Ice Age Atlantis? Exploring the Solutrean-Clovis 'connection'

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Abstract

Bradley and Stanford (2004) have raised now, in several instances, the claim that European Upper Paleolithic Solutrean peoples colonized North America, and gave rise to the archaeological complex known as Clovis. They do so in the face of some obvious challenges – notably the several thousand miles of ocean and the 5000 radiocarbon years that separate the two. And yet they argue in their recent paper that the archaeological evidence in support of a historical connection is 'overwhelming'. We are profoundly skeptical of this claim; we believe that the many differences between Solutrean and Clovis are far more significant than the few similarities, the latter being readily explained by the well-known phenomenon of technological convergence or parallelism. The origin and arrival time of the first Americans remain uncertain, but not so uncertain that we need to look elsewhere other than north-east Asia.

Keywords

Clovis; pre-Clovis; Solutrean; colonization of Americas; Paleoindian; marine adaptation; lithic technology.

Introduction

Early in the last century, the American geographer William Morris Davis published a paper entitled 'The value of outrageous geological hypotheses' (1928) in which he urged his colleagues not automatically to reject outrageous ideas, but to think about them – calmly if possible – to see just what conditions would have to be obtained to make them reasonable or acceptable, and whether those conditions were true or could be obtained. Some of us might respond, however, 'Why waste the time?' An answer can be found in the case of Alfred Wegener. One of the more outrageous ideas Davis pointed to was Wegener's foolhardy notion of continental drift, which continued to be outrageous until the moment some forty years later when geologists realized it was true.

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Archaeology has had its share of outrageous hypotheses, perhaps none less than the claim that the Americas were originally colonized by Paleolithic peoples from Europe, an idea first raised by nineteenth-century advocates of an 'American Paleolithic' (e.g. Abbott 1881). Yet, even after the idea of an American Paleolithic collapsed in the face of overwhelming archaeological evidence that the prehistories of the two continents were not of comparable antiquity and did not play out in identical 'evolutionary' fashion (Meltzer 1983), the idea was occasionally expressed there might still be a historical link between the two continents in Late Glacial times, specifically in regard to the Solutrean and Clovis techno-complexes (e.g. Hibben 1941; Greenman 1963).

Until the application of radiocarbon dating to relevant materials from both sides of the North Atlantic beginning in the late 1950s and early 1960s (e.g. Haynes 1964), it might have seemed logical to use the presence of some similarities among artifacts of the Solutrean techno-complex of southern France and Iberia to argue for a historical relationship to Clovis, despite mounting (and long suspected) evidence for a physical connection between Siberia and North America via the Bering land bridge (e.g. Bryan 1941; Johnston 1933). The Solutrean technology, with its mastery of the (often bifacial) production of a variety of elegant foliate, shouldered and stemmed points, has long seduced modern knappers and Paleoindian archeologists and *aficionados* in America, who think they see 'unique' similarities between Clovis projectile points and those of this supposedly distinctive European culture. European prehistorians are usually far less convinced of the 'uniqueness' of the Solutrean, being familiar as they are with a large number of other techno-complexes of both Upper and Middle Paleolithic age that produced 'leaf-points' by invasive retouch, not only in Western, but also in Central and Eastern Europe, and even in Africa (Freund 1952; papers in Kozlowski 1990; Clark 1982).

In any event, radiocarbon dating has now amply demonstrated that the Solutrean industry spanned the period from about 20,500–17,000 ^{14}C yrs BP (for calibrated calendar ages in this time range, add about 3000 years), while Clovis ranged from 11,500 to 10,900 ^{14}C yrs BP, though, as we will note below, there is variation in the age of this complex across the continent (add about 2000 years for calendar ages). With a time difference of about 5000 radiocarbon years separating the two techno-complexes, continued insistence on some sort of trans-Atlantic 'connection' between them would seem futile (Jelinek 1971).

Yet in recent years, first at public talks and in the popular media, and later in the archaeological literature, Bruce Bradley and Dennis Stanford (2004; Stanford and Bradley 2002) have resurrected and elaborated upon the idea of a Solutrean-Clovis connection. Their claims have been examined and criticized in varying degrees by several authors, each of us included (e.g. Goebel 2004; Meltzer 2002, 2004; Straus 2000; see also Clark 2004; Fiedel 2004; Merriwether 2002; Sellet 1998; Turner 2002). Nonetheless, Bradley and Stanford have stuck to their guns, most recently (2004) in a paper aptly published in a volume dedicated to debates in archaeology.

We remain profoundly skeptical of the claim for a Solutrean colonization of North America, and believe there are far more reasonable and parsimonious alternative explanations for the relatively few formal similarities that can be argued to exist between these temporally and spatially remote cultural manifestations – notably, the well-known phenomenon of adaptive/technological convergence or parallelism. Nonetheless, we acknowledge that the possibility of a trans-Atlantic contact should be investigated, albeit

with scientific rigor. And we should do so mindful of the lesson taught by William Morris Davis and Alfred Wegener.

A framework for discussion

Following that lead, let us assume for the sake of argument (1) that a group of Solutrean people successfully negotiated the Pleistocene North Atlantic (a journey that would otherwise stymie humans for 16,000 years); (2) that this boat or series of boats was carrying a mix of men and women; (3) that they brought with them the full complement of Solutrean culture, or at least their local version of it; (4) that there are pre-Clovis assemblages in eastern North America that are comparable in age to Solutrean; and (5) that there is cultural continuity between Solutrean, pre-Clovis and eastern Clovis materials (a matter for which we have no evidence since we have no intervening sites or assemblages). If all this were so, what would we see? The same thing we see in countless other instances in prehistory in which groups arrive on a new landscape (e.g. Kirch 1997): their landfall would have reverberated for centuries and, indeed, millennia afterward through their material culture, not to mention in their genes and languages, in so far as those can be detected among descendant populations.

