Chapter

5

An Old World Perspective on Potential Mid-Wisconsinan Settlement of the Americas

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INTRODUCTION

With the preliminary publication of Monte Verde and Pedra Furada, two promising South American sites that suggest an age beyond 30,000 years, it is appropriate to reexamine archaeological expectations and strategies in regard to possible "pre-Clovis" sites. The relatively simple and poorly standardized artifacts from Pedra Furada and Monte Verde are technologically similar to those used in eastern Asia before 30,000 B.P. Lithic assemblages in Asia tend to be very small and to include few formal tools. This is a problem for archaeological survey and site recognition. As processing tool kits, lacking in offensive weapons, such Asian assemblages imply a significantly lower level of hunting efficiency than that demonstrated for the later Paleoindians. In western Europe, recovered site frequency per unit time increases exponentially after 22,000 B.P. and in eastern Asia after 14,000 B.P., so that there should be 10–15 times as many sites per unit time at 11,000 B.P. than at 30,000 B.P. This shift from low, steady-state populations to a dynamic equilibrium mode followed the development of efficient, offensive weapons, stimulating rapid demographic growth and more complex adaptive strategies.

In the Old World large areas with low resource density or highly unpredictable resources remained unsettled for tens of millennia, interrupted by only brief periods of occupation at times of ameliorated climate. One could not expect more than a partial, highly incomplete colonization of the New World about 30,000 B.P. Search strategies in North America must take into account that the material record, subsistence proficiency, and demographic success of potential mid-Wisconsinan immigrants would diverge from the Paleoindian model. But the ecological parameters of settlement would also differ, requiring identification of regions with topographic constraint to animal migration, a predictable and low-seasonality climate, and sufficient productivity for a reasonably high game biomass. Some regional possibilities and sedimentary contexts are suggested. An effective search for New World sites older than 15,000 B.P. will require a new research paradigm, with multidisciplinary collaboration of paleoecologists, earth scientists, and archaeologists to devise appropriate methods of prospection and to identify or test potential sites in selected areas.

THE PALEOINDIAN PHENOMENON

The first peopling of the New World remains an object of controversy. The earliest immigrants arrived from Asia via the Bering Straits. This poses problems of an inhospitable, periglacial environment, a cold water body, barren mountain ranges, and oscillating glaciers. Interpretation is impeded by a persistently sparse archaeological record in both Siberia and Alaska.

The environmental context of this early migration is reasonably well resolved. During the last, Wisconsinan glacial, withdrawal of oceanic waters to feed the great continental glaciers left most of the Beringian continental shelf exposed as dry land, connecting Asia and North America about 65,000–13,500 years B.P. (McManus et al. 1983). However, the modern straits are ice covered in winter, and the actual crossing from Siberia to Alaska never posed a fundamental problem. A generation of research in paleontology and palynology has demonstrated that a tundra vegetation dominated the vast, unglaciated tracts of Wisconsinan Alaska and the emergent continental shelf, while large concentrations of herbivores provided potential subsistence for hunting peoples with the necessary technology to cope with the cold and to take advantage of big game (Hopkins et al. 1982). A final issue is physical access to the temperate and tropical parts of the New World via the eastern flanks of the western Cordillera, where the Laurentide ice sheet periodically approached the coalescing tongues of Piedmont glaciers. Views here vary (Reeves 1983), but at least it would have been difficult to find and negotiate a both passable and productive route through theMacKenzie Valley and along the eastern front of the Rocky Mountains at the height of the Wisconsinan glacial, about 30,000–13,500 B.P.

It was technically possible for prehistoric hunters to pass from Asia into more productive regions of the New World for tens of millennia prior to 30,000 B.P. But the coeval record of prehistoric settlement in eastern and northern Asia is poor (Aigner 1981, 1984; Wu and Olsen 1985; Ikawa-Smith 1978; Aikens and Higuchi 1982; Larichev et al. 1987), and there still is no convincing record of such antiquity in Canada or the United States. The earliest documented sites in Alaska and the Yukon may be as old as 14,000 B.P. (Hopkins et al. 1982; Bonnichsen et al. 1987), and in the United States the oldest is Meadowcroft Rockshelter near Pittsburgh (Adovasio et al. 1987), dating back to at least 14,000 B.P. (Adovasio and Carlisle 1988). Such early horizons include lithic blades, representing a technology basically similar to that used in Japan since about 21,000 B.P. Shortly after 12,000 B.P. there was a veritable explosion of archaeological sites in the continental United States (Figure 5-1) and later, and to a lesser degree, in Alaska and South America. This dramatic appearance of Paleoindians represents a highly successful human adaptation to big-game hunting (West 1983; Bonnichsen et al. 1987). The Paleoindian hallmarks are large, pressure-flaked, stone projectile points, hafted to the end of a thrusting spear. This innovation is not documented in archaeological horizons of Japan and northeastern Siberia until about 14,000 B.P. (Ikawa-Smith 1978, 1982; Aikens and Higuchi 1982; Dikov 1983; Aigner 1984; Yi and Clark 1985). Within 2500 years, Paleoindian people had dispersed through much of the United States, and not long thereafter they appeared at the other end of South America, near Tierra del Fuego.

