places. Other anthropologists have taken data from invertebrate paleontologists and begun the Pleistocene with the earliest appearance of north-Atlantic cool-water molluscan and foraminiferal species (Calabrian fauna) in marine rocks in Italy.

Glaciologists and Pleistocene geologists have assumed that the Quaternary Period, and thus the Pleistocene, began with the first appearance of the cyclic world-wide glacia-tions so significant to the more recent part of earth history. The problem of this assumption is that no two can
quite agree as to when the first glacial period began, how many there were, or whether or not they have ended. Oceanographers and marine micropaleontologists have been working together by logistic necessity and conclude that the Pleistocene began with the first appearance in deep ocean cores of specific microfaunal assemblages, the first indication in these cores of certain cold-water species, or the first major ocean cooling measured by oxygen isotope ratios in shell material. Geophysicists studying the earth's paleomagnetism have dated polarity changes by radiometric techniques and correlated these dates with data of the oceanographers, thus establishing an absolute time scale for oceanic sediments. Unfortunately, the paleomagnetic time scale is of insufficient detail to calibrate the numerous climatic fluctuations of the last few million years.

The chronology problem is further complicated by the inability of the discussants to establish an agreeable base from which to proceed. The Pliocene-Pleistocene boundary is coincident with the boundary between the Tertiary and Quaternary periods, and therefore should be represented by more than a minor change in the lineage of a few organisms (Hays and Berggen, 1971, p. 689). The boundary should reflect a real change in the world environment. It is becoming more and more apparent that the beginning of the late glacial periods referred to as the "Ice-Age," long thought
to mark a significant change in the world climate, is not significant enough for world-wide correlation. Rather, the general climate has cooled more or less steadily during the last ten million years or so, and glaciation has occurred in high latitudes and high altitudes millions of years earlier than in temperate lowlands (Hays and Berggen, 1971, p. 689). It seems likely that the period of gradual climatic deterioration and the fluctuating periods of highland glaciation blended into the more recent phases of fluctuating ice sheets covering the middle latitudes of the northern hemisphere land masses (Flint, 1971, p. 2).

It therefore becomes almost arbitrary where the Pliocene-Pleistocene boundary is drawn. The writer has chosen to follow the major outline of late Cenozoic chronology of Hays and Berggen (1971) who place the base of the Pleistocene at 1.85 million years BP. The writer considers time divisions based on world-wide climatic changes to be most accurately reflected in oceanic sediments which are not influenced by minor local fluctuations.

Time divisions within the Pleistocene are just as confusing and uncertain as the basal boundary because of the problem of exact correlation. To obtain a universal scale based on climate and sea level and dated by radiometric methods, correlations must be made between Pacific coral reefs, North American alpine and continental glacial deposits, volcanic ash beds in Africa, river terraces and
cave formations in Europe, and dry lake beds in the American southwest (Peccora and Ruben, 1965, p. 49; Emiliani, 1965, p. 59). This seems almost impossible when difficulty is encountered in correlating just from one local till to another. The only positive method of determining a universal scale is by absolute dating, but the discrepancy between the ranges of carbon-14 and the potassium-argon methods precludes this, at least for the present (Flint, 1971, p. 413). For the purpose of this paper, I again utilize the chronology outlined by Hays and Berggen (1971) with some modifications.

The paleotemperature and paleosea-level curves of several authors, together with the interpretations of glacial stages developed for this paper are shown in Figure 2. Significant to this report is that part of the Pleistocene that could have affected the migration of Early Man from Asia into North America and thus detailed examination is confined to the last 200,000 years. The changing level of the sea and the timing of the various glacial advances and retreats are of considerable importance and, as indicated above, the overlapping data of several authors, if not their consensus, and the interpretations of the writer have been considered in arriving at the chronology of events used herein.¹

¹Including, in addition to those cited in Figure 2: Carter, 1967, p. 10; Hopkins, 1959, p. 1524; 196b, p. 466; Straus, 1965, p. 11; Suess, 1956, p. 355, 357.
Figure 2
Paleotemperature, Paleosea-level, and Wisconsin Glacial Episodes
Illinoian glaciation, possibly the most severe of the upper Cenozoic (Donn, et al., 1962 p. 213), is considered in this paper as lasting from about 230,000 years ago to 175,000 years ago. A major interglacial period with high sea levels probably occurred between this glacial period and the earliest Wisconsin episode.¹

It appears that there were three major periods of glaciation (Figure 2) during Wisconsin time, the first of which began about 120,000 years ago (Bryan, 1941, p. 512; Carter, 1966, p. 14, 18; Sauer, 1956, p. 12). This first Wisconsin cold period, WI, may actually represent the classical Illinoian glaciation, but whatever correlation may ultimately result, it was probably the first glaciation to affect Early Man in the Bering Strait region. A major interglacial period occurred between 95,000 and 65,000 years before present (BP) marked by a high sea level several meters above the present at 80,000 years BP. A second (middle) glacial episode, WII, began 65,000 years ago and lasted until 50,000 years BP. This may not have

¹The terms "interglacial" and "interstadial" are used in this paper to describe different climatic periods between glacial episodes. An interglacial period is free of continental ice sheets with sea levels higher than at present. In this paper the periods between the Illinoian and Wisconsin I, between Wisconsin I and II, and between Wisconsin II and III are interglacial. An interstadial period is a brief pause in the advance or retreat of an ice sheet, thus occurring within a glacial period or between a glacial and an interglacial period. The present time is interstadial.
been more severe than the most recent, but there is some evidence that it was. The most recent glacial period, WIII, began 25,000 to 35,000 years ago, reached a maximum about 18,000 years BP, and lasted until 11,000 years ago when a rapid warming and retreat of the continental ice sheets marked the beginning of the Holocene Epoch.

Many authors believe that the Holocene is in fact another interstadial period (in their terminology—a very minor interglacial period in time) and represents climate similar to that of prior interglacial times (Ewing and Donn, 1956, p. 1061, 1066; Butzer, 1966, p. 325). Other authors are adamant that the status of the Holocene should not be reduced by calling it Pleistocene, citing geological precedence in keeping the Recent (Holocene) recent; that there has been sufficient time for significant evolution and deposition of strata to justify the name and describing of a separate epoch.¹

World climate during the interglacial periods was much as it is now; the general circulation of the atmosphere was the same except that with less ice in Greenland and Antarctica the sea levels were higher and the east-west climate belts were shifted somewhat poleward.

Glacial climate was basically different and involved much more than the equatorial shift of the climate zones

¹Personal communication, P. J. Fischer, 1972, Department of Geology, California State University, Northridge.
Ewing and Donn, 1956, p. 1063). A fundamental change in the circulation of the atmosphere must have occurred that created "Pluvial" conditions in areas where present day atmospheric conditions are unfavorable for precipitation, and reversed the polar high to a polar low. The local effect was that the northern hemisphere climate zones moved south, rains fell in normally desert latitudes, large continental ice sheets spread out from the mid-latitudes, and alpine glaciers formed and expanded. It is generally accepted that pluvial periods were closely synchronous with glaciations (Carter, 1951, p. 299 footnote; Ewing and Donn, 1958, p. 1161) but this does not necessarily imply an overall increase in world-wide precipitation; it merely requires a redistribution of precipitation caused by the change in the atmospheric circulation (Flint, 1971, p. 20).

A major effect of this redistribution was that land glaciations caused a world-wide lowering of sea levels. Amounts probably fluctuated greatly, but most workers agree that the maximum of any glacio-eustatic lowering was between 450 and 525 feet.