For this colonizing Solutrean group would have carried with them the full code for reproducing their culture. Every tool and artifact they and their descendants produced would have been determined by that knowledge. To be sure, new forms and technologies would be invented over time, but in the early centuries and millennia of settlement, their roots in Solutrean Europe would be deep and unmistakable (Fig. 1A). Thus, we should not see just one or a few similarities between the artifacts of America and Europe; we should see scores of them. We should see similarities not just in functional items (e.g. endscrapers), but also in the kind of culturally distinctive technologies and stylistic attributes humans use to mark who they are and the peoples to whom they belong (e.g. forms and manufacturing strategies of projectile points, which can be elaborated in culturally distinctive ways, beyond their minimal functional requirements). And we should not just see an instant abandonment of forms and attributes characteristic of the material culture they brought with them, but instead a series of evolutionary changes in the material culture occurring in different forms at different rates at different times, as old forms were adapted to new situations. All of this is in contrast to a situation in which two assemblages are historically unrelated (Fig. 1B).

Importantly, and unlike Bradley and Stanford (2004), we feel it is necessary to go beyond merely pointing (as they do with considerable hyperbole) to the 'amazing' and 'astounding' *similarities* between two complexes. After all, if one looks hard enough at two large and disparate assemblages, it is usually possible to find some similarities. But in order to assess whether those similarities are evolutionarily interesting yet historically trivial – that is, represent adaptive convergence of technology or adaptation – or whether they are historically profound – that is, mark a direct ancestral-descendant relationship – one has to examine them against the overall number of similarities and especially the *differences* between the two assemblages. If those assemblages are unrelated, there will be far more differences than similarities, and the similarities that occur will be primarily related to

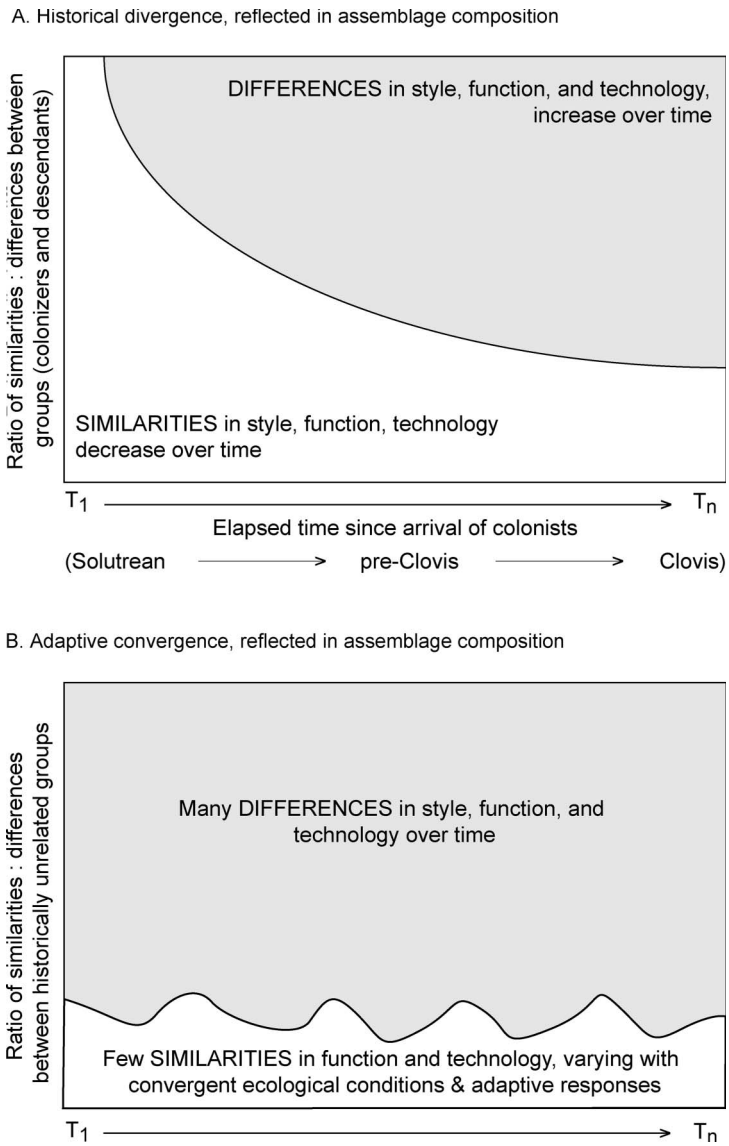

Figure 1 Graphical illustration of the anticipated assemblage differences between historically related (ancestor/descendant) groups (Fig. 1A) and two unrelated groups (Fig. 1B). Note that in Figure 1A, similarities between the assemblages of ancestor/descendant groups will incorporate stylistic, functional and technological elements, but will diminish over time, while differences will increase over time. Correspondingly, far greater similarities will occur between assemblages that are closer in time (Solutrean to pre-Clovis, in the Bradley and Stanford scenario), and considerably fewer between those more temporally distant (Solutrean and Clovis). Arguably, after a lapse of 6500 years, there may be very few similarities present. In contrast, Figure 1B illustrates the expected degree of similarity and difference between two geographically separated and historically unrelated groups (which may or may not be contemporaneous; e.g. Clovis to terminal Magdelenian versus Clovis to Solutrean). As shown here, the differences between the assemblages will far outweigh the similarities; there will be no similarities in style, only in function and technology; and the degree of similarity or difference will vary over time, as convergent ecological conditions trigger common adaptive responses.

adaptation and parallel evolution of technology (Fig. 1B), and represent similar responses to similar environmental challenges.