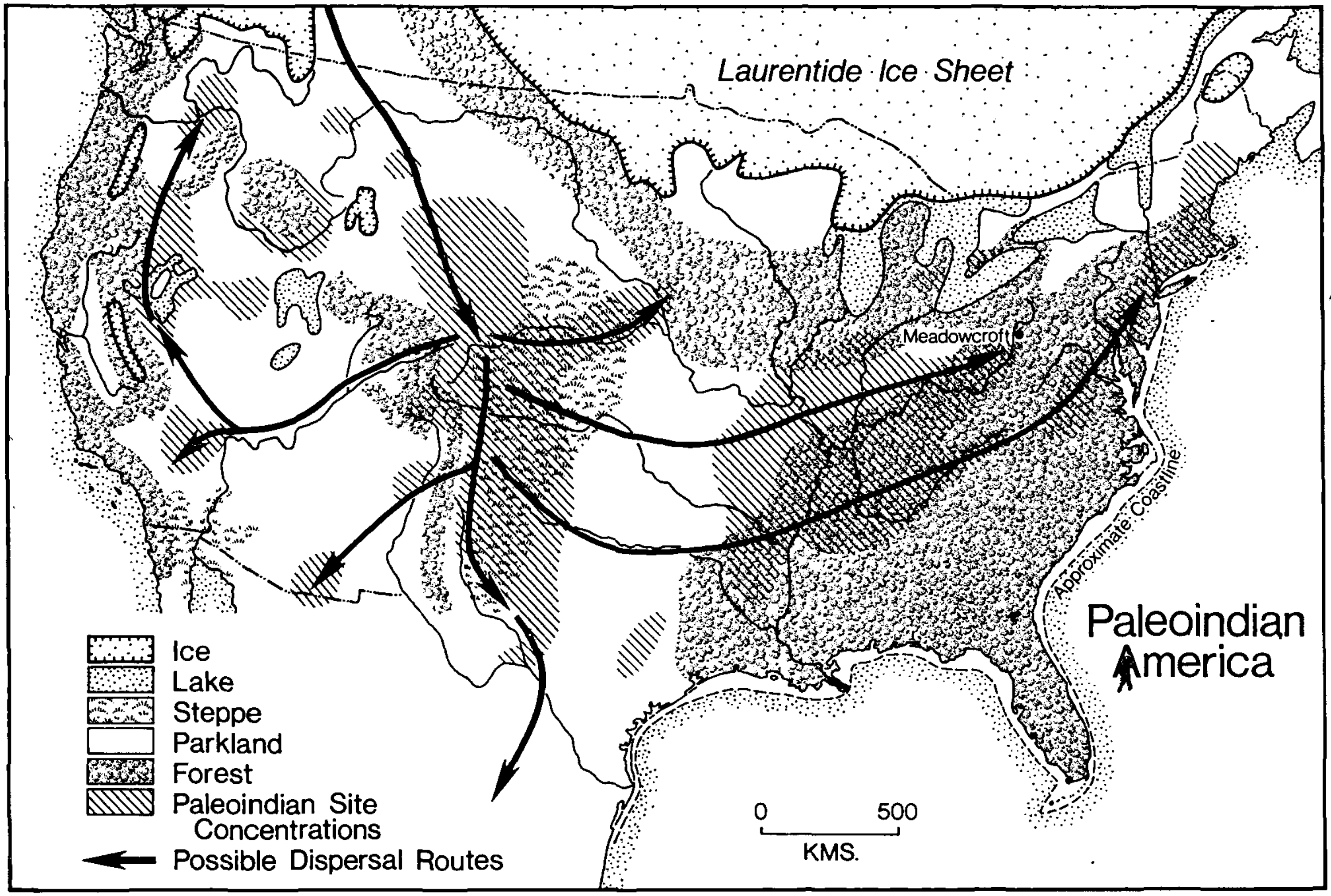

Figure 5-1. A Reconstruction of Paleoindian North America. Ice margins and proglacial or pluvial lakes represent their maximum extent about 12,000–11,000 B.P. Simplified vegetation patterns of grassy woodland (parkland) vs. closed forest is based on evaluation of all published end-glacial pollen profiles (see Porter 1983; Bryant and Holloway 1985). The steppe zone of the High Plains is inferred from open vegetation and late glacial eolian activation. (Adapted from Butzer, K.W., *The Making of the American Landscape*, Conzen, M.P., Ed., Unwin Hyman, U.K., 1990.)

The Paleoindians evidently were highly mobile, efficient, and adaptable (see Kelly and Todd 1988). But within the United States their site concentrations suggest a preference for relatively open environments with a high animal biomass: the pine-grass parklands of the High Plains and incipient Prairie Peninsula, the pine-sagebrush parkland of the western Great Basin, and the then-assembling deciduous woodlands of the east-central and mid-Atlantic United States (see Porter 1983; Bryant and Holloway 1985) (Figure 5-1). The classic Paleoindian sites on the High Plains mainly represent temporary encampments (kill or butchery sites) of bison hunters. Although there also are a few associations with bones of now-extinct mammoth, mastodon, and camel, the case for a human role in the late glacial extinction of a large array of large mammals remains equivocal (see Martin and Klein 1984). In the eastern woodlands archaeological bone is poorly preserved, but white-tailed deer may have been the major game species (Adovasio et al. 1987). As the Paleoindians penetrated further north and east, towards the margins of the retreating ice sheet, they hunted caribou (West 1983:Table 18-1).

It can be argued that the Paleoindians thrived in the open and semiopen, end-Wisconsinan environments of North America. Sedimentary contexts range from high-energy fluvial beds to spring deposits and shallow lake sediments in the case of most open-air sites, a fairly cosmopolitan spectrum of locations. More significant appears to have been access to a high biomass of K-select herbivores, commonly quite mobile or even migratory. This recalls the predilection of Upper Paleolithic hunter-gatherers in open habitats of glacial Europe. These people were effective hunters, who trekked across wide expanses of often featureless terrain to follow game and preferentially take animals near water sources and occasionally in topographic traps. Most are small kill or butchery sites, but some represent longer term or frequently revisited encampments with more substantial archaeological residues. It is above all a visible and increasingly commonplace record.

THE NEW WORLD

Theoretically, it is possible that earlier hunter-gatherers entered the New World from Asia during mid-Wisconsinan times.

1. Physically, as was discussed above, it was possible to penetrate into Alaska and further south, deep into the interior, during most of the Wisconsinan glacial.
2. Human groups, physically less advanced than modern *Homo sapiens* peoples and with an unsophisticated middle Paleolithic (Mousterian) technology, settled the European tundra to within close proximity of the ice fronts in both western and eastern Europe (e.g., Butzer 1986; Hoffecker 1987). Several late Acheulian sites were already located in tundra environments. Sites of such age have been found in caves, in the former floodplains of small streams, as well as in valley-margin deposits of colluvial loess. Unless we are unwilling to ascribe similar mental and cultural capacities to East and North Asian peoples during early and mid-Wisconsinan time, it is possible, even plausible, that they did penetrate the New World under harsh climatic conditions.
3. Sites with evidence of pre-Upper Paleolithic technology are not only found in Japan (Ikawa-Smith 1978; Aikens and Higuchi 1982) and North China (Wu and Olsen 1985). Recently, concentrations of simple, split-pebble artifacts, including choppers, scrapers, and cores, have been reported from under 40 m of alluvium in the present continuous permafrost environment of the central Lena basin in northeastern Siberia (Larichev et al. 1987). Pollen

from this site (Diring-Ur'akh) is dominated by cold-loving conifers and includes the Tertiary relict *Gingko biloba*, and the sediments apparently indicate reversed polarity. Like all other sites in eastern Siberia, China, and Japan, there are few or no data given on features or horizontal distributions. One only has a selection of illustrated artifacts to evaluate. These happen to be convincing and appear to demonstrate "early" settlement of the now coldest part of Siberia, on the outer peripheries of Beringia.

4. The most productive environment in Beringia, in terms of grazing potential and large, gregarious herbivores, is indicated for the 10 or more millennia prior to 30,000 B.P. Thereafter, from 30,000 to 13,500 B.P., the Beringian lowlands were transformed into a polar desert with much reduced productivity. Finally, between 13,500 and 10,000 B.P., the climate warmed up and rainfall increased, woodland expanded, and the large herbivores disappeared, as the modern environment of endless muskegs and poorly drained acidic soils began to be established (Hopkins et al. 1982). In other words, the optimal time for human residence or migration in Beringia was early, rather than late — *before* 30,000 B.P. (Aigner 1984).