Various criteria have been used to estimate the amount of lowering of sea level: calculations of the volume of ice, positions of river terraces left by changing base levels (Russell, 1957; 1964), actual shore-line features on submerged continental shelves, and submerged wave-cut platforms on Pacific islands (Donn, et al., 1962). The
relative sequence and ages of these lowerings do not meet with as much agreement as the total amount. Donn, et al. (1962, p. 212) were convinced that the maximum lowering of sea level occurred during the Illinoian (third last) glaciation and was about 525 feet below present sea level. They marked the remaining two glacial stages (early and classical Wisconsin) at -441 feet and -407 feet respectively. Others (Russell, 1964, p. 793) concluded that the maximum lowering was at 50,000 years BP (Wisconsin II this paper) and was at -450 feet. Haag (1962, p. 120) reported that the maximum Wisconsin lowering was -460 feet at 40,000 years ago.
III

THE BERING LAND BRIDGE

Physiography

The geology of Asia and Alaska indicates that the Bering Strait merely overlies a submerged segment of a single continental land mass; the Bering and Chukchi platforms form a continuation of the two exposed continents (Hopkins, 1959, p. 1519). If sea level were lowered only 150 feet (46 meters), a narrow land connection would be formed between the Chukotka Peninsula and Alaska by way of St. Lawrence Island; a 164 foot (50 meter) lowering would expose a narrow connection just north of the Strait; and a lowering of 328 feet (100 meters) would expose almost the whole extent of the Bering-Chukchi continental platforms (Figure 3), resulting in an expanse of land 1,300 miles wide from the Bering Sea to the Arctic Ocean (Hopkins, 1967b, p. 460; Haag, 1962, p. 120).

It appears that sea level fell by at least 328 feet (100 meters) during every major glacial episode of the Pleistocene and fell much further, to a maximum of 525 feet (160 meters), during a few of them. Thus, there was ample room for a migration path at the time of glaciation. A large shallow lake may have occupied the position of the
Figure 3 Beringia Area
present strait and the modern islands were small mountains on the exposed surface, but while exposed there were no significant physical barriers to migration during any time discussed in this paper.\footnote{Hopkins (1967b, p. 461 and Fig. 2) reports an embayment in the Anadyr Gulf extending into the Chukotka Peninsula during the Illinoian (Wisconsin I this paper ?). This author does not agree that this embayment existed, but in any case it disappeared or was significantly reduced by Wisconsin II time.}

The exposure of the land bridge is somewhat complicated by the addition of tectonic and epigenetic events in the region. The Anadyr Gulf was probably active tectonically during early parts of the Quaternary (Hopkins, et al., 1965, p. 1113) and may have closed the bridge during some glacial periods or opened it during some interglacial periods, but most of the region north of the Aleutians remained stable during the later Pleistocene (Hopkins, 1967b, p. 453). There is evidence of sea floor subsidence in the deep basin of the Bering Sea of as much as 1,000 meters (3,280 feet) in late Pleistocene time (Saidova, 1967, p. 367). Subsidence decreased toward the coast but was as great as 250 meters (820 feet) on the shelf. This certainly could have affected the amount of sea-level lowering required to expose the shelf during later Pleistocene glaciations; the water depth could have been much less than now. There may have been an additional amount of exposure caused by rebound of the Bering-Chukchi platforms.
due to the removal of the water overburden. Gilbert (1890, p. 362-368) has shown that the central portions of Lake Bonneville rebounded some 129 feet (39 meters) after the removal of 900 feet (275 meters) of fresh water. Bloom (1967, p. 1482) reported a rebound at Lake Bonneville of 65 feet (20 meters) after the removal of 475 feet (145 meters) of water.

Two additional, possibly offsetting, effects were taking place during the late Pleistocene glaciations. In the northwest Bering Sea the deposition of glacial moraine material and suspected regional uplift may have reduced the amount of sea-level lowering required to expose the land connection (Hopkins, 1967b, p. 460). The northeast Bering Sea was experiencing heavy sedimentation from the Yukon and Kuskokwim rivers, and there is some evidence of isostatic subsidence of the shelf (Hopkins, 1959, p. 1523).

The extent of the land bridge that was exposed is really a matter of speculation; all that can be said with certainty is what would be exposed if sea level were reduced by a given amount today. The surface of the Bering-Chukchi platforms has been described as one of the flattest areas on earth (Scholl and Sainsbury, 1961, p. 1433), relieved rarely by a few granite monadnocks that have become the islands in the Strait and the Bering Sea north of the Aleutians (Hopkins, 1967b, p. 453). Certainly the present surface of the platform is a result of heavy late
Pleistocene and Recent sedimentation. The long exposure of the platform before its initial submergence in Late Tertiary or early Pleistocene time must have resulted in a stream-sculptured topography with local relief of several hundred feet that now lies buried beneath the thickness of marine sediments forming the monotonously flat floor of the Bering and Chukchi seas (Hopkins, 1959, p. 1523, 1525). If taken alone, this sedimentation would have progressively built up the platform and lessened the depth of the overlying water, resulting in increased bridge exposure with lessening sea-level lowering during glaciations. Thus, with the same glacial and sea level conditions the earlier Pleistocene bridges may have been much smaller and more varied than those of late Pleistocene. This may even have had considerable effect during the Wisconsin glaciation, reducing the length of time that the bridge was open to migration in WI and WII. The sequence of opening and closing (see p. 34-40) may have been considerably altered; the bridge would have undergone extensive subaerial erosion during its long exposure with removal of much of the soft young sediments and redeposition of similar sediments during its submergence between glacial. The bridge may have been exposed rapidly at the onset of glaciation by removal of water from the sea, but was reduced in size because of erosion, causing the connection to become terminated very early in the waning stages of the glacial period.
This would cause an increase in the time separation between the end of the land connection between Asia and Alaska and the opening of the corridor to the south (see Figure 5, p. 37), especially during the WI and WII exposures (Hopkins, 1959, p. 1525).

Climate

The climate of the Bering land bridge during times of glaciation is a subject of hot debate and divergent opinion. Most traditional workers have maintained that the land bridge climate was always wholly arctic and that any species crossing the bridge, including hominids, must have been cold-adapted to survive the glacial age winters (Colinvaux, 1964, p. 328; Hopkins, 1959, p. 1527; 1967b, p. 471). Others have held that man generally is not and has not been an arctic species and propose the idea that there must have been a land bridge of mild climate during times of lowered sea level (Carter, 1951, p. 306; Sauer, 1969, p. 6). Each of these groups have gathered evidence from the field and maintain that their evidence supports their hypothesis.

The theory of glacial origin of Ewing and Donn (1956, 1958) has greatly aided the camp of those advocating a mild land bridge climate (Carter, 1957, p. 378). Ewing and Donn suggested that the glacial periods were characterized by an

\[1]\text{All agree, however, that the entire land bridge, along with the Siberian and Alaskan lowlands, was at all times free from glacial ice (except for scattered alpine glaciers in the mountains)} (\text{Colinvaux, 1964, p. 297}).
ice-free and relatively warm Arctic Ocean supplying the evaporation reservoir required for the increased precipitation of snow on the continental masses. They also postulated that a polar low-pressure cell replaced the normal interglacial high-pressure cell over the pole. Scholl and Sainsbury (1961, p. 1435) supporting Ewing and Donn, offered surface erosional evidence that the land bridge had a frost free season during glacial ages.

The effect of the closing of the Bering Strait, especially if the Arctic was ice-free, would reinforce the effect of the contribution of the warm Japan current on the land bridge climate. Flint (1971, p. 74–75) showed warm currents from the south during glacial times and a reduced storm track across the bridge. At present the major north Pacific gyre brings warm equatorial surface water up the east coast of Asia to Kamchatka where it mingles with the cold polar water from the Arctic basin through the Bering Strait. If the bridge blocked the strait, the source of cold water for the north Pacific would disappear and only warm currents would warm its southern shores (Kelley, 1971, p. 265; Gidley, 1912, p. 22). Many writers propose much sea ice in the Bering Sea and the Gulf of Alaska (Flint, 1971, p. 74, 75) but if the Strait was closed the only source would be from calving glaciers in the fjords along the Alaska Range and the Coast Ranges to the south, or from Kamchatka Peninsula. It is reasonable to assume that
floating sea ice from these sources would have been in small amounts with little effect on the southern land bridge coast.

