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ARTICLES

Why We're Still Arguing About the Pleistocene Occupation of the Americas

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Although empirical issues surround the when, how, and who questions of New World colonization, much of current debate hinges on theoretical problems because it has become clear that our understanding of New World colonization is not resolute.[1] In fact, the central issues of debate have remained essentially unchanged for the last eighty years. The now classic and probably incorrect story of New World colonization begins in Late Pleistocene Siberia, with small a population of foragers migrating across Beringia (~13,500 calendar years before present (CYBP) (Box 1) through an ice-free corridor and traveling through the interior of North America. High mobility and rapid population growth spurred southward expansion into increasingly distant unoccupied regions, culminating in the settlement of the Southern Cone of South America. Armed with the skills and weapons needed to maintain a megafauna-based subsistence strategy, early colonists necessarily had the adaptive flexibility to colonize a diverse array of Pleistocene landscapes. For a time, this scenario seemed well substantiated. The earliest sites in South America were younger than their northern counterparts, fluted artifacts were found across the Americas within a brief temporal window, and projectile points capable of wounding elephant-sized prey were commonly found in association with proboscidean remains. The Bering Land Bridge connecting Asia to Alaska and an ice-free corridor providing passage between the Pleistocene ice masses of Canada seemed to provide a clear route of entry for Clovis colonists. However, recent archeological, paleoenvironmental, biological, and theoretical work largely questions the plausibility of these events.

The status of Clovis as a technology representative of the initial colonists is perhaps the most tenuous of assertions. Claims of pre-Clovis-aged sites have been omnipresent in the Paleoindian arena and, until recently, have consistently been dismissed under professional scrutiny. Plagued by poor chronological control, problematic site contexts, questionable recovery techniques, and sometimes a lack of unequivocal artifacts, widely accepted evidence of a pre-13,500 CYBP occupation was absent. By the 1990s, however, pre-Clovis occupation had gained considerable support, if not outright acceptance, by the majority of archeologists.[3]

Monte Verde component II, dated to between ~14,650–15,600 CYBP[4] while still controversial,[5] provided the first distinctively non-Clovis evidence of occupation, (a lithic assemblage comprised primarily of flake tools and two El Jobo points). More recently, the Cactus Hill and Topper sites were also found to contain lithic assemblages possibly dating to ~17,000–20,000 CYBP. Excavations at Cactus Hill in Virginia revealed a lithic assemblage dominated by small blades and cores below a Clovis component in a dune adjacent to the Nottaway River. Dates range from to 15,070 ± 70 to 16,940 ± 50 ^{14}CYBP.[6,7] Two small pentagular points, somewhat reminiscent of Clovis, that were produced on flake blanks were also found. The oldest occupation layer, marked by an increase in phosphates and organics, is separated from the Clovis level by several inches of sand. Concerns have been raised regarding the discreteness and dating of the pre-Clovis occupation level, while geomorphological analysis of the site deposits has not been conclusive.[7,8] Topper has an assemblage of over one thousand small flakes and microblades, including burins and burin spalls, found in a terrace of the Savannah River in Georgia.[9] As at Cactus Hill, the early material was found below a Clovis occupation level. Tentative dates of ~16,000 ^{14}CYBP, as well as claims in excess of 50,000 ^{14}CYBP have been proposed.[10] Many ambiguities regarding site stratigraphy remain. Some archeologists have referred to the artifact assemblage as a collection of "geofacts". Importantly, however, these sites and the enduring claims of a pre-14,000 CYBP component at Meadowcroft, Pennsylvania,[11] have provided the impetus for an advanced suite of distinctions in the Clovis versus pre-Clovis debate.

The "pre-Clovis" position of New World colonization is more accurately described as a pre- or post-13,500, CYBP debate regardless of technological affinity. If sites such as Topper, Meadowcroft, and Monte Verde gain widespread acceptance, it would imply that colonization occurred not only earlier, but by peoples with distinctively non-Clovis-like technologies. If that is the case, Clovis could be considered a derivative of an earlier New World technology. Consequently, pre-Clovis proponents have begun to

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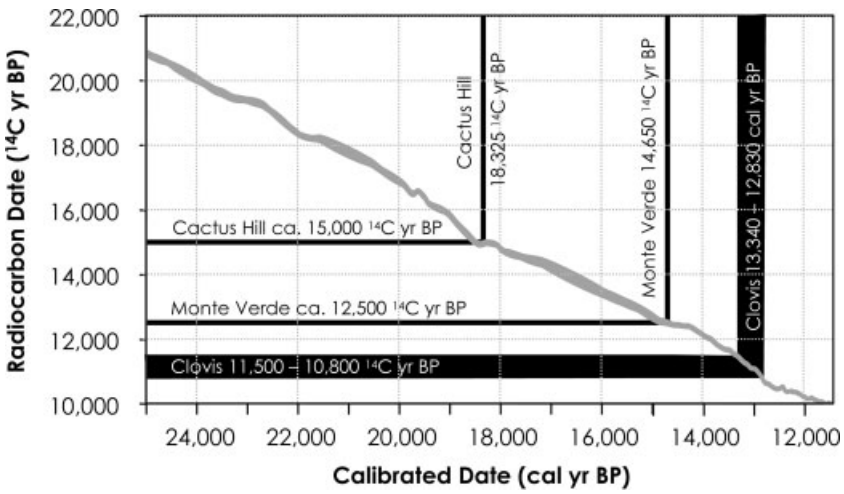
Box 1: Calibrated Radiocarbon Dates

Due to more reliable radiocarbon calibration curves, those accustomed to seeing an 11,000 to 11,500 BP date for the Clovis complex and New World colonization will need to calibrate their mental timelines. Radiocarbon calibration by itself pushed New World colonization beyond the 12,000 BP barrier, which had held for so many years. A simple rule of thumb is that all Pleistocene radiocarbon ages (^{14}CYBP) are typically 1,500 to 4,000 years younger than their equivalent calendar ages (CYBP). The Pleistocene-Holocene boundary at 10,000 ^{14}CYBP actually dates to approximately 11,500 CYBP. The Clovis complex, dating to approximately 11,500 to 10,800 14CBP represents 13,340–12,830 CYBP. Not only is the Clovis period approximately 2,000 years older than originally believed but, due to the steepness of the calibration curve, is actually shorter, having been compressed from a length of 800 C14 years to 500 calendar years. Radiocarbon calibration has not significantly changed discussions of New World colonization. However, it has important implications regarding the demography and genetics of Native American populations since the time range of New World prehistory has been expanded.