The essential point here is that, if the Solutrean claim is correct, we should not just see similarities in isolated traits between America and Europe; we should see broad similarities across entire assemblages in stylistic, functional and technological elements, and, early on at least (in pre Clovis times), very few differences. So what do we have here? We turn now to a critical examination of the archaeological evidence marshaled in support of a Solutrean:pre-Clovis:Clovis connection, as well as to Bradley and Stanford's (2004) claims that the Paleolithic records of north-east Asia and Alaska are irrelevant to questions of Clovis origins.

Technology

The archaeological crux of Bradley and Stanford's (2004) argument is the 'amazingly similar' artifact technologies, which are said to be alike 'down to minute details of typology and manufacture technology' between Clovis and Solutrean (Bradley and Stanford 2004: 465). We will leave aside for the moment the fact that, given the temporal gap involved (Fig. 1A), attention ought to be on similarities between Solutrean and *pre*-Clovis, not Solutrean and Clovis. Bradley and Stanford admit this (2004: 462) but subsequently largely ignore the point.

Like others before them (such as Hibben (1941) and Greenman (1963), in comparing the so-called Sandia points with Solutrean shouldered points), Bradley and Stanford focus particularly on apparent similarities between Clovis and Solutrean lithic technologies in blade and projectile production and typology. Some of their sweeping claims, such as 'Solutrean blade technology is more like Clovis than it is like any other European blade core technology used either before or after Solutrean' (Bradley and Stanford 2004: 466) and 'only these two groups consistently and purposefully used the overshot technique' (Stanford and Bradley 2002: 261; Bradley and Stanford 2004: 465), are subjective assertions that are empirically unsubstantiated.

In regard to overshot flaking, even a cursory examination of illustrations of foliate pieces from Middle and early Upper Paleolithic contexts (i.e. long before 20 kya) in Central and Eastern Europe, as well as from Aterian ones in north-west Africa and Middle Stone Age ones from Central and Southern Africa (e.g. Lupemban, Stillbay), suggests that overshot invasive flaking was not exclusive to Solutrean or Clovis. Moreover, the ubiquity of overshot flaking in Clovis is hardly demonstrated. Indeed, this technological feature occurs only rarely in fluted points in eastern North America (Meltzer 1988), and is most characteristic of the more 'classic' Clovis forms from the desert south west and the Southern High Plains (e.g. Bradley 1993). Even there, however, it does not occur in high frequency. In a large sample ($>$500 specimens) of Clovis points from Texas (Meltzer and Bever 1995; Bever and Meltzer unpublished data), of which 208 can be examined for the presence/absence of overshot flaking, only $\sim$12 per cent display that technique. Although edge trimming may have removed traces of it in some cases, its frequency is not likely to be significantly higher. The bottom line: not all Clovis technology involves overshot flaking; not all overshot flaking is Clovis or Solutrean.

In regard to blades, it is unclear from Bradley and Stanford's description what is supposedly so specific about Solutrean blade technology (as if there were only one such variant) as to make 'it' identical to Clovis blade technology. Moreover, it must be noted that the frequency of large blades and large blade cores in Clovis is highly spotty and hardly 'typical' (Bradley and Stanford 2004: 461). Large blades occur in assemblages in the south central United States, e.g. Aubrey and Gault sites (Texas), Carson-Conn-Short (Tennessee), but are extremely rare – if not altogether absent – in assemblages from the rest of the continent, including eastern North America – as Stanford (1991) and others rightly note (e.g. Collins 1999; Collins and Lohse 2004).

Ironically, in the only region where concave base points of Solutrean age purportedly most like Clovis points are common (according to Bradley and Stanford 2004: 466), the eastern half of Asturias and the western half of Cantabria in northern Spain, large blades are in fact very rare due to raw material constraints. In this region, good-quality flints occur only as small nodules, so that production of the uni- and bi-facial points is based primarily on the use of quartzites and poorer quality cherts (Straus 1977, 1980, 1983, 1991a, 1996; Straus et al. 1986).

Bradley and Stanford (2004: 463) make much of the fact that Clovis lacks microblades used in composite ('inset') weapons, while early Siberian and Alaskan techno-complexes do have microblades. This is evidence, they argue, against a north-east Asian origin for Clovis. Yet, the matter is much more complicated than they portray. Small blades have been recovered from the Gault Clovis site, the Shoop (Pennsylvania) fluted point site and the pre-Clovis age sites of Cactus Hill (Virginia) and Meadowcroft (Pennsylvania) (Adovasio personal communication 2003; Adovasio and Pedler 2004; Collins and Lohse 2004; McAvoy and McAvoy 1997). Indeed, it was based in part on those forms that Shoop's original investigator envisioned a historical/technological connection *to north-east Asia* (Witthoft 1952). Yet, these small blades are otherwise rare in Clovis and Clovis-like assemblages.