In studying the palynology of lake sediments spanning at least the whole of Wisconsin III in Lake Imuruk on Seward Peninsula, Colinvaux (1964, p. 316, 327) concluded that Ewing and Donn were in error and that the Arctic Ocean was frozen during all of each glacial period. Laughlin (1967, p. 422) agreed, citing mammalian migration evidence. He was convinced that the Arctic shore was the most inhospitable of all the available habitats on the land bridge during glacial times.

Carter disagreed, as did Wormington (1957, p. 251). They and others looked to the Ewing and Donn hypothesis as a possible solution to the seemingly insoluble problem of producing mild land bridge conditions during the height of a glaciation.

If the hypothesis that the presence of Early Man in the central United States requires an early crossing into Alaska is accepted, one must also accept one of the following two conclusions: (1) that at some time prior to the ending phases of the Wisconsin there was a land bridge of relatively mild climate during a period of substantially lowered sea level (glaciation on the continents), or (2) that the hominid groups that actually lived in the arctic during the migration across the land bridge were culturally
equipped, even at the required early migration, to survive in a hostile arctic environment.

Carter (1951, p. 306) wrote that lower paleolithic man could not have crossed an arctic climate and Ewing and Donn (1956, p. 1064, citing Giddings, 1954) used the evidence of early man long established in a circumpolar habitat and his presence in America at lower latitudes, as additional support for their ice-free Arctic theory of glaciation. They reasoned that, "The usefulness of the accepted land bridge between Siberia and Alaska would have been very limited if the Arctic Ocean had been ice-covered and the climate far colder than at present." Colinaux (1964, p. 326) arrived at different conclusions: "Attempts to find a mild land bridge, for the passage of men and animals, during the closing phases of its history must therefore be abandoned."

**Vegetation**

The only substantiated evidence of the vegetational history of the land bridge comes from Colinaux (1964, 1967) and his palynological studies of the sediments of Lake Imuruk.¹ His conclusions were that vegetation during glacial periods was the most frigid form of arctic tundra and that the bridge and associated continental lowlands

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¹Davis and Goodlett (1960, p. 353, 355-356) have shown that total reliance on palynological data is not tenable and thus Colinaux's conclusions must be viewed as approximate only.
were a broad expanse of tussockless grass and sedge, devoid of all trees and shrubs except willows (1964, p. 323). During the times of bridge flooding, the Siberian and Alaskan lowlands supported a rich tussock grass and sedge tundra, replacing the frigid tundra of glacial times, but this was the only vegetational cycle that occurred (1964, p. 312).

Hopkins (1959, p. 1526), in studying the paleobiography of the region showed that the tundra vegetation of both continents have merged repeatedly and recently, but that the forest vegetation of Alaska and Siberia has been separated for some time, probably since the beginning of the Pleistocene. No tree species has been found to occur in both Alaska and Siberia. He assumed (p. 1527) that summers were too short and too cold to support forest vegetation.

Most workers agree that the land bridge never supported vegetation other than tundra, but differing opinions must be considered. Giddings (1954, p. 84) suggested that migrant hunters of the late Pleistocene lived near the forest edge, reaping benefits from both forest and grassland environments. Citing the presence of migratory animals that do not live on tundra, Sauer (1956, p. 12; 1969, p. 6) reasoned that woodlands of some sort were present across the bridge and that forest-dwelling animals and their human hunters lived in them. Colinvaux (1964, p. 324, 326-327) conceded that there may have been a narrow zone of somewhat milder climate, and I assume, vegetation,
along the southern coast of the land bridge, but denied these coastal habitats to the migrants by placing them too far off the main migratory routes north of the mountain glaciers.

Hopkins (1967b, p. 468-469, 473) pointed out that the mammals crossing the bridge during the middle Pleistocene were adapted to a forest environment, but the mammals crossing in the late Pleistocene were mostly steppe and tundra forms. He described widespread arid climates for the bridge and extensive grasslands growing on the thick loess deposits supporting great herds of grazing animals. It is precisely in isolated, highly-specialized areas of this type, and in no other, that bison and feral horse survive in present-day Alaska (Hopkins, 1967b, p. 473). When large herds of these obligatory grazers were present, the loess grasslands must have been much more extensive. These higher, well drained areas may well have given way to true steppe grasslands during periods of maximum bridge exposure. The tundra biomass (and therefore carrying capacity) was certainly not low. The biological potential was there and archaeological and paleontological evidence proves that these large grazing herds were there (Butzer, 1966, p. 144 - 145). The bridge must have been a lush animal habitat during the glacial maxima—a paradise for plains big-game hunters (Solecki, 1951, p. 12; Hopkins, 1967b, p. 478).
Biogeographers have studied plant and animal migrations across Beringia for years. They have found that the total migration in each direction has not been equal, even before the "Ice-Age." The numbers of species crossing from Asia into North America has always been far greater than the number going the other way. This has become more one-sided since the beginning of the Pleistocene. The operation of the opening and closing of the land bridge and the closing and opening of the ice-free corridor into central North America has been as a set of one-way valves allowing free flow in one direction (west to east) and severely restricted flow in the other (Hopkins, 1967b, p. 475-476).

Animals that came across the bridge were not truly cold-adapted species typical of frigid climates (Haag, 1962, p. 121). There will always be a cold winter near the poles of a spherical planet with a rotational axis inclined in relation to the plans of its ecliptic, yet non-boreal animals survived quite successfully near the poles during winter in glacial periods. Camels, horses, mastodons, bison, deer, and mammoths require a somewhat warmer grazing-land than in present-day Alaska and Siberia (Carter, 1951, p. 306; Haag, 1962, p. 121; Sauer, 1969, p. 6). Yet, these animals were there, indicating a somewhat milder climate than most workers will accept.
IV

THE ALASKAN LOCK SEGMENT

The main hypothesis of this paper is that Early Man could have entered North America only during a major glacial stage when sea level was lowered, could have crossed Canada and entered the central United States only during a major interglacial stage when the ice sheets were less extensive, and that these two conditions were never contemporaneous for sufficient time to allow the populations of Early Man to cross from Asia into Alaska and also to make the trek south through Canada. The only long-term, extensive migration route from Asia to North America was the Bering land bridge and this connection was exposed only during a major glacial stage, when sea level was lowered at least 300 feet (Hopkins, 1967a, p. 47).\(^1\) The migration route from Alaska south into central United States was closed during periods of glaciation by the coalescing of the Laurentide ice sheet of central Canada (Figure 4) with the Cordilleran glacier system of the western mountains.

\(^1\)A sea level drop of only 160 feet would expose a narrow land connection but this writer suggests that a broad expanse is required for significant migration to occur. A drop of 300 feet would expose a major portion of the Chukchi-Bering platforms.
Figure 4
General North American Glaciation and Early Man Sites
Glaciation after Flint, 1971, 465, 490; Pleistocene lakes after Feth, 1961
Glacial termini in oceans are arbitrary
Many workers have clearly recognized the "lock segment" relationship of these corridors and barriers, but few have considered the implications. If Early Man was established in the central United States, south of the coalescent ice sheets (Laurentian-Cordilleran) during the time of the glaciation, and the route across from Asia was blocked by the sea during the immediately preceding interglacial period, his ancestors could not have come into North America later than during the next earlier glacial period (Figure 5). Also, if genuine Early Man sites have been found in the American southwest dated at 80,000 years ago, then the very latest that the forebears of these early men could have crossed the Bering land bridge was 95,000 years ago. The actual migration probably was somewhat earlier.

A clear understanding of the relationships between the chronological sequences of the opening and closing of the land bridge and the closing and opening of the corridor south is critical to an understanding of man's early geographic history in the New World (Hopkins, 1967b, p. 467).

1There may have been a minor coastal route open during glacial times; this will be discussed later. See Figure 4 and pages 69-70.