Radiocarbon calibration curve (gray) for the late Pleistocene showing approximate calibrated ages for the Clovis complex and the Monte Verde and Cactus Hill sites. Calibration curve reproduced from OxCal v. 3.10.[2]

question the temporal and morphological consistency of Clovis assemblages. It is argued that regional variation in Clovis and other penecontemporaneous technologies such as, Chesrow, Miller, and El Jobo reflect unique technological adaptations as colonists settled into particular environments.[6] Alternatively, technologically distinct artifact assemblages in excess of the 13,500 CYBP divide could be considered evidence of failed colonization attempts.[12] Moreover, the possibility that pre-13,500 CYBP sites simply reflect earlier variants of Clovis technology must also be considered.

Pertaining to the latter possibility, the Schaefer, Hebior, and Mud Lake sites in Wisconsin near the Laurentide ice margin contain mammoth remains. Much like Clovis sites, the faunal remains have been interpreted as displaying human modification (dismemberment and butchery) of proboscideans. Radiocarbon dates on wood and bone collagen range between 12,310 ± 60 and 13,500 ^{14}CYBP.[13] Given the lack of diagnostic artifacts, the possibility remains that these sites represent the activities of Clovis peoples. Human-modified mammoth bones from the Great Plains, dating to the Last Glacial Maximum (LGM), have also been reported as evidence of early occupation.[14] If these sites represent mammoth use comparable to that represented in the Clovis archeological record, they may extend the Clovis time frame deeper into the Pleistocene.

The question of timing rests, unfortunately, on extremely variable and subjective site reporting standards, often in nonpeer-reviewed popular media outlets. However, it must also be acknowledged that the chance of discovering the *first* site, or even multiple sites, created by the initial colonists is extremely unlikely. While the dating of colonization events in other regions, such as Australia, have been rapidly pushed backward in time, pre-13,500 sites in the Americas remain rare and controversial.[15] However, accepting the notion that Monte Verde and the earliest dated Clovis site (the Aubrey site in Texas, 13,350–13,500 CYBP) do not respectively represent the earliest occupants of South and North America renders a pre-13,500 colonization date certain.[16] The question, of course, is how much earlier? Related concerns at the forefront of contemporary Paleoindian studies are attempts to discern cultural and biological relationships from technology, skeletal remains, and genetic variability; the evaluation of possible migration routes; the demographic characteristics of colonists; and interpretations of Early Paleoindian subsistence. In this paper, these general themes are reviewed individually, followed by descriptions of two comprehensive scenarios that embody the spectrum of ideas concerning New World colonization.

EARLY PALEOINDIAN TECHNOLOGICAL ANTECEDENTS

Explicit comparisons of Paleoindian and Eurasian technologies appeared in the 1930s and have remained a continuous topic of research and debate. Two general approaches, both loosely based on biological models of morphological change, can be identified in the current literature. For simplicity, I refer to these as the "clinal" and "type fossil" models of technological change. Interpretations of technological relationships derived from clinal models

of variation rest on the assumption that technology changes in a predictable and regular manner as a function of geographic and temporal distance between biological populations of shared ancestry. As applied to New World colonization, the derived expectation is that as one gets closer, both temporally and geographically, to the source of a Clovis or pre-Clovis progenitor population, shared technological characteristics will become increasingly apparent.

Most Clovis and pre-Clovis sites are loosely linked by the production of bifacial projectile points and/or the use of flake and blade tools. However, the fluted point and its associated toolkit undeniably provide the first widespread, technologically consistent material cultural record present in unglaciated regions. The production of large blades from conical and, less commonly, wedge-shaped cores is now recognized as a relatively consistent, albeit regional, reduction strategy employed by Clovis peoples.[17,18] Assemblages from the Southern Plains now provide a well-documented record of retouched tools manufactured on large, longitudinally curved blades with associated production debris. Whether Clovis is truly "first" or not, the central question remains: How can technological attributes be used to reconstruct the biological or phylogenetic relationships between colonizers and their ancestral populations?