The argument against mid-Wisconsinan penetration of Alaska and less harsh New World environments is based exclusively on negative evidence, specifically the absence of credible sites older than roughly 14,000 B.P. in Beringia and the United States. Negative evidence has rarely proved durable in archaeology, where surprises are the rule rather than the exception. Australia and New Guinea are a case in point, where a series of good sites dating 35,000–20,000 B.P. were unexpectedly discovered during the 1960s (Jones 1968; Bowler et al. 1970; White and O'Connell 1982; Allen et al. 1988), pushing back human antiquity on that continental landmass by 25,000 years and inferring a mid-Wisconsinan crossing of a wide stretch of open water.

The apparent absence of "older" sites in Beringia is inconclusive, since this highly dynamic geomorphologic environment will require more sophisticated search strategies to locate low-energy deposits of the right age that may have met other conditions for site location (Hoffecker 1988b). An explanation for the absence of such sites in the coterminous United States is more difficult to formulate, but the issue now acquires a novel perspective in the light of two potential candidates for mid-Wisconsinan sites in South America that require serious consideration.

The first of these sites is Monte Verde in southern Chile, situated near Puerto Montt (41°30′S) on a tributary of the Rio Maullín. The present vegetation is a temperate, evergreen rainforest (January mean temperature 15.3°C, July mean 7.6°C, approximately 2000 mm annual rainfall). The context is a sandy alluvial body that forms a convex floodplain, bordered by marsh. Near the modern stream is an impressive archaeological level with a regular set of square wooden structures, paleo-camelid and mastodon bone, and artifacts that include pressure-flaked points dated ca. 13,000 B.P. (Dillehay 1986; Collins and Dillehay 1986). Further away from the stream axis is a second and lower cultural horizon, separated from the 13,000 year level by some 80 cm of laminated sands: it includes two shallow hearths, with ash and oxidized ("fired") lower contacts, dated ca. 33,000 B.P. (Dillehay and Collins 1988; Collins, personal communication 1987). This older level, 5–10 cm thick, includes two dozen modified pebbles of basalt and andesite, originating in an older, strongly weathered alluvial fill; Collins kindly allowed me to examine these pieces, and several of them are unmistakable artifacts. There is evidence of deliberate and sometimes extensive flaking, of percussion blows (from angles impossible for impacting adjacent stream pebbles), and of use microwear. Above all, these pebbles are dispersed in a sandy matrix, and natural pebble stringers are of substantially smaller caliber.

Botanical remains in the 33,000 year level at Monte Verde include beech (*Nothofagus*) and a reed (*Juncus*). The interval of time between the two horizons was relatively cold and dry, with the first contemporary with a sharp transition to colder and drier conditions, the second with a phase of warming and increasing moisture (Heusser 1984).

The second site is Pedra Furada, located near São Raimundo Nonato, Piauí Province, northeastern Brazil (8°50'S). This is a rockshelter, situated in a sandstone escarpment some 20 m above the head of an extensive peidmont surface. Modern vegetation is an open, deciduous thorn woodland (known as *caatinga*), and the climate is semiarid, tropical, with 650 mm rainfall and a long, winter dry season. Substantial hearth features, plausible but primitive stone artifacts (choppers, chopping tools, trihedral picks, denticulates, and a variety of rough, retouched flakes) that lack evidence of blade technology, and even fragments of ochre-smeared rock, have been dated back to 32,000 years by 17 consistent radiocarbon dates (Guidon and Delibrias 1986; Guidon 1984, 1986, 1987). These carefully documented excavations are currently down to 1 m below a level that has a new date of greater than 39,200 B.P. (Guidon, personal communication 1988).

The background sediment is a sand with abundant fine rubble and occasional roof blocks, all derived from the local sandstone, whereas the artifacts are made of quartz and quartzite that can be found on the lower lying pediment surfaces. Two hearth complexes, rich in laminated ash and dated to 17,000 and 25,000 B.P., have strong, three-dimensional definition (up to 20 cm thick), with artifacts concentrated around them. A slab in the 17,000 B.P. horizon has two parallel red lines painted on it. Blades and micro-blades first appear after 8000 B.P., most made on chert imported from some distance away; pressure-flaking is first verified in the level dated 6200 B.P. The geoarchaeological profile compares closely with those of Paleolithic caves in Europe and Africa, and indicates repeated, but discontinuous, high-intensity human occupation long before the advent of blade or pressure-flaking technologies. The technology of the artifacts in the lower levels is remarkably similar to that evident among the 33,000-year-old pieces from Monte Verde.

The early Holocene levels at Pedra Furada have abundant plant remains of various types, which remain to be published, and the animal bone includes cervids, giant armadillos, and birds. Paleoecological data on the lower levels are still unavailable, and a late Pleistocene climatostratigraphy has yet to be developed for northeastern Brazil. In all probability climatic oscillations were complex during the last 40,000 years, judging by the alternation of wetter and drier intervals at comparable latitudes in Africa, in northeastern Angola and western Zaire (see Butzer 1971:342–45). This is compatible with the very complex record of marine cores off the northern coast of Brazil, which include only a few and generally thin interbeds of coarser sediments, contrary to the simplistic generalizations of Damuth and Fairbridge (1970).

A great deal of work remains to be done in completing or publishing the research at Monte Verde and Pedra Furada before these sites can be considered as fully documented. Only at that point can professional archaeologists draw their own conclusions as to whether or not there is an irrefutable case for an early human entry into the New World more that 35,000 years ago. But Monte Verde and Pedra Furada are the first truly early sites that merit very serious consideration.

From a North American perspective, these South American sites may seem to be located in improbable, marginal parts of the New World. But Monte Verde was situated in a cool and wet environment, closely comparable to the setting of the well-documented middle and upper Paleolithic site cluster in Cantabrian Spain (see Butzer 1986), while Pedra Furada would not be out of place in the Pleistocene archaeological record of the central African savanna (see Burgess 1987). More problematical is the absence of similar promising sites in the United States and Alaska, despite decades of intensive research. Even the archaeological visibility of "pre-Clovis" sites of 15,000–12,000 B.P. remains so low that many specialists still question their validity.

Several factors may be responsible for this negative evidence: (1) difficulties in the recognition of sites older than 15,000 B.P.; (2) excessive expectations for a pre-Clovis record; and (3) poor search strategies for early sites. These factors are examined below, from the viewpoint of Old World experience, to argue that the Paleoindian record is both qualitatively and quantitatively different from the potential configurations of a settlement history several tens of millennia older.

RECOGNITION OF EARLY SITES

The most fundamental problem for site recognition raised by the artifacts from Monte Verde and Pedra Furada is the seemingly primitive lithic technology employed. Not only are the pressure-flaked points and readily identified blades typical of Paleoindian sites absent, but there also is no evidence for the prepared-core (Levallois) technique or of blade production. Blades and flakes with prepared or faceted platforms can be identified by a lithic specialist under field conditions, as can bifacial hand axes or cleavers. The absence of such diagnostic, relatively standardized tools poses a serious problem, particularly in areas lacking raw materials, such as flint or obsidian, that are easy to work and that generate far more distinctive types of debitage than quartz, quartzite, basalt, or other hard igneous rocks.