2Carter, 1957, p. 376; Bryan, 1941, p. 506; Hopkins, 1967b, p. 467; Flint, 1971, p. 786; Sauer, 1944, whence the idea for this paper came.
<table>
<thead>
<tr>
<th>Absolute Time (10^3 years)</th>
<th>Glacial Episodes</th>
<th>Bridge Open</th>
<th>Corridor Open</th>
<th>Early Man Sites</th>
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<tbody>
<tr>
<td>10</td>
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<td>Tierra del Fuego</td>
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<td>20</td>
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<td></td>
<td>Chapala III (?)</td>
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<td>30</td>
<td></td>
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<td></td>
<td>Minnesota Man</td>
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<td>40</td>
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<td></td>
<td>Flea Cave</td>
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<td>Tule Springs</td>
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<td>Clovis</td>
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<td></td>
<td>Chapala II (?)</td>
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<td>100</td>
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<td>Sandia</td>
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<td>Chapala I (?)</td>
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<td></td>
<td>Calico</td>
</tr>
</tbody>
</table>

La Jolla (San Diego)
The exact nature and sequence of the opening and closing of the gates at either end of this Alaskan lowland lock segment is little understood. Flint (1971, p. 786) felt that in general the opening and closing was sequential: ". . . when one end of the segment was open the other was closed. . . ." It has been suggested that there was a brief period during the waxing phase of a glaciation when there were simultaneously open routes across the land bridge and through the southern corridor (Hopkins, 1967b, p. 468), but it is certain that during the waning phase of a glaciation the sea level rose long before the glacial margins receded appreciably.¹ Thus, sea level fell rapidly in close association with the increase of land precipitation and the accumulation of snow at the beginning of a glaciation, and rose rapidly as the accumulation stopped, but the returning water came from surface ablation of the ice sheet long before the margins receded (Colinvaux, 1964, p. 327).

Both Donn et al. (1962, p. 214) and Shepard (1948, p. 676) reported relatively rapid glaciation and deglaciation and correspondingly rapid rising and falling of sea level, implying that during most of a glacial period the Bering land bridge and the Siberian and Alaskan lowlands were a continuous physiographic and biotic environment.

¹I have arbitrarily chosen 1,000 years for the overlap (Figure 5).
The joining of this environment with the American central plains to the south was slower and lagged considerably behind the rapid flooding of the land bridge and separation from the Asian lowlands to the west. Fauna that had reached Alaska long before they were allowed access to the southern corridor had sufficient time to establish themselves and then become extinct before the corridor was opened. Presumably, they were prevented by the flooded land bridge from returning to Asia and avoiding extinction (Hopkins, 1967b, p. 477).

The timing of the opening and closing of the central corridor is of crucial importance. Most workers agree that the corridor was closed from about 23,000 years ago until 14,000 to 10,000 years ago (Müller-Beck, 1967, p. 380, 398; Hopkins, 1967b, p. 467) by the last Wisconsin glaciation. A similar situation must have occurred during each preceding glacial episode in the Wisconsin and especially during the more extensive Illinoian (Hopkins, p. 466). If such assumption of uniformity is justified, the interpretations and inferences shown on Figure 5 can be used as a general framework of events for interpreting additional finds of Early Man sites. The periods shown when the route south was free might have to be shortened allowing even less time for overlap of open bridge and open corridor. The corridor during early and late parts of the closed period would have been intermittent, barren,
narrow, and generally inhospitable (Müller-Beck, 1967, p. 380). The land route from central or southern Siberia was free from all but alpine glaciation during glacial maxima, allowing free entrance to the exposed land bridge.\(^1\)

The fluctuation of sea level can be much more accurately measured than the presence or absence of an ice-free corridor. Abundant data are available based on independent criteria and the various interpretations are shown in Figure 2. The paleotemperature and paleosea-level curves plus the work of others form the basis for the interpretations of this writer of the glacial episodes of the late Pleistocene and I assume, in the manner of uniformity above, that the bridge was open during each major glacial period and closed at all other times.\(^2\)

\(^1\)Carter (1967, p. 376, 378) and in part Hopkins (1959, p. 1526) thought that the Asian approach to the land bridge was also blocked during glaciation; this writer does not agree. I support the view of Chard (1960, p. 283) that there was always potential access and that the bridge and central Alaska were more properly a part of Asia than of America during glacial periods.

\(^2\)Einersson et al. (1967, p. 323) cited evidence from Iceland of as many as ten periods of lowered sea level and bridge openings during the active Pleistocene. This paper is concerned only with the late Pleistocene and the three major periods of land connection presented here do not conflict with Einersson.
EARLY MAN ARCHAEOLOGICAL SITES IN THE AMERICAS

The idea that early man in America was of glacial age was never readily accepted. It took a dramatic discovery near Folsom, New Mexico, to convince most archaeologists to think seriously about the possibility. In 1926 a party from the Denver Museum proved that inhabitants of the Folsom site were big-game hunters preying on a now-extinct form of Pleistocene bison. An additional ten years were required to convince others that these hunters were indeed contemporaneous with a glacial phase, since confirmed as a late pulse of the dying Wisconsin III (Sauer, 1956, p. 9). As late as 1957 the boldest statement that could be made was that the presence of Early Man was firmly established as being beyond the 30,000 year range of carbon-14 dating (Carter, 1957, p. 378).

Since that time a great deal of work has been done and many pieces of important evidence have been collected, adding to the mounting body of proof that man was here during much of the last 100,000 years of the Pleistocene.

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1See Figure 4, p. 35, for location of the sites discussed in this chapter.
The Sites

The report of "Minnesota Man" created an exciting stir in the field of American paleoarchaeology until it was shown that the skeleton was of modern form. Since the feeling was that to be really glacial, a skeleton found in America should exhibit some primitive characteristics, e.g., heavy brow-ridges, then Minnesota Man was post-glacial because she (the skeleton is really a female) was modern. However, based on more detailed evidence, others concluded that the skeleton was naturally in place, and therefore contemporaneous with the varied silts in which it was embedded. These freshwater lake sediments were dated stratigraphically to be 10,000 to 20,000 years old (Kay, 1939, p. 462; Bryan, 1941, p. 513). Another site, found half a continent away at Tule Springs in southern Nevada buried beneath 14 feet of freshwater lake silts, was dated beyond the range of radiocarbon (then 23,500 years). These two sites alone place populations of man south of the ice sheets during the Wisconsin III glacial period. This late Pleistocene presence of early hunting cultures is further substantiated by the finds in the great plains and elsewhere of the Folsom, Sandia, and Clovis cultures.

The Folsom culture, associated with the extinct bison, may be nearly 25,000 years old (Bryan, 1941, p. 511) and is culturally contemporary with the upper level of a cave
in the Sandia Mountains near Albuquerque. Beneath a sterile layer of yellow ochre in this cave is another cultural layer given the name Sandia. This culture is certainly older than the Folsom-equivalent in the upper layers of the cave, but is probably a little younger than the reported 30,000-35,000 year old date assigned to the Clovis culture (Carter, 1957, p. 372, 377).¹ If these dates are correct, the placement of these sites is well into the WII-WIII interglacial period. Therefore, it is not surprising to discover that dart points have been discovered beneath moraines in the midwest.

In 1957, Carter (p. 368) recognized an American counterpart to the Paleolithic industry of the Old World in sites along the Pacific coast of southern California. He found stones which he felt were worked by humans in terraces and valley fill material that he judged equivalent to the great pre-Wisconsin interglacial. His dating at 80,000 years ago (1951, p. 306; 1966, p. 14; 1967, p. 12) places the site within the WI-WII interglacial period of the chronology of this paper.

At Santa Rosa Island off the coast of southern California, Phil Orr of the Santa Barbara Museum of Natural History has uncovered evidence of occupation by hunting groups extending back at least 37,000 years. Charcoal from

¹In a note, Science (1956, vol. 124, no. 3218 (Aug. 31), reports carbon-dated campfires culturally contemporary with the Clovis as being more than 37,000 years old.
numerous fire pits and charred pigmy-elephant bones have repeatedly given radiocarbon dates which average 29,759+3,000 years. The oldest fire pit material was beyond the 37,000 year limit of radiocarbon (Orr, 1968, p. 73, 82).