Moreover, the Solutrean side of this equation is not as Bradley and Stanford envision either. Solutrean assemblages from modern-quality (i.e. water-screened) excavations often contain large numbers of *backed* bladelets. For example, in some of the Solutrean levels at La Riera Cave (Asturias, Spain) backed bladelets make up between 10 and 24 per cent and even 71 per cent of retouched artifact assemblages normally totaling 100–200 pieces (Straus and Clark 1986). And the same is true for Solutrean assemblages from Amalda and Aitzbitarte IV in the coastal Basque Country, Cuevas Chufín and Morín in Cantabria, as well as Ambrosio and Parpalló caves in Mediterranean Spain (Straus 1993), Le Malpas (Montet-White 1973) and Combe Sauniére rockshelters in Dordogne (Geneste and Plisson 1986), among others.

Of course, the appearance of small blades is hardly necessary evidence of a historical relationship (e.g. Elston and Brantingham 2002), as they appear in the prehistoric record all over the world at different times.

As for bifaces, Bradley and Stanford report that unifacially flaked points comprise just under half of the Solutrean concave base points (Bradley and Stanford 2004: 466). In contrast, unifacially flaked points are completely absent from the large sample of Texas Clovis points (Meltzer and Bever 1995; Bever and Meltzer unpublished data) and rare virtually everywhere else across North America. Those few specimens that do occur

appear to have been hastily made expedient forms. The almost-universal bifacial nature of Clovis points highlights an obvious technological difference in primary reduction between them and Solutrean forms.

Moreover, Clovis points are almost always fluted on both faces (Collins and Lohse 2004); again, to give a specific example, 92 per cent of 421 Texas Clovis points for which data are available are fluted on both faces. Solutrean points, of course, are not fluted. Bradley and Stanford (2004: 461) dismiss fluting in Clovis as nothing 'special', merely part of the thinning process; this is a curious claim given the ubiquity of this feature in Clovis, and its nearly universal absence in all other North American lithic assemblages, save those of Folsom groups who immediately followed. But perhaps they advanced this line anticipating the problem posed by the absence of fluting in Solutrean points and, more critically, in pre-Clovis assemblages.

Yet, oddly, they still cite 'fluted bifaces' occurring in Solutrean as supporting evidence of a historical connection (Bradley and Stanford 2004: 466). However, the pair of stubby, convex-base foliates with possibly accidental basal flake removals from Laugerie-Haute in Dordogne, France, published by Smith (1963), are no more relevant than the isolated Siberian finds criticized by Bradley and Stanford (2004: 467–8).

Concave base foliate points are certainly not limited to these two 'cultures' (Bradley and Stanford 2004: 466), there being a number of industries in Eastern Europe that have a variety of such artifact forms, including the 30 kya Streletskayan of Russia, studied by Bradley (Bradley et al. 1995: Figs. 4,5) and others – some Middle and others Upper Paleolithic (e.g. Kolosov 1990; Monigal 2004; Matioukhine 1990). Yet, it would be an even greater stretch to argue that Clovis (or the Asturian Solutrean, for that matter) 'descended' from the Russian Middle Paleolithic or Crimean early Upper Paleolithic.

And where in Clovis or 'pre-Clovis' for that matter are the stemmed points and corner notched points of the Iberian Solutrean, which are frequent not only in Mediterranean Spain, but also in Portugal – where the Solutrean 'culture' is at its 'closest' to the US East Coast (a mere 5600 km)? Further still, where are the shouldered points, of which there are many types in the French, Spanish and Portuguese Solutrean, none of which look like the so-called Sandia points?

Beyond these differences in blades and bifaces, the highly diverse Solutrean lithic assemblages include true burins (i.e. with lateral spalls removed by burination), often between 10 and 15 per cent in modern-quality collections from Cantabrian Spain (e.g. La Riera, Morín, Chufín, Amalda), sometimes including microlithic Noailles truncation burins. Nothing like these is found in Clovis assemblages (Stanford 1991).

While Clovis is well known for blade and/or biface caches (Bradley and Stanford 2004: 462), those caches number only around two dozen (Collins 1999; Meltzer 2002), and almost all of them are restricted to *western* North America. Moreover, the only Solutrean caches are at Montaut in south-west France and (possibly) Le Volgu in eastern France, the latter with at least fourteen very unusually large bifaces (Smith 1966: 300–2). (Interestingly, stemmed and leaf-points very similar to those of the Solutrean recur much later in the prehistory of Western Europe – in the late Neolithic and Chalcolithic, a temporal gap of some 12,000 years – but no one suggests that they were 'related' to the Solutrean.)

Finally, although it is certainly true that both Solutrean and Clovis knappers often 'made a special effort to obtain exotic raw materials for the manufacture of bifaces'

(Bradley and Stanford 2004: 467), that is certainly not universally true. Whether the stone in an assemblage is exotic or not depended upon the scale of the settlement system; many Late Glacial-age assemblages in eastern North America are dominated by locally available lithic raw material (Meltzer 1988, 1993). It is true the material is usually of high quality, but then the same can be said of many mobile hunter-gatherers who had access to high-quality stone and who needed reliable and maintainable tool kits (Bamforth and Bleed 1997; Goodyear 1979; Kelly 1988). In any case it also must be emphasized, as Bradley and Stanford (2004: 462, 465) admit, that the stone used in Clovis assemblages was rarely heat-treated, while such was often practiced in Solutrean technology.