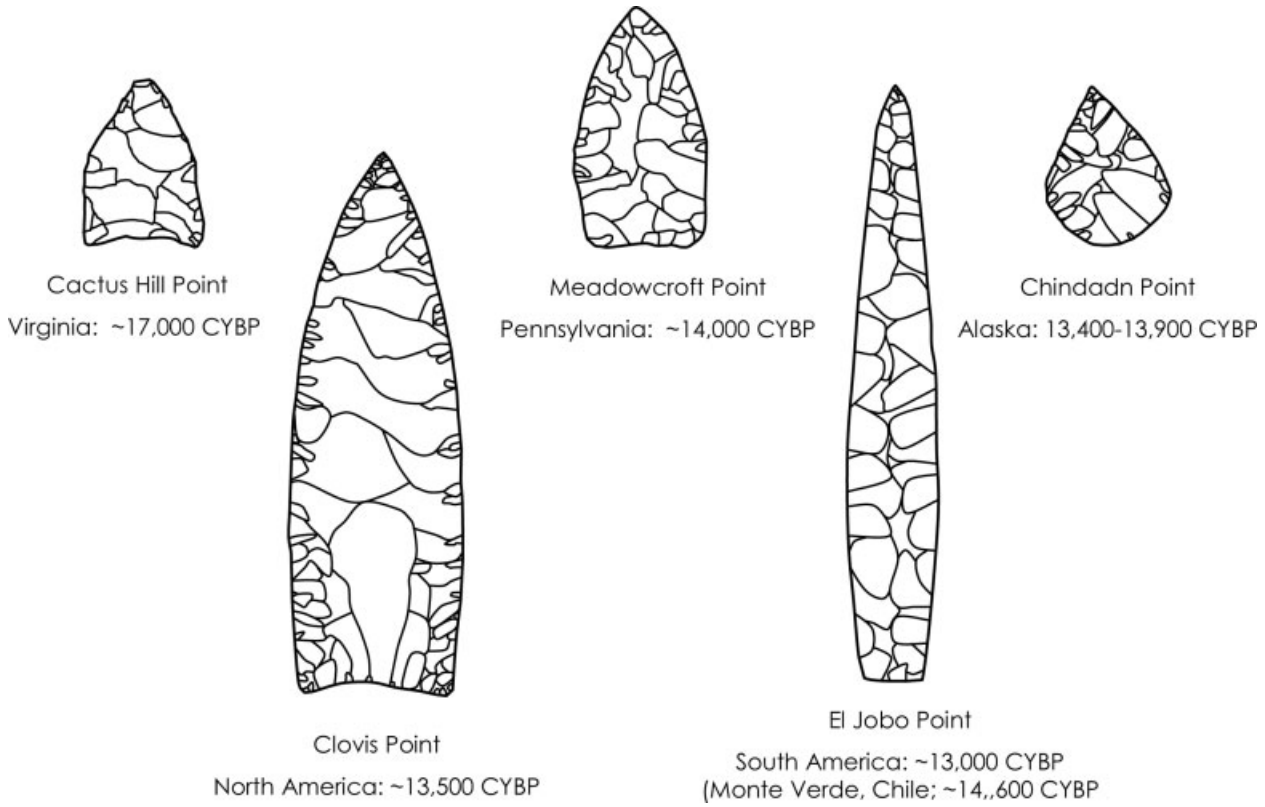
If colonization occurred via the Bering land bridge and the earliest materials from Alaska are products of this event, then the Pleistocene archeological record of Alaska can be expected, using a clinal approach to lithic variation, to display the strongest Asian affinities of any New World tool industry. Assemblages from the Tanana Basin of central Alaska from the sites of Swan Point, Mead, and Broken Mammoth consist of microblades, small burins, and scrapers. Dated from 13,400–14,000 CYBP, the material has broad morphological similarities to the wedge-shaped microblade core industries found throughout Siberia.[19] In Alaska, microblade assemblages are followed by the Nenana complex, which may date to as early as 13,400–13,900 CYBP, but is more consistently dated to ~13,000 CYBP.[20,21] Based on assemblages from sites such as Dry Creek, Walker Road, Swan Point, and Healy Lake in the Nenana and Tanana valleys, the Nenana complex is predominately characterized as a flake and macroblade industry, although microblades are sometimes present. Characteristic of the complex are large bifacial knives, retouched blade tools, endscrapers, pieces esquilles, and projectile points with diagnostic teardrop to triangular shapes (i.e., Chindadn points).

While the colonization of regions adjacent to Beringia is sufficiently complex to render a complete review of the topic inappropriate for this paper, the basic spatio-temporal trends revealed by new sites and dates warrants discussion due to its importance to clinal arguments. The earliest Upper Paleolithic technologies of Siberia appear ~40,000 CYBP from localities below 55° latitude.[22] The Yana RHS site, situated 71° latitude, dated to ~30,000 CYBP, is currently the oldest known site above the arctic circle in Siberia. This site has a mixed assemblage of bifacial and unifacially worked flake tools, various bone tools, and no blades.[23] Though Yana indicates the presence of humans in the high arctic before the LGM, it does not establish occupation of regions near the land bridge, since it sits approximately 1,500 km west of the Bering Strait. Trends in the Eurasian radiocarbon record suggest that the occupation of Siberia slowly grew in both population and geographic extent from ~40,000–22,000 CYBP, and that its growth slowed or declined during the LGM.[24,25] Continuous high-latitude occupation of Eastern Eurasia in regions closest to Beringia probably did not occur until after ~20,000 CYBP. Following post-LGM climate amelioration, expansion northward and eastward restrains the temporal window for establishing the presence of viable populations for continued migration across the Bering Strait.[26]

The earliest sites in Western Beringia, Berelekh (16,000–12,500 ^{14}CYBP), Ushki-1 (13,000–11,500 ^{14}CYBP), and Ushki-5 (13,000–11,500 ^{14}CYBP), contain both blade and bifacially reduced tool forms.[26] As a result of recent work, Ushki, previously reported as dating to 19,000–12,000 CYBP, is now known to be no older than 13,000 CYBP.[27] A microblade core, bifacial knives, large blades, and a "Chindadn-like" point on the surface[20] at Berelekh, as well as the nonmicroblade components at Ushki, which include large blades and leaf-shaped bifacial points, have possible parallels to Alaskan Nenana assemblages. It has been argued that a general trend of increasing reliance on bifacial reduction, culminating in Clovis projectile point technology, signifies a trajectory of technological change originating in the blade-dominated industries of Upper Paleolithic Siberia. However, the simple fact remains that the earliest material from Alaska, consisting largely of microblades and burins, bears little resemblance to Clovis technology.

The type-fossil approach relies more heavily on tracking the movement of unique, presumably culturally specific, technological attributes through space and time. From this perspective, it is assumed that discrete components of material culture, such as specific tool morphologies and/or unique processes of reduction, are more resistant to change than others. It is expected that at least some component of a colonizing population's material inventory will be retained through the migration process and reflect the population from which it originated. Since few formally recognized and defined tool forms are present in Clovis assemblages, efforts to trace specific technological attributes have focused almost exclusively on projectile-point morphology and the occurrence of basal thinning and fluting. Although numerous fluted points have been found throughout Alaska, nearly all are derived from surface sites or shallow deposits of questionable stratigraphic context.[28] Tentative dates on these finds attribute them to deposits younger than 13,000 CYBP, considerably younger than Clovis point finds throughout the interior United States. The Uptar site in Northeastern Siberia, known only to predate 8,300 ^{14}CYBP, produced a much celebrated "fluted" point.[29] This single artifact, a

Box 2: Variation in Early Paleoindian Projectile Point Technology



For decades, the fluted point served as an iconic representation of uniformity in Late Pleistocene hunting technology of the Americas. However, recent research suggests that a much more diverse technology may have been present at the time of colonization or developed soon afterward. Projectile points from Cactus Hill and Meadowcroft, possible pre-Clovis aged sites, Chindadn points of the Nenana industry, and Clovis and El Jobo points bear little resemblance to one another. Discerning technological parallels between these diverse point types and the lithic industries of Europe and Asia is hampered by poor chronological control and the persistent problem of linking biological and cultural affinities.

somewhat crude bifacially shaped flake bears no resemblance to Clovis biface morphology except for the presence of a possible basal thinning flake removed from one surface.