In the highlands of Peru, excavations at Flea Cave yielded a succession of tools and bones dating to 22,000 years ago (MacNeish, 1971, p. 42). These tools are crude corelike choppers, scrapers, and denticulate instruments and MacNeish compared them to those found at the Calico site in California (see below). They were made of local material, but of material that was carried in from outside the cave. The oldest carbon-14 date from bones unearthed in Flea Cave is in the second oldest layer (overlying the earliest tools) and is 19,600+3,000 years.

The site found by Louis Leakey in an alluvial fan near the Calico Mountains in southern California has perhaps caused more excitement and controversy in the field of early North American hominids than any other of recent times. Leakey (1969, p. 187) saw in the artifacts the oldest known cultural material anywhere in the New World. These choppers, scrapers, and cores are fashioned from the abundant chert fragments that form much of the cobble material of the fan, and they greatly resemble such crude tools readily accepted from the Old World. There is also evidence for a hearth at the site (Berger, 1972, p. 68). The geology of the site indicates that the fan was formed
during the Sangamon interglacial, which places the surface of the fan at the level of the hearth at about 80,000 years ago (Clements, 1972, p. 23; Leakey, 1969, p. 187). This site, along with Carter's La Jolla (San Diego) site at 80,000 years falls within the WI-WIII interglacial of this paper.

A series of sites at Pleistocene Lake Chapala in Baja California adds further evidence of a threefold Wisconsin chronology and a corresponding series of human habitation. Arnold (1957) described the geomorphology, climate, tectonic history, weathering, and cultural levels, and concluded that the whole of Wisconsin time was involved and that three separate levels of culture were present. These levels do not correspond to the glacial periods of this paper (Figure 5), but I conclude that, as man was living elsewhere in the southwest during interglacial periods, man could easily have been living at the sites described by Arnold at the times suggested here.

**Chronological Framework**

The implications of these archaeological data must now be considered. Earlier I proposed that early man in sufficient numbers to establish a population could only have entered the New World during a major glacial period when sea level was low enough to expose a broad Bering land bridge, and that he could have traveled south into central United States only during a major interglacial
period when the Laurentide-Cordilleran ice sheet complex was separated into two distinct sheets. That there is substantial evidence for the presence of Early Man south of the ice sheets during and before two major late Pleistocene glacial episodes has been shown. For the men or their culture to spread south during the time of the open corridor, these people must have entered the American arctic before the end of the preceding glaciation while the bridge was still open to be in position to follow the corridor south when conditions were such that it was open (Carter, 1951, p. 300; Bryan, 1941, p. 512).

Figure 5 is an attempt to arrange these data in a framework that exposes some otherwise obscured conclusions. Justifications for the Pleistocene chronology that I have selected have been discussed. The bars representing the times open to southern migration out of Alaska are based on inferred openings and closings of the land bridge and the corridor between the ice sheets as discussed earlier. I have chosen an arbitrary period of 5,000 years for the earlier, more severe glaciations, and 2,000 years for the milder WIII, as the delay between the flooding of the land bridge and the retreat of the ice margins opening the southern corridor. These figures work out remarkably well as will be seen in Figure 6, p. 52. By placing the best dates for the various sites that we have of Early Man on the chart (Figures 5 and 6), we can see significant relationships and voids (see footnote on page 60).
VI

EARLY MAN IN BERINGIA

From archaeological evidence it is difficult to determine just what material culture was possessed by a group and much negative reasoning is employed. Because objects of wood, bone, cord, or other perishable material are absent from a site, it does not follow that the group did not make and use these items. The majority of ancient artifacts found are of stone and we begin to think that the peoples possessing these tools used little else. Anything not found is thought of as not being there (Solecki, 1951, p. 15). The sites themselves represent only a tiny fraction of the living places of early cultures, and thus are poor samples for establishing criteria. Frequently the only sites found are hunting camps or kill-sites that would not reflect the full suite of materials used in living (Laughlin, 1967, p. 422). Many living sites did not favor permanent preservation over geologically long periods. Sites along watercourses or a lowered sea shore were not long preserved. Much of the best material is probably buried beneath 300 feet of water and 100 feet of recent sediment along the edge of the Bering shelf (Haag, 1962, p. 121; Russell, 1957, p. 422). Modern populations often
concentrate along sea coasts and populations probably did not differ in the past.

As mentioned earlier, the hypothesis of Early Man migrating across a Bering land bridge during a glacial period with lowered sea levels presents a dichotomy: either Early Man was culturally and physically adapted to a true polar climate, or, if man were truly primitive when he crossed (at least the first crossings) then the climate must have been milder than at present. If the climate required cultural development not possessed by the migrating tribes, the tribes could not have come (Mather, 1954, p. 304; Sauer, 1956, p. 12). Archaeology must show what the cultural (technological) level of the earliest migrants was and modern studies must show what the environmental limitations on primitive peoples are today.

Technology

Although there is considerable argument defending either view, the bulk of evidence supports the view that Early Man was equipped to survive in a fairly cold climate.\(^1\) However, Mather (1954) showed the clothing required to survive an arctic winter today and that these clothes were not possessed by presumed descendants of the early migrants. He studied the peoples of Tierra del Fuego

\(^1\)That Neanderthal was well equipped and did flourish in a subpolar environment is well established. Personal communication; Dr. Carol J. Mackey, 1973, Department of Anthropology, California State University, Northridge.
and concluded that only by running across the land bridge during the summer or by staying inside shelters all winter except for half-hour periods of food gathering could these people have made the crossing with their present-day clothing (Mather, 1954, p. 312). The other alternative (Carter, 1951, p. 306; Sauer, 1969, p. 6) is that these tribes had a more advanced technological level in the past when they were actually making the crossing and have since given up any hint of ever having possessed these advanced articles and skills, but this is contrary to normal archaeological and cultural reasoning.¹

The fossil-pollen evidence is very hard to ignore, and even with an ice-free Arctic Ocean, the winter climate on the exposed land bridge was probably quite cold. We do know that, although the animals on which early man preyed were not typical boreal creatures, they were quite at home in cold, if not arctic, climates. It is necessary, then, that the early human migrants were sufficiently well adapted culturally to establish themselves and to thrive in this cold sub-polar climate. There is clear evidence that hunting cultures existed on the Eurasian plains during the opening of the first late Pleistocene Bering land bridge.

¹McIntire disagrees. His opinion is that many groups have deculturated, and as they lived in tropical-subtropical environments their use for heavy clothing disappeared and their memories and skills to produce it long forgotten. Personal communication; Dr. Elliot McIntire, 1973, Department of Geography, California State University, Northridge.
Bands of big-game hunters were well adapted to life on the open tundra and cold steppes and thrived in a sub-arctic environment; the tundra was not a peripheral environment. Fire was presumably employed (Butzer, 1966, p. 142) and there may have been bone needles and other tools necessary to make tailored clothing, at least among their American descendants (Roberts, 1951, p. 18). Sauer (1956, p. 10) suggested that they might have had such sophisticated tools as cords, nets, and baskets in central United States, in time to have been brought from the second wave of migrants across the bridge (Sandia I; see Figure 6, p. 52).