Art

Although small numbers of bone artifacts have been found in Clovis contexts (e.g. Lahren and Bonnichsen 1974; Stanford 1991), Solutrean osseous assemblages are much richer, with *sagaies* (antler points), wands, spatulae, eyed needles and works of portable art (for Cantabrian Spain, see Corchón 1986: 256–74). The latter can be made on stone (e.g. the nearly 2500 engraved or painted slabs from the Solutrean of Parpalló Cave in Valencia (Villaverde 1994)), tooth (e.g. the bird figurine on a bear canine from the Solutrean of El Buxú Cave in Asturias (Menéndez and Olávarri 1983)), antler or bone. Perforated and sometimes engraved teeth (notably red deer/elk canines), presumably used as necklace beads, are frequent.

To be sure, part of the scarcity of such artifacts may be that bone preservation in Clovis sites is often poor (Bradley and Stanford 2004: 462), but there are many Clovis and pre-Clovis age sites with good faunal preservation (e.g. Cannon and Meltzer 2004) that do not yield such materials.

In recent years, especially as a result of direct AMS radiocarbon dating of images made with charcoal, it has become apparent that much more Upper Paleolithic cave art in Spain and France is of Solutrean age than had once been thought (for example, by the Abbé Breuil). We know that drawings and paintings in such sites as Nerja and La Pileta in Andalucia (Sanchidrián et al. 2001), Phase II of Cosquer (Clottes and Courtin 1994), Tête de Lion and Cougnac (all in southern France) and engravings in Ambrosio (Andalucía) (Ripoll 1994), Le Placard (Charente) and Isturitz (French Basque Country) were done in Solutrean times, and we have strong reasons (e.g. archeological associations, stylistic similarities to dated portable art) to believe that many other cave art images are also of this age – including friezes of sculpted images at Fourneau-du-Diable and Roc de Sers in south-west France and the red outline paintings of the so-called 'Ramales School' in over a half-dozen Cantabrian caves (see Straus 2001, with refs.). It is even highly likely that much of the open-air rock art of the Côa valley in north-east Portugal is of Solutrean age, given the proximity of Solutrean living sites and stylistic similarity to the Parpalló engraved slabs (Zilhão 1997). Finally, the most recent, major study of Lascaux (Aujoulat 2004) concludes that much or even most of its art is Solutrean.

Nowhere in Clovis (or pre-Clovis) is there rock art like this. Bradley and Stanford (2004: 462) observe that engraved limestone pieces have been recovered (Bradley and Stanford 2004: 462), but the entire corpus consists of only a few dozen specimens, all but two of

which come from a single site in Texas (Gault) (Collins 2002; Meltzer 2004). In this regard, little has changed since the nineteenth century, when the search began in America for art comparable in antiquity or form to that of Paleolithic Europe. So pronounced was the dearth of early art even then, that one unbalanced American archaeologist went so far as to fabricate a specimen of counterfeit 'Paleolithic art', using the La Madeleine mammoth plaque as a model to engrave the outline of a mammoth on a whelk shell he claimed to have found in Pleistocene deposits in Delaware (Meltzer and Sturtevant 1983).

Obviously Upper Paleolithic Solutrean peoples practiced non-perishable art in many forms and contexts, while Clovis peoples did not. This dichotomy between the European and American records dramatically does not fit the expectations of a Solutrean-Clovis peopling scenario. Why would the artistic ability and productivity of Solutrean people have been lost during a supposed trans-Atlantic voyage?

Coastal distributions and marine resource exploitation

Another expectation of the Bradley and Stanford (2004) trans-Atlantic peopling model is that Solutrean and Clovis sites should display a clear connection to open ocean environments and resources. At La Riera Cave in eastern Asturias, a spatially limited excavation in the peripheral remnant of this important site revealed significant evidence of early Solutrean exploitation of coastal and estuarine resources (Straus and Clark 1986). Of the sixteen thin Solutrean levels, five yielded more than 500 (two of them more than 1000) identifiable marine mollusks – almost all large limpets (Ortea 1986). Other Solutrean sites in the same area, as well as in Cantabria Province (notably Altamira), are also known to contain abundant littoral shellfish. The La Riera Solutrean levels also produced small numbers of salmon and trout, but no oceanic fish (Menéndez de la Hoz et al. 1986). Two seal flipper phalanges were found in one La Riera Solutrean level and one in another (Altuna 1986). These join a single flipper phalanx from the Solutrean of Altamira (Altuna and Straus 1976).[1] There are no cetacean remains in the Cantabrian Solutrean – just a few in one Magdalenian level in Santa Catalina Cave on the present shore of Vizcaya, which the excavator (Berganza 2001) attributes to scavenging, which is also the best explanation for the seal bones.

La Riera, and many other nearby Solutrean sites in eastern Asturias, and Altamira in Cantabria are located about 9–10km from the −120m isobath, which is where the shore would have been during the Last Glacial Maximum: a two-hour walk. Large quantities of edible mollusks were carried back to these sites – but no ocean fish or marine mammal remains of any significance. In precisely the only area where Solutrean people were making (unfluted) concave base spear points, the surviving sites were closest to the Pleniglacial shore. Yet there is no evidence of seafaring (including no boat images in rock or portable art), marine mammal hunting or deep-sea fishing. While it is true that seals were represented in cave art of possible/probable Solutrean age in Cosquer (which also has auk images), Nerja and La Pileta, these are *Mediterranean* sites and there is no evidence of seal hunting or deep-sea fishing there either. Some Solutrean people no doubt were aware of seals and whales, which can be seen (dead or alive) along the shore, but they did not hunt them. Evidence of seafaring in the far smaller and easier Mediterranean

appears at the very end of the Upper Paleolithic at such sites as Nerja (Andalucia) and Franchthi (Greece), about 6000 years after the Solutrean. What happened in the tropical waters of Indonesia tens and even hundreds of thousands of years ago, namely the peopling of Sahul and Flores, is simply irrelevant to the Ice Age North Atlantic (cf. Bradley and Stanford 2004: 464).