Since fluting, the most distinctive feature of Clovis technology, currently stands as the first clear technological departure from an Asian and/or Alaskan substrate, some researchers have looked elsewhere for type fossil material parallels. Bradley and Stanford[30] have argued that the shared use of outré passé flaking (a method of biface thinning through controlled removal of flakes that span the entire width of the biface), the production of beveled bone or antler rods, and the use of red ochre between Solutrean peoples of Iberia and Clovis suggest a European origin for New World colonizers. Interest in a Solutrean origin has received widespread attention in the popular press, but is regarded with extreme skepticism by archeologists.[31,32] Because the Solutrean, terminally dated to ~19,500 CYBP in Southern Spain and Portugal, predates Clovis by at least 5,000 years, this scenario necessarily requires that New World colonization took place well before Clovis.

Despite the availability of new archeological data, it can be argued that we are no closer to solving the problem of tracing migration through prehistoric material culture then we were 80 or even 150 years ago. A staunchly historical particularist approach to lithic technology as a means of identifying population movement is well entrenched in New World colonization research. Yet the approach has not revealed any satisfying means of reconstructing antecedent relationships. The inherent diversity within the technologies often attempted to be linked (Box 2) clearly suggests that straightforward comparisons are likely to reveal superficial, if not meaningless, similarities. If, for instance, we were able to compare long lists of typological and technological attributes between Early Paleoindian assemblages of the Americas with Paleolithic assemblages of Europe and East Asia, what would be the significance of observed similarities and differences? An established, theoretically in-

TABLE 1. Early Skeletal Finds From North America

SITE	LOCATION	~AGE	
		C^{14}	Calibrated
Anzick	Montana	11,115	13,000
Arlington Springs	Santa Rosa Island, California	11,000	12,900
Buhl	Idaho	10,675	12,750
Marmes	Washington	10,500	12,500
Warm Mineral Springs	Florida	10,250	12,000
Gordon Creek	Colorado	9,700	11,150
Wilson Leonard	Texas	9,600	10,900
Harn Shelter	Texas	9,560	10,900
Grimes Shelter	Nevada	9,470	10,700
Spirit Cave	Nevada	9,400	10,650
Wizards Beach	Nevada	9,250	10,450
On-Your-Knees Cave	Prince of Wales Island, Alaska	9,200	10,300
Kennewick	Washington	8,400	9,450

formed set of criteria is desperately needed for distinguishing between which, if any, technological commonalities are most likely to represent antecedent relationships.

BIOLOGICAL PERSPECTIVES

Studies of modern human genetics and prehistoric skeletal biology have the potential to improve on the inadequacies presented by the technological record of New World colonization, but few if any firm conclusions have been reached. Concerted efforts have been made to analyze all of the known Late Pleistocene and Early Holocene human remains from the Americas, a sample that includes material from only six sites older than ~11,000 CYBP in North America (Table 1). The vast majority of these remains, including the famous Kennewick and Spirit Cave finds,[33] postdate colonization by thousands of years. As famous as these finds have become, they simply were not and should not be considered "colonizers" by any stretch of imagination. Although modern and, to a lesser extent, prehistoric genetic data are available in increasing abundance, theoretical difficulties persist in linking large-scale geographic patterns of mitochondrial and y-chromosome haplotype frequencies to the colonization processes from which they derived.