The sites in question have yielded rough, and in the main part, minimally modified tools or flaking debris, which are not prone to catch the eye when scattered on the surface. Such lithic materials fall well within the spectrum of pre-Upper Paleolithic tool types or technology in the poorly reported archaeological record of China (Aigner 1981; Wu and Olsen 1985) and Japan (Aikens and Higuchi 1982), which antedates 25,000 B.P. The absence of the rare East Asian tool types that are more standardized and diagnostic (good chopping tools, rough bifaces) may reflect the size of the lithic assemblages at Monte Verde and Pedra Furada, or that these were limited-activity sites. It is also possible that such New World lithic tool kits were impoverished, by comparison with their East Asian counterparts. If so, the problem of recognition would be compounded.

At face value, the Chilean and Brazilian lithics would rarely be recognized if present among a surface gravel lag. Even if recognized, their human origin would be difficult to demonstrate to the general satisfaction of lithic specialists. The same problem has plagued the recognition of potential non-Acheulian artifacts on the surface of early Pleistocene sediments or within mid-Pleistocene gravels, both in Europe and Africa, including a variety of spurious claims of "pebble tools". Lacking tangible "features," such as hearths, a few questionable pieces, even if buried in a low-energy sedimentary matrix, tend to remain in limbo and have been disregarded, usually with good reason, by critical reviewers. Few very early non-Acheulian sites in the Old World have been demonstrated to general satisfaction without associated human fossils, hearths (e.g., the Choukoutien caves of China, see Liu 1985), or patterned butchery remains (e.g., the lakeshore of Olduvai Bed I, Leakey 1971).

For all practical purposes, "early" surface sites are, at least at present, unlikely to be found. Even if found, they are likely to remain dubious and therefore unhelpful in resolving the question of an "early" human presence in the Old World. For the interim, geologically sealed sites with corroborative archaeological features will be indispensable. We now examine the matter of reasonable archaeological expectations, before turning to appropriate search strategies.

ARCHAEOLOGICAL EXPECTATIONS: SITE SIZE AND ABUNDANCE

Assuming that "early" sites exist in the U.S., whether or not they will be found depends to some measure on the expectations of the archaeologists looking for them.

One basic aspect of this issue is lithic abundance. It is well known that most Paleoindian sites, mainly representing kill or butchery sites, have few stone implements, in part because finished tools were curated. Paleolithic sites in Europe, Africa, and parts of India have comparatively abundant stone tools and debitage, so that lithic sites tend to be well defined by concentrations of modified pieces, complementing evidence based on diagnostic types.

A reasonable suspicion persists that formalized tool types had more than a functional purpose, perhaps also serving aesthetic or symbolic needs. In any case, simple, unretouched flakes can be used to perform most butchery tasks, while *ad hoc* tools of perishable materials can serve for many or most other forms of processing. In most of Asia, Pleistocene lithic assemblages tend to be much smaller and formal tools few in number or limited in diversity (Aigner 1981; Aikens and Higuchi 1982; White and O'Connell 1982; Wu and Olsen 1985; Larichev et al. 1987). This situation is remedied to some degree after 20,000 B.P., but a quantitative difference persists. Whether East Asian knappers were more parsimonious, or whether the range of stone-tool functions was strongly complemented by the use of wood and bamboo, is impossible to decide at this time. Whatever the reason, New World mid-Wisconsinan sites should have low lithic visibility and abundance.

Site frequency is another consideration. Isaac (1972) showed that cultural complexity as well as site density increased exponentially during the course of African Pleistocene prehistory. The point is made more quantitatively by an ambitious site survey in southern Africa (Sampson 1985): in this particular case there were 517 sites spanning perhaps the first 500,000 years, 968 for the next 100,000 years or so, 1250 for about 4000 years at the Pleistocene-Holocene transition, some 4900 for 8000–1500 B.P., and 7200 covering the last 1500 years. The area is preeminently an erosional landscape, so that exposure is less of a problem than surface preservation. A similar pattern is evident in Cantabrian Spain (Butzer 1986), where the number of identified sealed and surface sites per thousand-year time interval increases from 0.2 about 75,000 B.P., to 1.4 about 28,000 B.P., 8.8 about 19,500 B.P., 9.5 about 13,500 B.P., 14.3 about 10,000 B.P., and 25.7 about 8000 B.P.

All other factors being equal, these ratios suggest that "recoverable" sites dating to 11,000 B.P. should be about 10–15 times more common than those 30,000 years old, regardless of the reasons involved. Applied to the U.S. if sites do exist for the time span 40,000–25,000 B.P., less than a dozen of these would be "recoverable" with archaeological expertise comparable to that applied to Paleoindian sites recently. Such a figure should not be taken literally, but it puts an estimate on how few one might reasonably expect. If and when Monte Verde and Pedra Furada are fully verified, such "early" sites would in fact be unusually well represented in relation to the Paleoindian sites now known from South America.

The primary reason for the sudden increase of site visibility in late Wisconsinan time was rapid, exponential population growth. The "take off" is sharply defined, but its date varies considerably from region to region. In Cantabrian Spain it coincides with the early Solutrean, with its large, foliate projectile points and micro-blades (very probably hafted on arrow shafts), about 22,000 B.P. (Butzer 1986). In the Nile Valley, archaeological visibility increases dramatically about 18,000 B.P., with the simultaneous appearance of four new industries, three of these with micro-blades (Butzer 1982:273–275). In northwest Africa, Iberomaurusian sites with micro-blades appear about 18,000 B.P. but become common only after 13,000 B.P. (Camps 1975). In southern Africa the takeoff only began about 12,000 B.P., with the Albany industry of the later Stone Age, at which point subsistence activities shifted to smaller game, aquatic resources, and plant foods, somewhat later than the appearance of micro-blades (Deacon 1984).