Indeed, it is also in the Magdalenian of France (as documented by Cleyet-Merle 1990) that one finds numerous images of seals and fish in rock and portable art. Several of the seal images are far from the Atlantic shore, but seals are known to have swum far up many of the rivers that were teeming with salmon until recent times. Salmon (together with pike) remains can be quite abundant in many Magdalenian sites of Cantabrian Spain and south-west France – often associated with antler harpoons or possible gorges – but not ocean fish and not in the Solutrean.

It is worth recalling that during the Last Glacial Maximum, which corresponds exactly to the time of the Solutrean techno-complex, the human range in Western Europe had contracted to southern France and the Iberian Peninsula. By approximately 25,000 ^{14}C yrs BP, people had been forced to abandon Wales, southern England, Belgium, Germany and northern France, where they had lived before, during the Gravettian in Isotope Stage 3 (Straus 1991b). Southern Britain would not be re-colonized until *c.* 12,500 ^{14}C yrs BP (Tolan-Smith 1998). There is no evidence, despite the presence of some other mammals that people lived in Ireland (even in the unglaciated south) until around 9,000 ^{14}C yrs BP (Wickham-Jones and Woodman 1998). So where on the ice-free shores of the southern British Isles is the evidence of supposed marine mammal-hunting Solutreans navigating the eastern waters of the North Atlantic?

As for the use of marine resources in Clovis, Cannon and Meltzer (2004) reviewed all occurrences of faunal remains in Clovis and Clovis age sites across North America ($n = 78$ sites), and of those only two – Aubrey (Ferring 2001) and Shawnee-Minisink (Dent 2002) – produced reliable evidence of the use of an animal that lived on, around or in the water (Cannon and Meltzer 2004: Table 5). In both cases, the remains were fish, species unidentified, though, as each site is more than 160km from the present coast, it seems certain neither is a marine fish. There is no evidence from any of the Clovis or Clovis age sites nearer the coast for the use of marine resources – fish or mammal (Cannon and Meltzer 2004). If the earliest North Americans were direct descendants of Solutrean marine mammal hunters and fisherman, there is no evidence of that adaptation, or that they continued that tradition upon arrival.

On the assumption that Solutrean groups were hunters of marine mammals and other resources, which of course we believe is factually in error, Bradley and Stanford provide what they describe as 'informed speculation' about the nature of the North Atlantic resources and how Solutrean groups may successfully have crossed the North Atlantic. Their discussion of sea-surface and sea-edge productivity is interesting but, at best, debatable. The optimistic, but largely undocumented, claims for an Eden-like North Atlantic fed by rich upwelling of sea-floor ooze, with melting icebergs sailing *eastward* along warm Gulf waters, at the very least need to be measured against the actual geological and sedimentary record in the sea floor of Heinrich events, LGM sea surface temperatures and the changes in North Atlantic Deep Water production and thermohaline circulation (e.g. Bard et al. 2000; Boyle 2002; de Vernal and Hillaire-Marcel 2000;

Vidal et al. 1999; Weaver et al. 2003), and the effect of all these (and other) variables on biological productivity, especially that of marine mammals. This is not a matter to be left to archaeologists, ourselves included, so no more need be said on this point, save to recall Bradley and Stanford's (2004: 460) admonition of how easily (they were speaking of the Pleistocene peopling from northeast Asia) 'informed speculation' such as this can become dogma and ideology.

Solutrean, Clovis and pre-Clovis

Early on in developing their idea of a Solutrean connection, Stanford and Bradley focused on the similarity between Solutrean and Clovis (e.g. Stanford 1999). However, when it became obvious – as it quickly did (Adovasio and Page 2002) – that there was a vast spatial and temporal gap between the two, several (though not all) of the North American pre-Clovis sites were brought into the picture to 'provide the ''missing'' chronological and technological links' between Solutrean and Clovis (Bradley and Stanford 2004: 473). Nonetheless, we could not help but observe that Bradley and Stanford devoted much of their effort to showing that Solutrean and Clovis were like one another; when it came to the scattered pre-Clovis assemblages, they merely averred that 'most of the technological characteristics we propose for the developmental Clovis technology are present' (Bradley and Stanford 2004: 472).

Leaving aside all the questions and controversy surrounding the age of these pre-Clovis sites – dating matters are not nearly as tidy as Bradley and Stanford (2004: 472) assert – we note that none of these sites is fully accepted by the archaeological community and collectively they do not display any consistent technological or assemblage patterning (Adovasio and Pedler 2004; Meltzer 2004). Moreover, these sites are few in number, their assemblages are largely undocumented and not described in any significant detail, and are scattered over several thousand years of time and hundreds if not thousands of miles across the North American landscape (if one includes the pre-Clovis assemblages Bradley and Stanford omit; see Adovasio and Pedler 2004). The data necessary for any meaningful comparisons between Solutrean and pre-Clovis, and pre-Clovis and Clovis, are slim, at best (Collins and Lohse 2004).

But taking these data at face value, if these pre-Clovis assemblages truly represent missing links, then why, as noted above, do they yield only small blades and blade cores? One of these pre-Clovis assemblages has concave base projectile points (Cactus Hill), but then another (Meadowcroft) does not. As Collins and Lohse observe, 'neither the points nor the blades [at Cactus Hill and Meadowcroft] are technologically very similar to those of Clovis' (2004: 182; see also Adovasio and Pedler 2004).