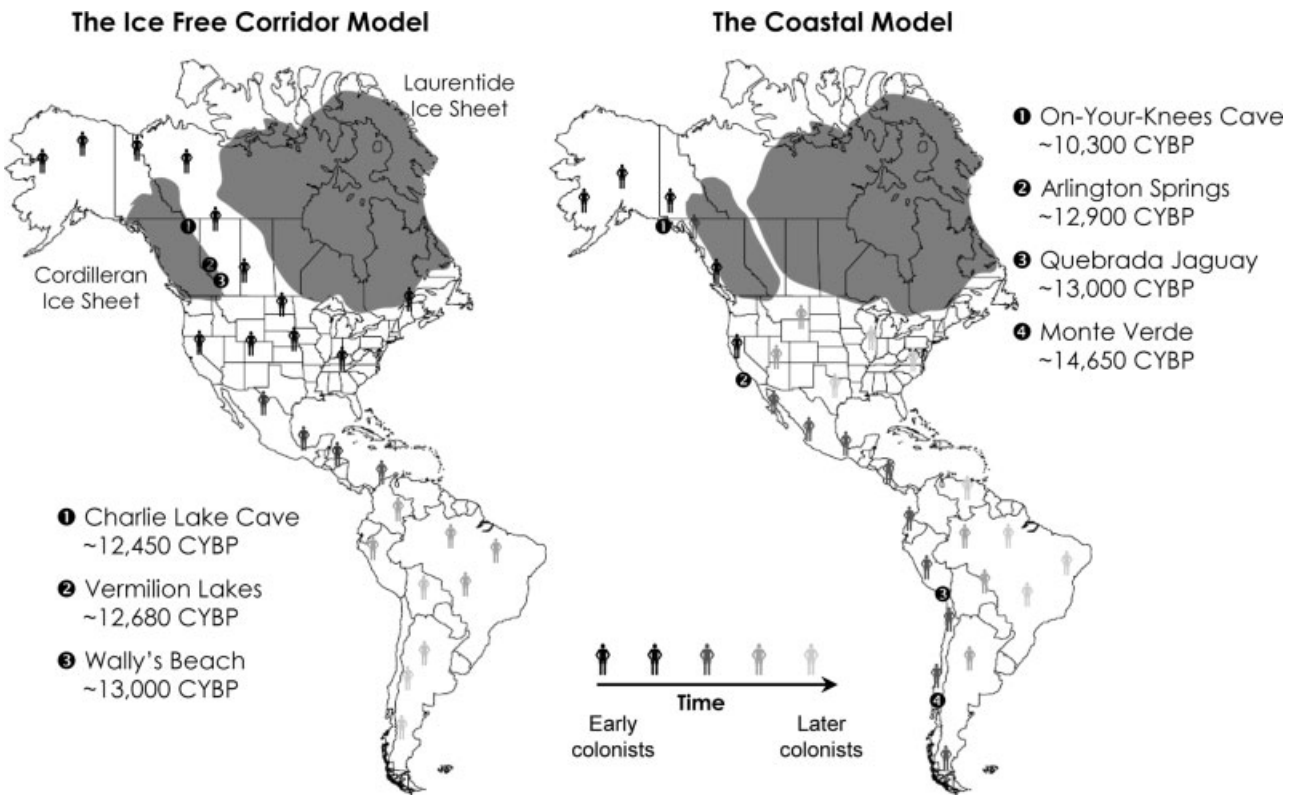
Multiple osteometric analyses and comparisons of material older than 8,800 CYBP tend to converge on two points: 1) Early skeletal material from North and South America is highly variable and displays little internal morphological consistency; 2) Early skeletal material bears little craniometric resemblance to any single modern population.[34] The Buhl burial, a single female dated to 10,675 ^{14}CYBP, has been reported to display distinctively Polynesian affinities,[35] while others find similarities with recent Native Americans and Asian populations.[36,37] The "Luzia" skull from Lapa Vermelha IV, a female approximately 11,900–10,200 ^{14}CYBP found in Brazil, is argued to have vague similarities with Australians, Africans, and Polynesians, but not modern Asians.[38] The Spirit Cave material, dated to ~9,000 ^{14}CYBP, is also identified as non-Asian and said to exhibit the strongest affinities with Ainu or Norse populations.[37]

These findings and the popular media's fascination with publicizing facial reconstructions which often use light-colored clay "skin" and arbitrary eye and hair colors, have led to the widespread characterization of early skeletal material as being decidedly non-Native American in appearance. However, unless one is willing to assume the untenable position that the diverse array of Native peoples of North and South America have not undergone any changes in their craniofacial morphology for the last 8,000+ years, denial of Native ancestry is premature.[39] As it currently stands, the earliest individuals we have look dissimilar to each other, and appear largely distinct from recent Native North and South Americans. Variation could be the result of multiple founding populations[34,40] and/or the effects of genetic drift among small widely scattered populations.[41]

The genetic record, based on regional and population frequencies of mtDNA and Y haplotypes, does consistently indicate an Asian origin for native New World populations. For a brief time, the identification of mtDNA haplotype "X" fueled European origin theorists. Haplotype X, found in low but significant frequencies among the Ojibwa and the Nuu-Chah-Nulth, is found more commonly among Europeans than Asians.[42] Recent work indicates that the haplotype is present, albeit in low frequencies, among peoples from the Altai mountain area and regions westward, as well as among prehistoric populations of South and North America.[43] As opposed to a Pleistocene European presence in the New World, haplotype X likely represents the complex colonization history of eastern Eurasia.[44] Based on mtDNA[44,45] and y-chromosome studies,[44,46] posited geographic origins of colonizing populations is generally placed in the area between the Altai Mountains and Lake Baikal of Siberia. Disagreement primarily centers on the number and timing of prehistoric migration events necessary to account for modern genetic diversity.

Single migration events by peoples carrying mtDNA haplotypes A-D are supported by models that account for known migration events of Native populations throughout the Holocene.[40] Others argue that mtDNA hap-

Box 3: Competing Entry Routes



Researchers are divided on how the initial colonists of the New World migrated into unglaciated regions. Two options are possible, along the Pacific coastline or through an ice-free passageway between the Laurentide and Cordilleran ice masses over present-day Alberta and Saskatchewan. Although some researchers have favored coastal models since the 1960s,[51] they have remained less popular than the Ice-Free Corridor route until recently. Interpretations concerning the productivity of the corridor vary greatly, depending on the paleonvironmental indicators used, time periods examined, and the assumptions made regarding human subsistence requirements.[52] Estimates range from a relatively diverse landscape capable of both attracting and supporting human populations to a wasteland virtually uninhabitable by humans. Both routes provide clear predictions of where the earliest sites should be, depicted here by the placement of "colonists" through time either within the corridor or immediately adjacent regions or on the coast. The earliest sites currently known from these regions, as shown, provide little direct evidence to support either model.

lotype B, haplotype X, or haplotypes A-D represent genetically distinct migration events.[43,44,47] Similarly, analyses of Y-chromosome haplotypes show evidence frequencies that are arguably derived from either a single Pleistocene migration event[48] or two or more founding populations.[46,49] Estimates of when populations carrying particular haplotypes first entered the Americas are highly variable. Estimates for the primary mtDNA groups range between ~35,000–20,000 CYBP; Y-chromosome haplotype estimates range between ~30,000–8,000 CYBP.[43,44] Genetic studies are currently plagued by equifinality, as it has become clear that multiple scenarios of initial colonization and later population movements can be devised to account for the modern frequencies of American haplotypes.

ROUTES OF ENTRY INTO THE AMERICAS

Despite the longstanding appeal of the ice-free corridor (IFC) as a natural feature that effectively funneled early colonizers into the interior of North America, the coastal-migration (CM) model has experienced a resurgence of support.[50] The IFC has clear implications for the spatial distribution of Pleistocene-aged sites in North America and later expansion into South America. A key to the IFC model is that the corridor existed and provided an ecologically viable habitat when the initial entrants sought passage into the Americas. As originally conceived, the IFC formed through deglaciation of the Cordilleran and Laurentide ice sheets in the Yukon and McKenzie River Valleys (Box 3) during the Late Pleistocene.