In northeast Siberia (mainly cave sites) and Japan (mainly buried, alluvial sites), a rapid increase in visibility was delayed until the appearance of micro-blades and pressure flaking after 14,000 B.P. (Dikov 1983; Yi and Clark 1985; Ikawa-Smith 1978, 1982; Aikens and Higuchi 1982). Foliate points are absent in China, where persistent questions about geoarchaeological context, homogeneous assemblages, and contradictory reporting of ^{14}C dates complicate the matter of early micro-blades; in any event, site visibility, as inferred from site number and assemblage size, increased with the establishment of the "developed micro-blade tradition" about 13,500 B.P. (see various authors in Wu and Olsen 1985; Chung and Pei 1986; also Aigner 1981, 1984). New World site visibility began with the Clovis industry, also characterized by pressure-flaked points and micro-blades, a

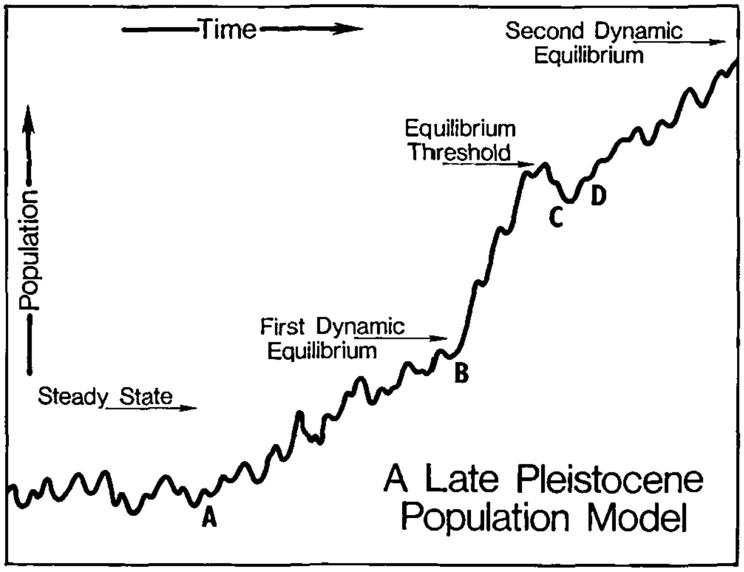

Figure 5-2. A late Pleistocene population model. (A) Initiation of dynamic equilibrium mode in Eurasia between 35,000 and 20,000 B.P. (Upper Paleolithic). (B) Initiation of population explosion to a new threshold, e.g., the European Solutrean ca. 22,000 B.P., the micro-blade technology of eastern Asia ca. 14,000 B.P., or the Paleoindian phenomenon ca. 11,500 B.P. (C) Hypothetical, temporary "overshoot" and readjustment. (D) Continuing, minor positive feedbacks allow resumption of dynamic equilibrium mode. Scales are relative.

little before 11,500 B.P. (Bonnichsen et al. 1987), very much in line with Old World developments. The greatest lag was in Australia, where micro-blades and pressure-flaked points appear and site visibility increases about 5000 B.P. (White and O'Connell 1982:117–121).

In detail, both pressure flaking and backed micro-blades vary considerably from one region to another, and it is immaterial whether independent invention or stimulus diffusion were responsible for the temporal gradient of this technological datum. Large foliate points leave little doubt that they were mounted as spear points. Backed micro-blades were more complex. In Africa and Europe they apparently were mounted transversally as cutting edges on arrow tips, judging by ethnohistorical examples from South Africa (Deacon 1984); in East Asia and the New World they were inset along the sides of reindeer antler spear points, to increase damage to wounded prey (Aigner 1984). In general, these technological innovations suggest effective, offensive weapons that should have dramatically improved hunting efficiency. Such innovations late in the Pleistocene record seem to have had a major impact on demographic patterns: improved food procurement allowed a spurt of population growth, followed by a state of dynamic equilibrium while scheduling and other strategies were adjusted, to provide positive feedbacks that, at least in some areas, included a greater emphasis on an expanding variety of plant resources. The notable spatial expansion of settlement at the end of the late Pleistocene appears to have been a direct consequence of this systemic change. Local site density also increased, with at least temporary use of all potential types of settlement location (see Butzer 1982:Chap. 4).

Population levels appear to have oscillated in a steady state during the European and Near Eastern Middle Paleolithic. The same applies to the subsaharan Middle Stone Age and probably also to the East Asian "Middle Paleolithic". This same, extremely low-density, stable population mode would have been introduced to the New World in mid-Wisconsinan time. Populations began to increase very slowly (dynamic equilibrium) shortly after the development or introduction of Upper Paleolithic-type technologies, mainly between 35,000 and 20,000 B.P. in the Old World. In this broader context, the Solutrean, Albany, or Paleoindian takeoffs would represent a sudden jump to a notably higher equilibrium level (Figure 5-2). If we are indeed confronted with two Pleistocene penetrations of the New World from Asia, one before 30,000 B.P. and the other after 15,000 B.P., then two radically different demographic models must be applied. In the first case, population levels would be very low and in steady state, in the second they would be substantially higher and expansive. A quantum difference in site number and site distribution would therefore be logical.

ARCHAEOLOGICAL EXPECTATIONS: SETTLEMENT DISCONTINUITY

In terms of spatial parameters, the Old World Paleolithic record indicates a wide range of mobility patterns that, at least in Europe, suggest a progressive increase in versatility during the span of Wisconsinan time. Middle Paleolithic sites of early to mid-Wisconsinan age tend to be clustered in the French Dordogne, Cantabrian Spain, or parts of southern Russia, with some indication of short- or medium-range seasonal mobility (Laville et al. 1980; Butzer 1986; Hoffecker 1988a). Upper Paleolithic settlement networks, as demonstrated by the dispersal of lithic raw materials or smaller, seasonal sites, were more extended and, on the North European Plain, eventually encompassed deliberate movements across several hundred kilometers (Spiess 1979; Kozlowski 1986; Schild 1984). In combination with spear-throwers, deadly thrusting spears, effective bows and stone-tipped arrows, and eventually, harpoons, the impression obtains that European hunters progressively acquired great skill in exploiting migratory animal resources between 35,000 and 10,000 B.P.

On a regional scale, the resolution of the European database is unavailable for other parts of the Old World. But the question of a qualitative difference in the effective settlement of marginal environments can be addressed through spatial and temporal analysis of the archaeological record. At issue is that many archaeologists have the impression that all reasonably productive Old World environments were more or less continuously settled during the later Pleistocene. But this was not the case. Large areas lack evidence of human occupation for periods of 50,000 years or more at a time.

The point can be illustrated by a case study from the interior of southern Africa (Butzer 1988), a region with a reasonably detailed and archaeological framework (Volman 1984; Deacon 1984). Figure 5-3 presents the archaeostratigraphy of seven major excavated sites, site complexes, or surveys, arranged in a transect from southeast to northwest, along a modern precipitation gradient from 1250 to 300 mm. Vegetation today ranges from open, subtropical woodland at Border Cave and Bushman Rock, to a mosaic of grass and temperate woodland at Rose Cottage Cave, temperate grassland at Florisbad, and subtropical savanna or bush to the west of Alexandersfontein. The columns represent local stratigraphies, calibrated to 40,000 or 50,000 years by radiocarbon, and beyond that by extrapolated sedimentation rates, cross-correlated by climato-stratigraphic criteria (Butzer 1984a, 1984b). Occupation levels are indicated in black (Figure 5-3).