Bradley and Stanford (2004: 472) further assert that overshot flaking is present in pre-Clovis artifacts, but no examples of such are cited or illustrated. We have not seen such reported in any of the pre-Clovis assemblages they cite nor have we seen such in our (admittedly limited) first-hand examination of the assemblages from several of these and other sites.

Their claims for the Page-Ladson point are illustrative of the careless nature of the connections being drawn between Solutrean and pre-Clovis. Bradley and Stanford

illustrate and describe this specimen type as being 'probably associated with artefacts and mastodon remains dated to nearly 14,345C BP' (Bradley and Stanford 2004: 472). Yet, Dunbar (the original investigator) reports that the Page-Ladson point 'has not been recovered in context, [but he] (Dunbar 2002) believes there is circumstantial evidence that this form is a Clovis ancestor. At Page-Ladson two specimens were recovered from displaced context. The Page-Ladson form is the most likely candidate for association with Unit 3, dating to 12,420 $\pm$ 80 ^{14}C yrs B.P.' (Dunbar and Hemmings 2004: 66). Since Page-Ladson points have not been recovered in a primary context, since the discussion of the circumstantial evidence indicating they are a Clovis ancestral form has not been published (Dunbar 2002), since Page-Ladson forms do not have apparent overshot flaking, and since Bradley and Stanford used the calibrated age instead of – as throughout the remainder of their paper – the uncalibrated age, thereby giving the impression the type is older than it appears, there is little reason to put much weight on this 'missing link'.

More problematic, if these pre-Clovis sites are 'missing links', created by recently landed Solutrean boat people, then where are the large foliate Solutrean points, the shouldered points, the burins, the large blades and conical cores, the parietal art (Meadowcroft is a rockshelter, after all), the rich bone *art mobilier* that they assert were bequeathed by Solutreans and appear in Clovis? We freely admit that the pre-Clovis sample is small, but, if it is in any sense meaningful as Bradley and Stanford (2004) take it to be, then its supposed Solutrean roots ought to be far more apparent than they are at present. Perhaps this explains why Bradley and Stanford concentrated so much more of their effort on comparing Solutrean and Clovis. Yet, ultimately, any effort to link the Solutrean and Clovis has to go through pre-Clovis – the 5000 year radiocarbon gap demands it – and until that case is made with more than thin assertion, it remains unconvincing.

And in regard to the radiocarbon record, it is true that Clovis is still relatively poorly dated (Bradley and Stanford 2004: 460); however, it is incorrect to imply that the earliest radiocarbon-dated Clovis sites are from the south east (Bradley and Stanford 2004: 472), and thus closer to Europe. Rather, the situation is just the reverse (Meltzer 2004; Taylor et al. 1996): Clovis sites in western North America range from 11,550 to 10,900 ^{14}C yrs BP (Holliday 2000; Stanford 1999; Taylor 2000), while those in eastern North America are as a group several radiocarbon centuries younger than the youngest of the western sites (Anderson et al. 2002; Goodyear 1999).

There is one exception to that trend, and it is on that exception that Bradley and Stanford (2004: 472) base their chronological claim: the dates from the Johnson site, which is located in central Tennessee. Again, however, they neglect the troublesome details. The stratum in question has actually yielded a suite of conventional ages, ranging from 11,700 ^{14}C yrs BP to 12,660 ^{14}C yrs BP, all of which were associated with apparent cultural features, but none with diagnostic artifacts (Barker and Broster 1996; Broster et al. 1991). Moreover, a pair of samples from that same stratum also yielded AMS ages on various fractions that cluster around 9,000 ^{14}C yrs BP (Barker and Broster 1996: 103). At the very least, questions remain about the antiquity of the Johnson site, and whether these ages do mark Clovis, pre-Clovis, or indeed if they are even anthropogenic. It is hardly sufficient to warrant overturning the radiocarbon slope of more and older well-dated Clovis sites further west.

In any case, why should it matter to Bradley and Stanford (2004) if Clovis is earlier in the east? Given that 5000 radiocarbon years separate the Solutrean ancestors from Clovis

descendants, over which time groups surely spread into the interior of North America, there is no reason to expect that the oldest Clovis sites would still be close to the eastern seaboard. But, since Bradley and Stanford (2004: 472) believe that to be important, we would simply note that the radiocarbon trail leading from Solutrean to pre-Clovis to eastern Clovis is still not a very well marked one.

If not Iberia, then Siberia?

Bradley and Stanford (2004: 462–3) are quite correct in their statement that the origins of Clovis are not readily obvious in north-east Asia and Alaska. We find serious fault, however, in their discussion of the timing of Beringian colonization as well as their characterization of Siberia and Beringia's Upper Paleolithic industries and how they might relate to Clovis.

Bradley and Stanford (2004: 462–4) would lead us to believe that no archaeological site predating the time of Clovis has been found in Beringia. If we accept that Clovis is no older than 11,550 ^{14}C yrs BP (Stanford 1999), and not the 12,000 ^{14}C yrs BP that Bradley and Stanford (2004: 462) imply, then one should have no difficulty identifying some 'pre-Clovis' Beringian sites. In central Alaska, basal occupations at Mead, Broken Mammoth and Swan Point convincingly date to 11,600, 11,800 and 12,000 ^{14}C yrs BP, respectively (Crass and Holmes 2004; Yesner 1996), and in the lower Indigirka valley of north-east Siberia, the Berelekh site has an Upper Paleolithic occupation potentially dating to as early as 13,400 ^{14}C yrs BP (Mochanov 1977; Goebel 2004). Other Beringian sites contain basal occupations that are as old as Clovis. They include the Nenana complex sites of Walker Road, Dry Creek, Owl Ridge and Moose Creek, all convincingly dated to between about 11,300 and 11,000 ^{14}C yrs BP (Hoffecker et al. 1993; Powers and Hoffecker 1989).