Assuming that the corridor was open and capable of providing at least minimal food resources, the IFC model implies that the earliest sites would be located within the corridor and the earliest dispersal of colonizers would occur in the interior of North America, just south of the ice sheets. Movement southward and outward from the interior toward the coasts would follow. The initial Clovis finds of the 1930s and 1940s on the Great Plains provided considerable impetus for the IFC model. Recent arguments for general north-to-south temporal and technological trends in the early Paleoindian record[53,54] have been marshaled to support this view. However, no sites either predating or of comparable age to mid-continental Clovis sites have been found within the bounds of the corridor. Sites such as Charlie Lake Cave,[55] Vermillion Lakes,[56] and Wally's Beach[57] all postdate 13,500 CYBP.

Despite the clear gaps in the archeological record predicted by the IFC model, two key discoveries have renewed interest in coastal models. First, the relatively widespread acceptance of Monte Verde presents a continental archeological record where a near-coastal South American site predates all early interior sites. Second, recent geological work concerning the location and boundaries of continental ice masses has altered our understanding of the corridor. It is now generally acknowledged that the Laurentide and Cordilleran ice sheets coalesced during Wisconsin glaciation. Further, cosmogenic dating of glacial erratics associated with the Laurentide ice sheet,[58] together with other geologic evidence, imply that the corridor was not open between 26,000–14,000 CYBP, severely limiting the temporal "freedom" the IFC model allowed for colonization. If Monte Verde is as old is it appears to be, humans were south of glacial ice before the opening of the corridor.

Key features of CM dispersal scenarios are that the northern coastline regions of North America were relatively ice-free by at least 15,000 CYBP, if not earlier, and that the outermost regions of the coast experienced only brief intermittent periods of ice accumulation throughout the Pleistocene.[59,60] Considered a viable route, most CM adherents further suggest that the initial colonizers followed the coast from initial entry into North America all the way to South America, dispersing inland only after coastal environments accrued unsustainable population levels. This initial colonization of coastally adapted foragers in both North and South America was followed by eventual migration inland. Appealing features of the CM model include a temporally flexible entry date into the Americas and clear predictions concerning where early sites should be found. If it is assumed that colonists followed the coast in order to maintain occupation of familiar and preferred coastal habitats, it follows that coastally situated sites should predate inland sites and provide evidence of a coastal foraging lifestyle such as aquatically derived fauna and associated technologies. Neither has been found. None of the earliest sites along the northern coast predate 13,000 CYBP,[61] with the possible exception of the Manis Mastodon locality in Washington[62] and Daisy Cave in California.[63] Further south, some South American localities[64] and skeletal finds may provide Clovis-age dates.

The paucity of early sites on the Pacific coast is generally explained as the product of submerged shorelines. As the ice masses melted in the Late Pleistocene and Early Holocene, the Pleistocene coastline and the sites potentially situated on it were inundated. While that is a valid point, it remains difficult to accept the notion that *all* of the presumably thousands of early coastal sites were located on the outermost regions of the coast and are now under water. In fact, the key to arguments regarding the habitability of northern coastlines is the presence of bears in Pleistocene deposits.[65] The presence of such large omnivores suggests that humans could also have successfully foraged in such environments. However, this also begs the question of why "bear sites" are discovered but human ones are not. In addition to the lack of sites, arguments based on optimal foraging and demographic models have questioned the plausibility of migrants maintaining a coastally limited dispersion to South America before venturing inland.[66]

PLEISTOCENE MEGAFAUNA: PALEOINDIAN SUBSISTENCE AND EXTINCTION

Few images of Pleistocene foragers in the Americas have captured the imagination like that of a small group of spear-wielding mammoth hunters. While captivating, the certainty of New World colonists as big game hunters has come under scrutiny. The repeated association of Pleistocene megafauna and artifacts established in the mid-twentieth century remains on solid empirical ground, as many fauna bearing Clovis sites do contain extinct species, particularly mammoth. However, interpretations of the zooarcheological record vary widely. The debate largely centers on the *significance,* not the presence, of megafauna in the archeological record.

Marking a departure from longstanding interpretations of Clovis, recent arguments classify New World colonists as generalized foragers who used a diverse array of large and small prey, plant resources and infrequent use of megafauna. It is argued that taphonomic and zooarcheological biases favoring the preservation, discovery, and analysis of megafauna have produced an archeological record that erroneously over-represents the contribution of large prey to the Clovis diet.[67] As a result of better preservation, visibility, and attention by zooarcheologists and paleontologists, the record of megafauna predation is deemed to present an inflated view of megafauna use. Assuming that a more comprehensive Clovis zooarcheological record not associated with megafauna exists, but remains largely undiscovered is problematic, but not improbable. Widespread association between Late Pleistocene artifacts and *only* small game prey species and artifacts or residues attesting to frequent plant use has yet to be discovered. However, new interest in the small-game assemblages associated with Clovis artifacts has made it clear that a broad array of prey species was used.[68,69]

In order to winnow the zooarcheological record into a sample including only the faunal material with the clearest evidence of human modification, Grayson and Meltzer[70] argue that only 14 of 76 Early Paleoindian sites show subsistence use of extinct megafauna. According to Grayson and Meltzer, this evidence does not bode well for the large-game specialist argument. Based on counts of prey species by body size class, it has been argued that a diverse array of species were used and that smaller prey outnumber megafauna in Clovis sites.[68–70] From this perspective, the distinction between specialized and generalized hunting strategies depends exclusively on the use of small-bodied taxa whereby generalists use small game resources and specialists do not. In direct opposition to a pan-continental subsistence regime based on hunting Pleistocene fauna, proponents of a generalized food economy argue that while now-extinct mammoths and mastodons may have been hunted occasionally, the vast majority of the diet came from a variety of floral and faunal resources.