Figure 5-3 illustrates that, except for Border Cave, there is a yawning hiatus of many tens of millennia between the latest middle Stone Age and the earliest later Stone Age, a break in settlement that ranges from over 30,000 to almost 80,000 years. The longest interruption is in the lower Vaal-Riet River basins, in what are now semiarid lowlands. This settlement hiatus is representative of a 200,000 km² area that, at present, receives less than 500 mm rainfall, and the only exceptions are low-resolution occupations in Wonderwerk Cave, located on the periphery of a mountain range. Site surveys (Butzer 1982:266–273; Sampson 1985) show that almost all Pleistocene open-air living sites were linked to lakes now reduced to generally dry playas, springs now defunct, or floodplains now entrenched. By comparison, late Holocene peoples, although still dependent on water availability, spread their activities over all parts of the landscape in an expanded repertoire of activities.

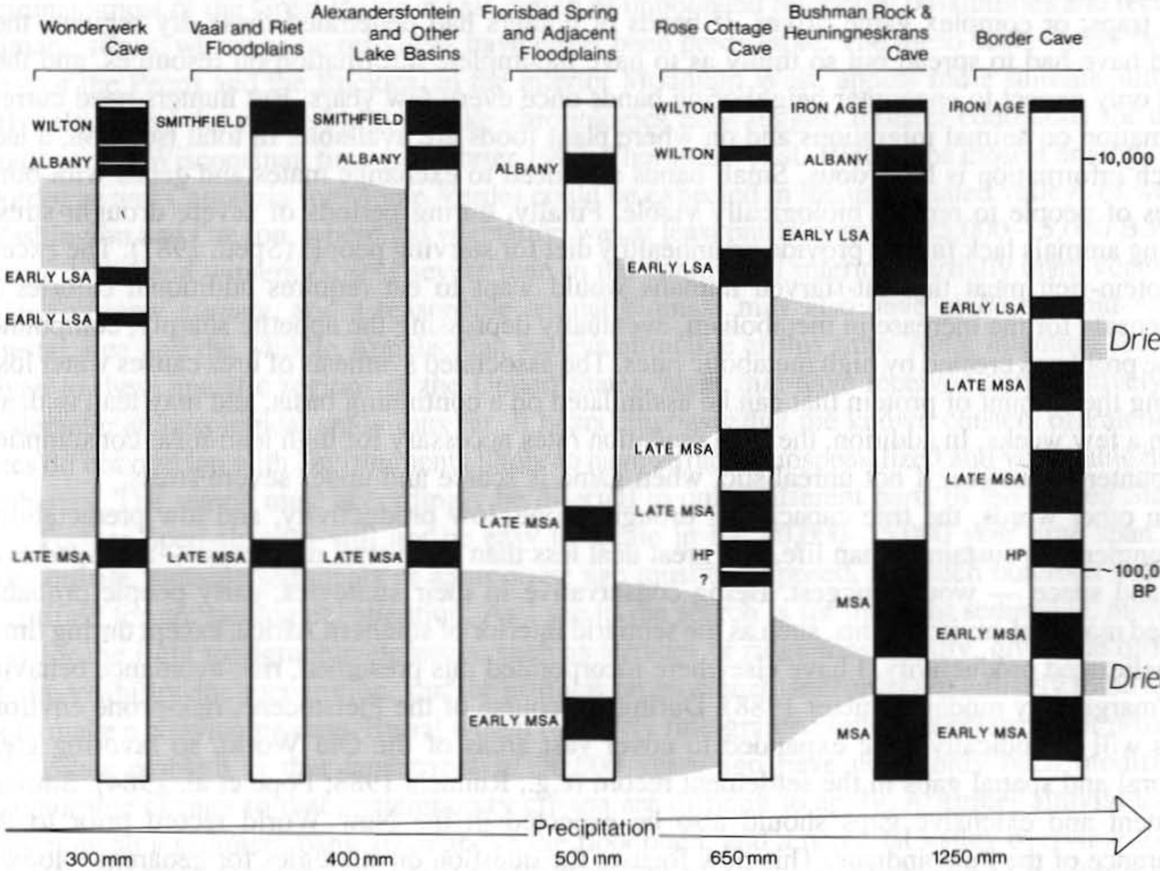

Figure 5-3. A spatio-temporal framework for later Pleistocene Settlement in southern Africa. The archaeostratigraphic columns show the intervals of occupation (black) at key sites or site complexes, arranged as a transect from the humid Southeast to the semiarid Northwest (see precipitation gradient below). MSA = middle Stone Age, including Howieson's Poort (HP). LSA = later Stone Age, including Albany, Wilton, and Smithfield. Modified after Butzer (1988).

Two primary conclusions emerge from this regional study (Butzer 1988): (1) Pleistocene settlement was remarkably discontinuous in time and space, with repeated spans of many tens of millennia during which large areas, such as the interior of southern Africa, were essentially uninhabited and unutilized, except for sporadic and peripheral hunting forays; and (2) Pleistocene settlement, both in caves and in "open-air" locations, was limited to periods of substantially moister climate and closely linked to dependable sources of water, although not all periods of moister climate were accompanied by an expansion of settlement into the interior.

Two secondary inferences can be drawn by way of extension. Firstly, Pleistocene populations in the region appear to have been demographically conservative, not necessarily responding to improved environmental resources by automatic territorial expansion. And, secondly, Holocene peoples had markedly improved technologies and organizational modes, that allowed more flexible demographic adjustment, with effective settlement across the entire region.

This evidence for major spatial and temporal gaps in the Pleistocene settlement record of southern Africa raises a fundamental question. There always were some perennial streams and springs in the area, even during periods as dry as or drier than the present. The best explanation for this seems to be that people avoided drier macro-environments because unspecialized hunter-gatherers in prehistoric times preferred to avoid risk.

Food resources would have been few and thinly spread during the dry seasons of poor years. Plant foods would have had low predictability and low net productivity, while the available game, primarily the small springbok, would have been difficult to hunt without bow and arrow, sophisticated traps, or complex game drives. If bands of hunters had penetrated these dry regions, they would have had to spread out so thinly as to have incomplete information on resources, and they could only expect to encounter neighboring bands once every few years. But hunters need current information on animal migrations and on where plant foods are available. In total isolation, a lack of such information is hazardous. Small bands also need to exchange mates and genes with other groups of people to remain biologically viable. Finally, during periods of severe drought stress, starving animals lack fat and provide an unhealthy diet for starving people (Speth 1987). The excess of protein-rich meat that fat-starved humans would want to eat requires additional calories to compensate for the increase in metabolism, eventually depressing the appetite sharply, compounding the problems created by high metabolic rates. The associated synthesis of urea causes water loss, limiting the amount of protein that can be assimilated on a continuing basis, and may lead to death within a few weeks. In addition, the high predation rates necessary for high lean-meat consumption are counterproductive, if not unrealistic, when game is scarce and under severe stress.