Primitive peoples living on the land bridge must have had sound shelters that could withstand severe winters, especially if their clothing was crude. Pfeiffer (1969, p. 123) reported that primitive men living in France 300,000 years ago built complex huts of stone and poles and had hearths inside the structures. That men living in China and Siberia at about the same time would have been familiar with building huts of stones and poles and probably skins, is a reasonable assumption. As these peoples moved out onto the treeless tundra (the willows notwithstanding) they would have substituted thick sod for rocks and built snug shelters half below and half above ground with sod blocks and skins. These people were accustomed to hunting large animals in a steppe environment and would
naturally adapt readily to the land bridge. The lack of forest would hardly have been a hindrance. Fuel must have been remarkably abundant in the form of fecal chips from the grazing herbivores and the interior of the huts could have been warm and cozy all winter. The sluggish braided rivers running across the plains, with their banks of glacial flour drying to be picked up and removed by the wind, would have provided these early hunters with abundant raw material in the form of rounded stream pebbles for primitive or sophisticated lithic technology. They would have had the game as a source for finer tools of bone and antler, as well as the copious skins for shelters and tailored clothing. Even in the hardest winter the survivability of these people was secure.

Episodes of Movement

Inferences derived in part from data in Figure 5 have been summarized graphically in Figure 6 which may be used as the framework to discuss a realistic approach to the time involved in the migration of Early Man and to arrive at some conclusions. By beginning with the thesis that humans lived in Flea Cave in Peru 22,000 years ago, i.e., during the Wisconsin III glaciation, and that the latest possible time that their antecedents could have begun the southern trek from the Alaskan lowlands was 45,000 years ago (Figure 5), these dates can be plotted on a graph of latitude (Figure 6) and will produce a rough curve for
Figure 6
Rates and Episodes of Migration

<table>
<thead>
<tr>
<th>Sites</th>
<th>Migration Episodes</th>
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<tbody>
<tr>
<td>Calico</td>
<td>Calico</td>
</tr>
<tr>
<td>Sandia I</td>
<td>Sandia I</td>
</tr>
<tr>
<td>Sandia II</td>
<td>Sandia II</td>
</tr>
<tr>
<td>Recent</td>
<td>Recent</td>
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TIME BEFORE PRESENT (10^3 years)
rate of travel. Having established these two points and connected them with a straight-line curve for travel rate (Sandia I Episode), additional data can be plotted on the graph. A line of the same slope placed through the location of the sites of Calico and La Jolla (Calico Episode) meets the latitude of the Alaskan lowlands exactly at the time when the corridor was first open for southern migration for the preceding interglacial (Figure 5). If the Flea Cave rate line is extended to the latitude of Tierra del Fuego, the expected time of arrival is the date given for the oldest sites there, 8,000 to 11,000 years ago (Wormington, 1957, p. 252; Haynes, 1967, p. 270, 272). Further, a third line (Sandia II Episode) through the time of the occupation of the Arctic as inferred by Müller-Beck (1967, p. 374, 399), supported by archaeological finds (Anderson, 1968, p. 28; MacNeish, 1971, p. 46), and recently confirmed by Irving and Harington (1973), with the same slope (rate), falls exactly on the date and location of the site of Minnesota Man. Based on the above data, the travel rate (line slope) of 2,250 miles in 10,000 years is reasonably correct.

By adding the remaining site data to Figure 6, some additional relationships can be seen. The earliest dates for Santa Rosa Island, Clovis, and Sandia lie very close to the middle (Sandia I) line. Folsom and Tule Springs sites seem to belong to the Sandia II intermediate migration
line. Sites along this Sandia II intermediate line can be interpreted in either of two ways: (1) the Old Crow River people either simply stayed in Alaska or migrated south later, just before the corridor closed, and are the ancestors of Minnesota Man, or (2) Minnesota Man descended from the Santa Rosa Island, Clovis, or Sandia cultures or other earlier Sandia I migrants as did the Folsom and Tule Springs cultures. In either case, the Old Crow River culture remained behind in the Alaskan lowlands while the Sandia I migration episode was occurring. The Sandia I migrants and the Old Crow peoples had to have crossed the Bering land bridge during the same glaciation (Wisconsin II), but they were not necessarily one population.

The only data considered herein that does not agree very well with the interpretations of this paper are the three levels of culture found at Lake Chapala. If placed in Figure 6 at the appropriate positions on the migration lines, they end up on Figure 5 in reasonable chronological places, but two of the cultural levels are during interglacials. This site does not rule out the validity of the interpretations here; it correlates well with the interglacial nature of many of the other southwest sites. In addition, there is some question about the dates of the Lake Chapala material.

The writer concludes that there were three major episodes of migration from Asia to Alaska and three from
Alaska to central United States and beyond. The first involved people who crossed the land bridge sometime between 120,000 and 95,000 years ago, began going south from Alaska 90,000 years ago, and possibly became extinct in the American Southwest; the second followed the land bridge between 65,000 and 50,000 years ago, left Alaska about 45,000 years ago, followed the land bridge between 65,000 and 50,000 years ago, and continued the whole extent of the Americas to Tierra del Fuego; and the third began from crossings from Asia between 25,000 and 11,000 years ago, left Alaska about 6,000 years ago, but was masked by the abundant numbers of dwellers already in the United States from the previous migrations. This last wave of migrants would have reached middle U. S. latitudes by the present time.¹

Orr (1968, p. 74) has presented evidence of continued occupation of Santa Rosa Island for at least 26,000 years --from 37,000+ to 11,300 years ago. This is viewed as representing the cultures of the second migrational episode, Sandia I, that lasted until the end of the last major glacial period (Wisconsin III). Carter proposed (1951, p. 305) that people were living in the American southwest during the Illinoian glaciation (Wisconsin I of

¹Possibly represented by the Athapascans who reached the southwest ca. 1700; McIntire (see footnote p. 49.)
This paper. His proposal was based on amounts of desert varnish and desert pavement associated with some stone ring sites, but although possible, groups living at these sites would have had to cross the Bering land bridge between 238,000 and 192,000 years ago and begun the trip south no later than 187,000 years ago, and this is too long ago to make any conclusive statements.

Earlier efforts to arrive at migration rates, were based on the premise that groups of Early Man could not have begun moving south until the ice sheets parted 11,000 years ago (Ewing and Donn, 1956, p. 1064). Some have suggested a definite rate—two miles per season—that would put migrants at the tip of South America only 5,000 years after they left the Alaskan lowlands. This author suggests that a rapid rate of travel is not realistic; the mechanism for population movement (see p. 56-60) precludes rapid migration. The great distances involved and the adaptation to a tropical climate and readaptation to a cold climate requires a long period of adjustment (Müller-Beck, 1967, p. 396, Fig. 11a).

Mechanics of Migration

Many writers (Colinvaux, 1964, p. 326) have mentioned the migration of early nomadic hunters across the land bridge and pictured a group of people set on discovering a new land, marching steadfastly onward across a narrow strip of land, wind at their backs, practically between
the tides, then scurrying south to avoid the winter cold soon to descend upon the north. Other writers have pointed out that this is surely not the case. It was not a migration at all, but an enlargement of an ecological niche, a random adaptation to newly exposed environments, and perhaps to newly perceived environments. Many generations took thousands of years merely to cross the bridge from Asia into the North American continent. The tribes did not stand daily at the edge of the retreating sea and wait for the waters to recede. They were not aware that the sea was falling, exposing new land. They knew where the shore limited their range and perhaps had legends that in the time of their great-great-grandfather, the sea had been somewhat closer to camp. The hunting parties probably moved about their territories seasonally, and from one generation to the next the eastern margin of this territory moved imperceptibly closer to North America.

Inch by inch as the sea level receded, salt marshes formed on the tidal flats to be replaced in a hundred years or so by less salt-tolerant sedges and willows, and finally after many generations of the nearby big-game hunting hominids, grass-tundra or perhaps steppe replaced the marsh grass, thus expanding the range of the hunters a few feet. This same slow process took place as the southern corridor through the American ice sheet began to open. The first beginnings of an avenue was filled with rushing meltwater
choked with silt, sand, gravel, and boulders. It was a long time before enough width was present with permanent loess plains to establish sufficient grasslands to support the large herds of grazing mammals that Early Man depended on.