Other studies of subsistence have reached different conclusions.[71–73] Waguespack and Surovell[73] argue that just as the hunting of megafauna by itself does not necessarily indicate a specialist subsistence strategy, the hunting of small game does not necessarily indicate a generalist subsistence strategy. Instead, the distinction between specialist and generalist strategies hinges on the relationship between what could have been hunted and what was actually taken. Based on the relative abundances of large and small game in Clovis faunal assemblages, they argue that Clovis hunter-gatherers were regularly ignoring opportunities to take small-bodied species, instead focusing most of their subsistence effort on the largest available prey. In contexts where human population densities are low and large game are available (presumed conditions during colonization), it is proposed that a specialized strategy incorporating large high-ranked prey is the predicted use of resources derived from optimal foraging models. They argue that the traditional "Clovis as specialist" argument not only still holds merit but receives strong support from the archeological record.

The role of early colonists in the extinction of Pleistocene megafauna remains divided in accordance with subsistence arguments. In addition to climate change and human predation,[72,74–76] hypervirulent pathogens have recently been invoked as causal agents.[77] The disease argument suggests that during colonization multiple species of Pleistocene megafauna were exposed to novel pathogens carried by humans or associated species such as domesticated dogs.[78] Excluding the possibility that New World colonization occurred significantly earlier than is currently believed, Pleistocene extinctions are roughly coincident with the arrival of humans. Yet little evidence of human predation on extinct species except mammoths, mastodons, and possibly camels and horses has been found, prompting the claim that the North American overkill hypothesis has itself gone the way of mammoth.[79] The reorganization of habitats,[80] massive vegetational changes,[81] and the loss of keystone species[82] can cause extinctions, but why this process had such detrimental effects during the Pleistocene-Holocene transition and not during previous glacial to interglacial transitions remains problematic. Alternatively, human predation, while providing a clear mechanism for extinction, cannot be demonstrated to have occurred for the vast majority of extinct species.

TIME, SPACE, AND DEMOGRAPHY

Although routes of colonization within the New World may have taken the form of a wave-like expansion across space,[75,83] a linear spread through river valleys,[84] or perhaps a combination of both,[85] no clear spatio-temporal patterns of colonization have emerged from the archeological record. Most archeologists accept an initial Beringian entry point, yet the oldest sites in the Americas are far from Beringia if purported pre-Clovis contenders east of the Mississippi and in South America are reliably dated. If Clovis represents the colonizing population of North America, one might expect the greatest densities of Clovis points to be in the American Great Plains or Northwest.[86] Despite the increasing popularity of models of coastal colonization, they are dramatically weakened by the paucity of early sites in the far west. Such contradictions between data and hypotheses have served as the inspiration for work attempting to understand what the archeological signature of a colonizing population might look like under various migration scenarios. Recent studies have begun to explore the links between human demography and the spatio-temporal dynamics of New World colonization.[87]

Advocates of a pre-Clovis entry date often refer to the Monte Verde site as necessitating thousands of years of occupation before entry into South America. It is also often assumed that populations must achieve critically high densities and/or accumulate an adequate degree of landscape knowledge before venturing into unoccupied, unfamiliar landscapes.[88,89] While the motivation and preparedness of colonists to migrate through and occupy an ecologically diverse continent are important issues for ascertaining the tempo of colonization, basic demographic factors must first be explored.

Notable colonization scenarios have assumed high rates of mobility and fertility[75,90] and have been criticized for relying on the seemingly implausible combination of rapidly moving kid-toting foragers.[91] Mathematical models and comparisons of ethnographically derived mobility and fertility rates for hunting and gathering populations have established that rapid colonization is congruent with frequent residential moves.[92] Rates of population growth, upwards of 2.5% per year, can be and are maintained by mobile foragers. These findings establish that it is at least possible that the entirety of North and South America could have been colonized by small initial populations in as little as 1,000 to 2,000 years.[92] Though demographically plausible, verifying that colonization took place rapidly or slowly has proven extremely difficult.

If we had the luxury of watching the colonization of the New World happen, we would see population growth and migration decisions combine, eventually causing people

to occupy all of North and South America. But apparently our sampling of the archeological record does not cleanly translate into cells on a roll of film that can be put into spatial and chronological order to make a coherent story. Continuing this analogy, in theory radiocarbon dating could be used to arrange our cells (sites) in chronological order, but the inherent imprecision of the radiocarbon method makes it possible to order them only in a vague way. Assuming we had a large enough sample of dated sites, however, we might expect a somewhat ordered colonization process to emerge from archeological sampling. Arguing from mathematical traveling wave models, Hazelwood and Steele[93] have shown that colonizations characterized by long-distance dispersal, not necessarily coupled with high population growth, may not produce easily detectable space-time trends in the archeaological record. So while there is no disagreement that the "peopling" of the New World involved population growth, how population growth translates into geographic dispersal is not clear, but hinges on the issue of decision making by colonizers.

What are the rules and currencies governing decisions about whether, when, and how far colonists should move into unoccupied areas? Beaton[94] proposed a distinction between "transient explorers" and "estate settlers" as strategies of expansion for colonizing populations, defining transient explorers as following a pattern of long-distance moves by small daughter colonies that maintain minimal social and biological contact with their progenitor group. In contrast, estate settlers are typified by the movement of larger groups settling "closer to home" who sustain contact with their friends and relatives. Demographically, the transient-explorer strategy is argued to be riskier, as small groups in unfamiliar settings are more likely to be susceptible to stochastic events, both genetic and ecological, while estate settlers follow a more conservative path, maintaining social and ecological familiarity. Though Beaton's terms are not always used, the strategies he outlined delineate the basic dichotomy between proponents of a rapid, ecologically diverse expansion front limited by only a few key resources[15,95,96] versus advocates of slower selective migration into favored habits.[12,88]

Would New World colonizers have been characterized by rapid or slow population growth? How did they decide to move into unfamiliar regions? Would these decisions be based on economic concerns, social concerns, or perhaps both? Would the unfamiliarity of unoccupied lands hinder colonization? How does colonization behavior translate into spatio-temporal archeological residues? These are all issues that deserve further attention.