In other words, the true capacity of drought-prone, low productivity, and low predictability environments to sustain human life, is a great deal less than its overall resources — averaged over time and space — would suggest. Being conservative in their strategies, early people probably avoided marginal environments, such as the semiarid interior of southern Africa, except during times of ameliorated productivity. I have elsewhere incorporated this presumed, risk-avoidance behavior in a "marginality model" (Butzer 1988). During the course of the Pleistocene, risk-prone environments will periodically have expanded to cover vast areas of the Old World, so favoring great temporal and spatial gaps in the settlement record (e.g., Runnels 1988; Pope et al. 1984). Similar, persistent and extensive gaps should also be expected in the New World record prior to the appearance of the Paleoindians. This now focuses the question on strategies for geoarchaeological survey and testing, something that admittedly is not popular with research foundations that prefer to fund full-scale excavation of proven sites.

SEARCH STRATEGIES

This risk-minimization model, proposed to explain major spatial and temporal discontinuities in the African archaeological record (Butzer 1988), can be applied to geoarchaeological exploration strategies for the New World. The African case study emphasized negative factors, concluding that semiarid or arid environments with low resource predictability and reliability were unlikely to be inhabited in Pleistocene times. Similarly, the African archaeological record suggests that the low animal biomass of tropical rainforests discouraged their settlement until late in the Pleistocene (Butzer 1977).

At the other end of the spectrum, the middle Paleolithic Neanderthals of Western Europe thrived in those cool, wet, but open subarctic environments of southwestern France and northern Spain, where game was predictable in the constrained valleys *and* standing animal biomass high; these same people shunned the high interior plains of the Iberian Peninsula, where winters were far more severe and large herbivores were highly migratory (Butzer 1986). The exceptions are low-level mountain passes used by migrating herds (Butzer 1977). Preliminary indications suggest that the setting of Monte Verde may have been similar to Cantabrian Spain ca. 33,000–13,000 B.P., with a comparable topographic matrix, and with a more open vegetation in the heart of the now-dense, south Chilean rainforest (see Heusser 1984).

Suitable areas must therefore first be identified by regional specialists and according to various paleoecological criteria, where late Pleistocene resources would have been abundant and predictable, and where environmental hazards would not have been a major threat. Such criteria would eliminate most of the Great Plains, a vast region of unbounded migratory possibilities and recurrent climatic stress, where game resources have never been predictable. The meso-scale valley systems west of the Pecos and the Rockies, in the interior Mountain West, appear more suitable, although palynology and the revised pluvial lake chronologies now suggest moister conditions for only a small part of Wisconsinan time (see Porter 1983; Thompson et al. 1986). The closest analogs to the Dordogne and Cantabria (or Monte Verde) could be expected in the unglaciated valleys of western Washington and Oregon, where the vegetation was at least partly open ca. 25,000–15,000 B.P. (see Porter 1983) and winters far less severe than in the continental interior. Partially open vegetation, a less extreme climate, and a reasonable animal biomass may also have made the mid-Atlantic coastal area and the Middle Appalachian valleys attractive at this time. More attention should be given to these specific regions of the United States, areas that have received comparatively little systematic archaeological study thus far. It bears emphasis that the known clusters of Paleoindian sites do not overlap with environments likely to have attracted unspecialized and vulnerable hunter-gatherers. The search must accordingly be directed to quite different parts of the United States.

Former open-air sites will not be easy to locate in the 40,000–15,000 year time span. As a prerequisite, suitable sediments of appropriate age must be exposed, and such outcrops should be identified for archaeological attention. As I see it, the search is for the right sediments, more than it is for the right topographic elements, such as terraces or ridge tops. Firstly, given the difficulty of site visibility and recognition, surface artifacts on erosional landforms are unlikely to be spotted or to make a convincing case. Burial within relatively fine-grained sediment offers better prospects. The other problem is that landscapes of 30,000 years ago have commonly been modified by geomorphic change so that contemporary criteria are difficult to apply. A former alluvial location may now be a sediment bank 10 m above the floodplain, and a potential valley overview location may be obscured by 3 m of younger slope debris, which in turn might now be covered by soil and a closed forest. Looking for 30,000-year-old sites involves a different mix of experience, intuition, and luck than search for a Paleoindian counterpart in an essentially "modern" landscape.

The most familiar suggestions that can be offered for site localization strategies would build directly upon Paleoindian search strategies in now arid/semiarid environments. But most of the studied alluvial sequences in the Southwest begin with terminal Wisconsinan, low-energy deposits; earlier sediments are either fragmentarily preserved or of much greater antiquity, and they tend to be high-energy, gravelly beds, in which artifacts such as those of Pedra Furada or Monte Verde would be very difficult to recognize. Lacustrine deposits will not be easier to examine, since the highest lake stands are now variously dated between 15,000 and 13,000 B.P. (see Thompson et al. 1986, with references), so that older shorelines are generally buried under later lake beds or were eroded during lake expansion. Raised beaches on mobile coasts may seem to be promising, but cobble beaches were repeatedly quarried by later peoples, and coeval artifact recognition will again pose severe challenges to all but a few lithics specialists. Much the same applies to other potential quarry sites around specific lithic outcrops.

As this outline suggests, the prospects for such relatively familiar Paleoindian-type strategies are not too encouraging. They would also be of little help in the Pacific Northwest or in the Appalachian countryside. My own bias in regard to potential "open-air" sites is to look for (1) former valley margin sites buried within or under colluvial soils, near potential seepage zones or small lateral streams; (2) old spring sites that probably do not function as springs today and that may stand out as a carbonate-cemented mound, or be little more than a zone of clayey beds laterally interfingering with an alluvial sand or gravel. The problems involved need no emphasis.

Cave or shelter sites are undoubtedly the most promising. However, many caves are relatively young, and older caves more often than not have been flushed out and early fills partly or completely removed, sometimes more than once. It is essential that sediments of appropriate age are present. Deep, dank caverns are improbable sites for human occupation, and open caves or large rockshelters are most suitable. Perhaps ironically, those caves of the central Appalachians that have yielded the best late Pleistocene faunas (see Lundelius et al. 1983) tend to be confined animal traps, too shallow or too wet to be good candidates for repeated human settlement (see Burgess 1988). Most Old World caves I have examined have no archaeological deposits, for whatever reason, and environments with promising cave locations are rare, even in karstic terrain. Where to look for suitable caves and what to test, therefore, requires considerable regional experience. Even then, cave use may not have been popular at a particular time for a particular group of people. This, too, cannot be predicted with any confidence. But a cave with a long record of sedimentation is ideal.

A few, simple artifacts can be most readily recognized in a circumscribed cave context, particularly in the case of exotic lithologies, provided that the archaeologist or geoarchaeologist can recognize lithics rather more problematical than those of a Paleoindian assemblage. The best field clues are provided by hearths, identifiable in trench faces by several possible criteria: dark lenses with organic enrichment or carbonization; ash lenses or laminae, often but not necessarily white; and reddish, baked, or oxidized laminae (Butzer 1982:82–85). Combinations of such thin-bedded strata obviously need closer examination, by laboratory analyses, to confirm their identification, but they offer the easiest features to spot and examine.