Hunting and gathering societies depend upon their accustomed environment with its familiar way of life. They do not seek new territories requiring invention or borrowing of new techniques to exploit the food and materials of a new environmental configuration (Linton, 1951, p. 315). These hunters were dependent on the grazing herds and would not enter a new environment and leave the herds behind. Just as they followed the herds across the land bridge as the Beringian steppe was established, they followed the herds down the corridor as its steppe was established. This reason supports the contention of this writer that the first migrants did not come down the Pacific coast, even though they may have been occasional or accidental coastal dwellers while on the bridge.

Eventually their territory was not bounded by permanent water but by ice, and the migrant populations met the Cordilleran-Laurentian ice sheet complex. Here they remained, as before, slowly expanding their territory as the margin crept south. The migrations envisioned by some, taking at most a few thousand years, does not seem reasonable or plausible, except for very late newcomers who
might have known through legend where they were going. The figure presented in this paper of a rate on the order of 2.25 miles in ten years (2,250 miles in 10,000 years; Figure 6) is much more realistic. These people were not on a forced march, trudging ahead of the locusts or seeking new lands or riches; these people were culturally equipped hunting animals expanding their niche into every available space. They expanded in all directions and the sum-total resultant was toward Alaska and then toward the central United States. Man did not leave Asia and enter America as if he were going on a trip. Rather, his exploitable territory changed to include this new land.

They were as sedentary as possible (Sauer, 1969, p.12) and moved only as they perceived that life could be a little easier at some location elsewhere. Raw materials, food, and fuel were brought to the centrally located hearth and the hearth was moved as infrequently as possible. Groups of people do not seek the unfamiliar over the known. They become accustomed to a certain local environment and do not move individually. Migration is accomplished only by sons leaving home; movement is generation by generation, not by individuals. They spread more than they migrate. The population was thinly distributed over the whole of the territory and as the range expanded, the population expanded to fill the environment to the limits of the new boundaries. Sons hunted little beyond the limits of their
fathers, and some stayed at home forever. The whole population did not leave one area for another, but new persons left others behind and filled the entire range. When men finally emerged onto the open prairies in the central United States, their contemporary relatives were still in the north, although many generations removed.

**Grades of Hominid Possible for Movement**

Some writers have suggested that *Homo erectus* might have been the first migrant hominid to set foot in the New World. He was poised in Asia in position to take advantage of the Illinoian glaciation and exposure of the land bridge, and was culturally equipped to survive the winters. Leakey (1969, p. 185) reasoned that they must have crossed in small numbers following the animals they are known to have been hunting (Mann, 1971, p. 175) and their way of life was not appreciably different from the early hunting cultures of *H. sapiens*. There is some further reason to question the matter. It is believed that populations of very early and primitive hominids were in the central United States 80,000 years ago (at Calico and La Jolla) about the time that the great Pleistocene extinctions were taking place. Some have blamed early man for these extinctions, and then had the hunters wander off, not to be heard from again for 40,000 years.\(^1\) It is possible that these

\(^1\)The void in Figures 5 and 6 of sites between 50,000 and 65,000 years old is significant here. If the populations of the first migration continued south, they should
early users of chopper tools were late \textit{H. erectus} forms and that they became extinct in America (along with the mammals) while their counterparts in Asia and Europe were being replaced by \textit{H. sapiens}. If the line of the first migration proposed in this paper (Calico Episode, Figure 6) is projected back to the corrected latitude (distance) for Choukoutien, it intersects a departure date of 110,000 years ago, not too late for \textit{H. erectus}. It is possible that earlier groups may have reached Alaska and died out there during the Illinoian as Leakey suggests.

be represented by sites of this age in southern South America. If they remained at about the same latitude, there should be sites of this age on Figure 6 between Calico and Santa Rosa Island. However, because the sites of age 737,000 years BP are based on the present limit of radiocarbon dating, perhaps Santa Rosa Island, Sandia, Clovis, and Lewisville are really 50,000 to 65,000 years old and represent the descendants in the southwest of Calico and San Diego populations. The thought is intriguing but herein only speculation.
VII

ROUTES OF MOVEMENT

Across the Bridge

There were two major zones available for migration across the Bering land bridge (Figure 7); the interior route of the plains-dwelling big-game hunter and the southerly route of the more sedentary coastal-dwelling hunter and gatherer. Some workers see a significant route along the ice-free Arctic Ocean coast leading to a circum-polar cultural settlement (Chard, 1960, p. 283; Solecki, 1951, p. 13). The two major routes could have formed a geographic separation, in the genetic sense, between two populations that followed these different paths. By exploiting the environment in different and non-conflicting ways each group could develop with little contact with the other. Laughlin (1967, p. 445) saw this as providing evolutionary separation leading to the American Indians (descendants of the interior big-game hunters) and the Mongoloids (the Eskimos and Aleuts, descendants of the coastal dwellers). Both of these migratory routes could have led to permanent settlements, but Laughlin thought that the coastal people were more stable, more secure, more successful than those inland. Anderson (1968, p. 25)
agreed; the inland environment could not support as many hunting groups as the game-rich shore.

The entrance to the bridge from Asia is disputed. Chard (1960, p. 284) showed two probable routes (Figure 7); one going up the northern coast of the Sea of Okhotsk, above the Kamchatkan Peninsula, arriving on the land bridge at the Gulf of Anadyr, the other following the northern coast along the Arctic Ocean. Hopkins (1967b, p. 466, 477) restricted the incoming migrants to the north shore route based on his interpretations of the Siberian glaciation and the embayment in the Gulf of Anadyr connecting with the terminus of a large alpine glacier. Glaciation in Siberia probably had little to do with the migration of early hunting populations onto the land bridge; both the southern coastal route and northern as well as interior routes were available (Figure 7).

It is becoming increasingly common to find in the literature proposals that early man could have found life along the seashore much easier than inland away from the rich, easy source of food and supplies, and thus migrated across the land bridge along the southern coast. Required energy and time expenditures would be significantly reduced in the shoreline environment. Transportation of goods would have been much easier, gathering-foods of great variety and nutrition available in all seasons, the harsh climate modified by the stabilizing effect of the sea, and
Figure 7 Movement and Routes Across Beringia (Includes Eastern Siberian Glaciation)
Glaciation data modified from Flint, 1971, p. 75, 465, 662; exposed shelf from various sources
young, weak, and feeble able to contribute to the general economy. Gathering would have been particularly rewarding in the intertidal zone. Readily available protein-rich foods such as mollusks and algae and the incredible rich source of ready-made tools, e.g., awls, scrapers, bowls, scoops, grinding and core stones, and mat and rope fibre, would have made permanent dwelling sites feasible and attractive. The hunters could have brought home sea mammals with their furs and skins, ivory, bones, and meat.

A migration probably occurred along this coast, but the primary route must have been inland. The groups of primitive peoples living in Siberia, China, and central Asia who were the ancestors of the first migrants were plains-dwelling big-game hunters adapted to a life in a steppe environment, absolutely dependent on the large herds of grazing mammals for the bulk of their food and materials for manufacturing goods. The large herds do not live along the coast; they roam far and wide across grasslands between freshwater rivers. Man was accustomed to this life, was familiar with its requirements, and would have been loath to move to the seashore. For plains people, the shore was a hostile environment filled with the unknown and not exploitable by the methods and equipment that the interior tribes would have brought with them. Similarly, the coastal peoples who did come would not have left the coast to venture inland. They would remain on the coast and
follow its margin south in small numbers.