CONCLUSIONS

It is unfortunate that a review of Early Paleoindian archeology cannot be organized around a laundry list of important new sites, dates, and artifacts. Contemporary research into New World colonization simply is not a topic that lends itself to answers sought only "in the ground." Moreover, developments appear in the intellectual realm at a faster pace than they do in the empirical. It has been the theoretical questioning of assumptions and behavioral implications in light of advances in our understanding of hunter-gatherer ecology, taphonomy, paleoenvironments, human demography, and the biases inherent in the archeological record that have pushed the field forward. Lest this review present only a string of plausible options regarding the colonization process, akin to a "choose-your-own-adventure" novel of New World prehistory, integrated models have emerged that attempt to link many facets of colonizing events and behaviors. I will outline two of these.

The Pre-Clovis, Coastal, Generalized Forager Model

Advocates of pre-Clovis-aged colonization (~15,000 CYBP and earlier) generally agree that particular sites in South America for example Monte Verde and/or some North American sites such as Cactus Hill, Meadowcroft, and Topper necessitate a substantially longer period of New World occupation than shown by Clovis. To successfully navigate their way to South America and eventually occupy a diverse suite of Pleistocene environments, it is postulated that a lengthy process involving the acquisition of knowledge, technological adaptation, and population growth was prerequisite. In order to minimize the constraints imposed by unfamiliar landscapes, it is proposed that the initial migrants first moved down the coast where resource continuity could be maintained. Inland occupations were then established when coastal environments were fully populated or in particularly favorable locales. The coastal model solves one particularly troubling component of the pre-Clovis archeological record. If it is accepted that New World prehistory extends significantly further back in time, thousands of years before Clovis, why are there so few uncontested sites documenting this occupation? The coastal route provides an obvious remedy; the earliest sites have simply been concealed by rising sea levels.

Pre-Clovis scenarios also have broad implications for subsistence and other life-style characteristics. A lengthy period of co-existence between colonists and megafauna might weaken human predation as the primary factor in Pleistocene extinction. Computer simulations indicate that even minimal levels of predation over a brief period can result in the extinction of extremely large prey with slow reproductive rates.[74] Technologically, pre-Clovis proponents often emphasize the diversity inherent in Pleistocene-aged assemblages throughout the Americas. Variation, considered to be suggestive of environmentally specific cultural and technological developments that accrue over time, is considered congruent with populations that grew slowly and ventured into unfamiliar environments cautiously.

The Proto-Clovis, Inland Route, Specialized Hunter Model

Arguments for a "Clovis first" model are often caricatured as assuming that colonizers arrived in the Americas at exactly 13,500 CYBP, carrying Clovis technology and quickly establishing populations with high growth rates

and long-distance mobility regimes fueled by megafauna hunting. These attributes are then dismissed as unsustainable and extravagant compared to ethnographically documented hunter-gatherers. The classic model of colonization has become far more sophisticated and remains a viable option. Supporters of Clovis as colonizers generally accept that Clovis technology did not spontaneously develop upon arrival into the New World, and that, due to sampling issues, the earliest dated Clovis sites are extremely unlikely to reveal the earliest Clovis inhabitants. "Clovis first" has come to mean that Clovis peoples were the first to colonize large swaths of the continent. This claim acknowledges that the initial New World migration certainly predates Clovis, but not significantly. It is further reasoned that Clovis technology developed in North America, so the initial migration event involved peoples with distinct, or Clovis-like, lithic tool kits.

The difference between pre-Clovis and Clovis first centers around how much earlier than Clovis colonization occurred, and arguments about whether Clovis peoples represent a later inland migration event or were part of the initial colonization process. The longstanding Clovis versus pre-Clovis divide forces the debate into semantically inaccurate terms, since it essentially boils down to a short (hundreds upwards of 1,000 years) period of proto-Clovis occupation quickly developing into Clovis or a long (1,000+ years) period of occupation by populations with a decidedly "pre-Clovis way of life". The former position is frequently allied with an inland population spread south of the continental ice masses, rapid expansion into diverse environments, and a hunting-based subsistence economy.

Based on optimal foraging models, it is argued that selective predation on high-ranked resources, specifically megafauna, is predicted in colonization settings where large game is abundant and human population densities are low. Lacking competing human populations, colonists are construed as having undergone rapid growth and expansion. Morphological changes in Early Paleoindian projectile points and radiocarbon dates drawn from a hemispheric sample have identified a north-to-south gradient of increasing technological divergence.[53,54] In conjunction with interpretations emphasizing the rapid and widespread appearance of Clovis technology, a pan-continental subsistence strategy based on hunting, and the close parity in dates between accepted North and South American sites, many argue that migration was not habitat-dependent and that colonists migrated quickly outward from the point of entry in all available directions.

Numerous variations on the two scenarios have been proposed,[87] but these positions characterize the main issues of recent debate. Currently, our expectations of the archeological record and the reality of the record lack congruence. Interpretive ambiguities and problems of equifinality continue to render integration of various topical models and lines of evidence into a cohesive model. Excavating more sites and dating more deposits are simply not enough to resolve these issues. How technology and skeletal morphology reflect population level relationships, how our sampling of the archeological record, coupled with radiocarbon accuracy and prehistoric human behavior, affect our ability to detect initial colonization events, and our understanding of the zooarcheological signature of prehistoric subsistence strategies and the human demographic response during colonization events are all theoretical topics that, with greater study, have the potential to provide far more insight into New World colonization than does any single site, assemblage, or date.

It may be tempting to conclude that the lack of resolution concerning the when, where, and why of colonization indicates a lack of progress by Paleoindian archeologists. To the contrary, the current state of debate is the product of a more sophisticated understanding of the cultural, biological, and demographic nature of colonization. Our understanding of the process is likely to become even more contentious and uncertain as the complex relationships among the migration of people, culture, and biology are refined. So why are we still arguing about the Pleistocene occupation of the Americas? As is always the case, the call for more reliable and consistently collected data is warranted. More importantly, theoretical constructs capable of integrating such data are needed. Fortunately, as interpretations of New World colonization become increasingly complex, they are also to likely to provide an increasingly more accurate portrayal of the Pleistocene occupation of the Americas.

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