This brief sketch for a geoarchaeological search strategy suggests that pre-15,000 B.P. sites are most likely to be found in parts of the United States that have received limited archaeological attention to date. Quaternary geomorphologists must pinpoint appropriate sediment outcrops, and more caves must be tested in new contexts. In any event, such archaeological residues will tend to have limited visibility. Discontinuous settlement and low mid-Wisconsinan settlement densities in the Old World further suggest that such sites will be uncommon. But above all, successful Paleoindian search strategies will need major revision as to both assumptions and criteria before they can expect to yield effective results. Ideally such efforts should be undertaken by multidisciplinary teams, because paleoecological and geoarchaeological components will be as important as archaeological ones.

DISCUSSION

Regardless of how individual investigators are inclined to evaluate the available evidence from Monte Verde and Pedra Furada, these sites are sufficiently challenging to warrant both an open-minded examination and some reflection on the premises of prevalent opinions on the likelihood of a mid-Wisconsinan entry to the New World. Americanist archaeologists have developed sophisticated expertise in locating new Paleoindian sites, as well as in the interpretation of that technocomplex. But several recent reviews, categorically rejecting the very proposition that earlier sites *may* exist (e.g., Owen 1984), show little appreciation of what a pre-15,000 B.P. record in the New World might look like. The Old World Paleolithic provides both experience and time-space frameworks that must be incorporated into the assumptions that underlie any working hypothesis for or against an earlier settlement history.

Technology

Paleoindian lithic technology included blade production, with specific refinements such as micro-blades and especially pressure flaking. Basic (macro-) blade technology is verified in eastern Asia since about 21,000 B.P., and the other refinements first appeared after 14,500 B.P. Pressure-flaked bifoliate points are not verified in North America before 12,000 B.P., and this technology failed to reach northeastern Brazil until 6200 B.P. Blades were present at Meadowcroft about 14,000 B.P., but do not appear in Brazil until after 8000 B.P. This gradient, representing stimulus diffusion, immigration, or even multiple innovations, is coherent. In the absence of demonstrably older macro-blade sites in the New World, any North or South American sites older than 15,000 B.P. must derive their technology from the atypical and poorly defined "Middle Paleolithic" of eastern Asia, the age of which remains undetermined.

This has two major implications:

1. New World sites older than 15,000 B.P. can be expected to share much of the technology available in eastern Asia, prior to that regional Upper Paleolithic. East of Lake Baikal, in the absence of the Levallois-core preparation typical of the European Middle Paleolithic (Larichev et al. 1987), the repertoire of available tool types focuses on choppers and chopping tools, trihedral picks ("points"), occasional rough bifaces, and a poorly standardized assortment of retouched flakes. The older levels of Pedra Furada and Monte Verde compare well with this Asiatic tradition. The problems of spotting such artifacts are of a different order of magnitude than recognizing Paleoindian lithics, and the prospects of identifying surface sites of this kind are poor. Finally, the difficulty is compounded by the apparent pattern of eastern Asian lithic assemblages to be small and to exhibit a limited diversity of tool types, compounding the issue of low visibility.
2. This simple Asiatic lithic technology represents a processing rather than procurement tool kit, and there are no preserved offensive weapons suitable for effective hunting, such as stone-tipped spears or arrows. The other associated skills of European Upper Paleolithic hunters — wood or bone spear-throwers (also applicable to untipped wood spears), animal traps, or complex game drives — may well have also been absent. People reaching the New World before 15,000 B.P. would have ranked far behind the Paleoindians in hunting efficiency, most of all, one would expect, in taking scarce, mobile game during poor years, i.e, with respect to the critical threshold of dependable food supplies. Corresponding carrying capacities were probably much lower, and some regions will have been too marginal to utilize, not because of ambient temperatures but due to unpredictability or low standing biomass of suitable game.

Demography

This technological inference finds strong support in the Old World settlement record, where site frequency increases dramatically during the late Wisconsinan. Recoverable sites per unit time at 11,000 B.P. should be 10–15 times more common than at 30,000 B.P. Archaeological visibility increases rapidly after 22,000 B.P. in western Europe and after 14,000 B.P. in eastern Asia, with the appearance of Clovis by 11,500 B.P. fitting well along a similar cline. This change is best attributed to rapid population growth after the development of efficient, offensive weapons. Until mid-Wisconsinan times, population densities in settled parts of the Old World were very low and in steady state; by the end of the Wisconsinan, they were substantially higher and in a state of dynamic equilibrium, in response to repeated, minor improvements in adaptive strategies (Figure 5-2).

Not only should the number of recoverable New World sites older than 15,000 B.P. be very small. The Old World record also suggests that large areas, of marginal attractiveness under certain paleoclimatic conditions, would be unoccupied for tens of millennia (Butzer 1988). This implies that early settlement would only have led to *partial* colonization of the unglaciated New World. When the expansive Paleoindian populations and their descendants subsequently dispersed through the Americas, they settled some regions for the first time and, in others, they would have swamped any low-density, older occupants. It would be naive to expect tangible linguistic or biological traces of such mid-Wisconsinan immigrants in the modern indigenous population — contra to the assumptions of Greenberg et al. (1986) — any more than Neanderthal lexical or dental components can be expected in the human mosaic of contemporary Europe.

Search Strategies

The preceding discussion identified the degree to which the subsistence proficiency, demographic success, and material record of potential mid-Wisconsinan immigrants in the New World should diverge from that of the Paleoindians. But the ecological parameters of settlement would also have been different. Many environments attractive to the Paleoindian peoples, because of a high standing animal biomass, would have been precarious to their potential predecessors, because the prime game species were too migratory and insufficiently predictable, due to the nature of the topographic matrix or pronounced climatic seasonality or a high incidence of severe climatic anomalies (Butzer 1988). The "marginality model" suggests that the centers of a mid-Wisconsinan population in the New World should not coincide with the established concentrations of Paleoindian sites. They must be sought according to radically different strategies in environments with some degree of topographic constraint, with a low-seasonality and predictable climate, and sufficient herbivorous productivity to support a reasonably high biomass. North American glacial-age environments that conform to these expectations would be comparatively few: eastern Washington and Oregon, some valley systems of the desert Southwest and interior Mountain West, and possibly the middle Appalachians and mid-Atlantic coastal areas, south of the ice fronts. Such regions might profitably be considered for more careful examination.

The selection of areas for closer study must be made according to sophisticated, paleoecological criteria that incorporate modelling of animal and human movements. At a smaller scale, contemporaneous, preferably low-energy sediments must be identified by competent specialists, with a view towards surveying for buried "open-air" sites. But the best prospects for success can be expected in open caves or large rockshelters that preserve sedimentary fills of appropriate age.

In sum, an effective search for New World sites older than 15,000 B.P. will require a quite different research paradigm from that applied to Paleoindian projects in recent years. It should incorporate different settlement, subsistence, and demographic models, and it will require multidisciplinary collaboration by paleoecologists, earth scientists, and archaeologists.

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