There are strong arguments for the dispersal of early man along the seacoasts (Sauer, 1962, p. 311; Anderson, 1968, p. 24) and there was probably considerable attraction to this environment. Surely the coast was settled early in the New World and has continued to support permanent settlements ever since.¹

South from Alaska

As on the bridge, two major routes were possible for migration south from Alaska but only the interior corridor (Figure 8) was used extensively. By the time the two populations were separated on the bridge, they were separated on their choice of paths to follow south. Peoples living in the coastal environment would not have left that environment to take up a new way of life as an interior plains hunter. Similarly, the interior big-game hunters would not have left the central lowlands to follow a coastal route south. Thus, the divergence was determined long before the migrants reached the bridge and their response in choosing their routes south were predictable. Even the varying width of the land bridge would have had little effect on the routes ultimately followed. When the bridge was narrow, the coastal peoples would have maintained their position along the coast and followed it

¹An excellent description of primitive life in a coastal environment and the rewards of such a life can be found in Laughlin, 1967, p. 423-431.
south to the Aleutian Islands, while the plainsmen quickly left the bridge to follow the herds inland along the Yukon and Kobuk rivers.

The inland route (Figure 8) began at the eastern margin of the central-Alaskan lowlands and followed either the Yukon or the Mackenzie River valley south and east to the central Canadian plains in the shadow of the eastern front of the Rocky Mountains. The presumed corridor between the two North American ice sheets followed the mountain front to the southern ice margin at the Canadian-United States border. This route was, at its best, difficult, especially during the first few thousand years of its existence and the initial passage was probably delayed somewhat even after the corridor was ice-free. The coastal route, however, was probably even more difficult (Bryan, 1941, p. 506). The crenulations of a fjord coast, the heavy forest covering the steep slopes to the water's edge, and the possibility of frequent large valley glaciers extending out to sea beyond the land would have made travel

Carter (1957, p. 378) described a Cornell PhD thesis by Raymond Gilmore (1942) that made an important contribution to this discussion. Gilmore said that on zoological evidence the corridor east of the Rockies never existed, but that a corridor along the coast was open early. He also wrote that the Bering area was isolated from both the Asian and American continent by ice barriers during glaciations. This writer accepts the opinion of others that an interglacial corridor existed inland (Farb, 1964, p. 14; Leachman, 1949, p. 186; Bryan, 1941, p. 506; Ewing and Donn, 1956, p. 1064; Wormington, 1957, p. 250; Linton, 1951, p. 24; Solecki, 1951, p. 14; Flint, 1971, p. 492.)
Figure 8
Deglaciation and Inland Corridor
Deglaciation after Flint, 1971, p. 492
difficult.

Advocates of a northern coastal route across the land bridge (relying on the ameliorated climate of Ewing and Donn) suggest that the interior corridor was first reached by these northern migrants from the Arctic shore north of the Brooks Range (Ewing and Donn, 1956, p. 1064; Wormington, 1957, p. 250; Linton, 1951, p. 314). Sauer (1944, p. 205) suggested the possibility of an intermontane corridor through British Columbia and the Western Yukon opening and allowing passage southward (Figure 9). While this is a possibility, this writer feels that it would be unlikely, and that any rainshadow would more strongly affect the area to the east of the Rocky Mountain front than the intermontane valley behind the coast Ranges.

Flint (1971, p. 785) was strongly opposed to the idea that man could have migrated down the Pacific Coast (Figure 4, p. 35). He reasoned that rough coastal topography and heavy mountain glaciation that extended beyond the narrow exposed shelf precluded any possible route along the shore. Other writers (Sauer, 1944, p. 224) believed that a coastal route could have existed physically but was beyond the technical capabilities of Early Man. The use of boats, advanced hunting and fishing skills, and tools that they are not known to have would have been required. Yet there is a suggestion (Flint, 1971, p. 785; Sauer, 1956, p. 11-12) that Early Man may have known the rudiments of boating
skills by 25,000-35,000 years ago or so, and possessed simple skin boats (coracles) and skills required for range expansion along the coastal environment. But these simple peoples were not migrating, boat-caravan-like down the coast. They dwelt in a seashore environment and expanded by generations in the direction of least population pressure—to the south. A fjord or valley glacier encountered would have stopped or slowed this creeping expansion for a time, but when it was perceived that a son could establish his family on the other side and still not be an alien in his homeland, the migration would have proceeded a mile or two farther.

It is evident that the interior corridor was always the major route of expansion from the Alaskan lowlands to the central United States plains. The populations of steppe-adapted big-game hunters in Asia were larger and the extension of the grassland environment from Asia across the bridge into Alaska and down the corridor to the American plains was more uniform and the expansion more regular. The coastal corridor did have a narrow exposed shelf, possibly grass-covered (Simpson, 1969, p. 49), interrupted at infrequent intervals by fjord-glaciers and probably carried small groups of specialized inhabitants that managed to arrive in Washington and Oregon, but their impact on the habitation of the continent was probably minor.
VIII

SUMMARY AND CONCLUSIONS

The arrival of Early Man in America has been studied long and from differing viewpoints. This paper is an attempt to examine some of these studies and to form some sort of framework from which the writer and others may proceed. Obviously an absolute time scale for the last 200,000 years of the Pleistocene must be formulated that can serve as a time framework to arrange the existing data and future data so that an overall picture of a logical sequence of events will emerge. The existing data are scattered and generally uncorrelated. A find in one part of the continent means little to a worker in another part, except in itself, because of the lack of any way to relate the two finds. The sequence of glaciations and sea level fluctuations and the relative position of the various sites within these fluctuations must be determined and fitted to the chronological framework before any of it can be properly interpreted. Much more work will have to be done by archaeologists, looking for sites contained in Pleistocene deposits, not just on their surfaces.¹ Ancient alluvial

¹Personal communication; Dr. George F. Carter, 1972, Department of Geography, Texas A&M University.
fans, dry-lake terraces—not on the existing surfaces, but on buried terraces below higher levels—in stream terrace material left high because of recent downcutting, and submerged beaches, deltas, and parts of the continental shelf, are places where the earliest North American sites should be sought.

Based on data of others, the Pleistocene has been arbitrarily divided and a chronology proposed that seems reasonable, if not strictly precise. The actual sequence of glaciations and climate fluctuations is probably more varied than that presented herein, but the position of this writer is that the sea level and the ice sheet margins—those criteria of most influence on the migration of Early Man—would respond significantly only to major warmings or coolings and not have been affected by minor oscillations.

An inverse relationship exists between the opening and closing of the Bering land bridge and the ice-free corridor south through the Cordilleran-Laurentian ice sheet complex—when one was open the other was closed. Generally, during a period of glaciation, the sea level was reduced and a broad, grassy land bridge was exposed between Siberia and Alaska. Early Man moved slowly out of Asia across this land bridge. When the seas were again high, flooding the bridge during interglacial stages, the grassy corridor led from Alaska to the central United States plains. Early Man followed this route south and his remains and tools
are being found from the ice margin to the southern tip of South America.

It is well established that hunting man was in the American southwest and the mountains of Peru contemporaneously with and prior to the last and possibly next to last major glacial stages, WII and WIII. The writer proposes a sequence of possible times of migration both across the land bridge and through the corridor and establishes an average rate of travel of 2,250 miles per 10,000 years.

The climate of the Beringian bridge has been examined and the results are somewhat inconclusive. If the Ewing and Donn hypothesis is correct, the ability to withstand severe arctic winters is obviated, and if the exposed bridge was truly polar in climate, Early Man must have been sufficiently equipped to survive.

Early Man was primarily a big-game hunter and although small populations might have lived successfully along the coast, the majority of the migrants followed the grazing herds across the central grasslands of the bridge, through the Alaskan lowlands to the grassy corridor between the glaciers to emerge onto the grassland plains to the south. Man moved, not with intent or knowledge, but by slow, random expansion of available territory, with the territory boundary giving way to the east and south. This movement was by generations, not by individuals; the son ranged farther but never lost contact with his father.
The latest that Early Man could have first arrived in North America was 95,000 years ago; his arrival could have been as early as 120,000 years ago and still be consistent with the facts now available. It is conceivable that he could have wandered in and out of Alaska earlier than that, during the preceding glaciation, but no evidence for such a move exists. Available evidence leads to the conclusion that movements of people into North America was across the Bering land bridge, exposed during a glacially lowered sea level, and that the major influx southward was inland along a corridor east of the Rocky Mountains during an interglacial.
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