And what about the lowest cultural layer preserved at the Ushki sites in Kamchatka? Bradley and Stanford (2004: 262) write that it is 'unfortunate' that layer 7 at Ushki-1 and Ushki-5, long thought to date to about 14,000 ^{14}C yrs BP, has been re-dated to only 10,700 ^{14}C yrs BP. Yet, as before, Bradley and Stanford (2004) have omitted critical details, and cited only the youngest of the new AMS ^{14}C dates for this component and disregarded the other five, which together range from 11,300 to 10,700 ^{14}C yrs BP and average 11,000 ^{14}C yrs BP (Goebel et al. 2003). In fact none of the above-described Beringian sites is 'too late to figure in a first Americans scenario', as Bradley and Stanford (2004: 462) argue. Since, along with Clovis, they represent nearly synchronous populations that existed across north-east Asia, Alaska and mid-latitude North America, all are significant in establishing the origins of the first Americans.

Apropos the age of these sites relative to Clovis, and Bradley and Stanford's (2004: 463) assertion that the ice-free corridor stayed impassable 'until after 11,000 years ago, too late for use by Clovis ancestors', we would note that the geological literature they cite is outdated. In a recent and thorough review of the Canadian deglaciation record, geologist Arthur Dyke (2004) cautions against drawing 'categorical conclusions' about when the corridor opened, for there is no evidence at present that the route was impassable until 11,000 years ago. The same holds true for its biological viability, the precise timing of which is still not resolved (Mandryk et al. 2001; review in Meltzer 2004).

Bradley and Stanford (2004) further argue that early sites in Siberia and Beringia do not 'contain a lithic technology that remotely resembles anything we would be expecting as a precursor to Clovis'. Even a cursory review of the published literature on the Siberian and Beringian Upper Paleolithic, however, shows the shallowness of this claim. In Table 1 we present the list of traits used by Bradley and Stanford (2004: 460–2) to compare Clovis and Solutrean, and we consider the presence/absence of these traits in the Siberian Upper Paleolithic generally, and at the Ushki, Tanana and Nenana sites specifically.

Consider first the Siberian Upper Paleolithic. All but three of Bradley and Stanford's (2004) Clovis traits have been reported from a sufficient number of Siberian sites to be considered common. Features that are rare are limited to intentional overshot flaking (we can find only two instances of this technique, Ust'-Kova and Berelekh (Goebel 2004: 320, 340)) and double-beveled osseous rods (which to our knowledge have been recovered only from Yana RHS (Pitulko et al. 2004)). The single feature that is absent is incised stones; however, such artifacts have been found in the post-Clovis-aged layer 6 at Ushki-1 (10,400 ^{14}C yrs BP).

Now consider the Beringian (Nenana, Tanana, Ushki) complexes. All three of these complexes contain elements of biface reduction and blade technologies (Goebel and Slobodin 1999; Goebel et al. 1991). For example, Nenana and Ushki have basally thinned points and bifaces, examples of pressure flaking and unifacial tools made on biface thinning flakes. Further, Ushki has several very thin bifaces with invasive flake scars grading on being *outrepassé*. Even the small Tanana lithic assemblages contain many biface thinning flakes and a few bifaces (Crass and Holmes 2004; Yesner 1996). In addition, some tools in the Nenana, Tanana, and Ushki assemblages are made on blades, but blade cores are virtually absent. The lack of large, elegant bifaces and blade cores in all of these Beringian industries probably has more to do with lithic raw material constraints than anything else. Nearly all retouched tools found in the early Nenana, Tanana, and Ushki assemblages were produced from small cobbles or pebbles of fine-grained lithic material procured from local alluvial or glaciofluvial deposits (Graf and Goebel 2004; Yesner et al. 2004). Nonetheless, a quick scan of Table 1 indicates that these Beringian complexes in fact do share many of the lithic aspects of Clovis.

Missing, however, from the Nenana and Ushki sites is an ivory, antler and bone industry. Faunal remains are absent from these sites, too, indicating that this is a preservational (not cultural) difference, and thus akin to the situation Bradley and Stanford (2004: 462) describe for Clovis. Yet, at the Tanana Valley sites where faunal remains are well-preserved, so are bone and ivory artifacts. Although the total number of osseous tools recovered from the Broken Mammoth, Mead and Swan Point sites is still small and most come from latest Pleistocene deposits (cultural zone 3) that post-date Clovis by about 500 years, worked pieces include ivory points and rods, a possible atlatl handle and eyed needle (Holmes 2001; Yesner 1996).

Taken together, the early Nenana, Tanana and Ushki complexes document not only that Upper Paleolithic humans were present in Beringia during and just before the time of Clovis, but also that these humans tended to manufacture stone tools from bifaces, biface thinning flakes and blades. Further, they produced osseous tools similar to those from Clovis sites in mid-latitude North America. We agree with Bradley and Stanford (2004) that there are technological and typological peculiarities that distinguish these industries (there are even differences within the Beringian complexes presented here); however, we

Table 1 Comparison of Clovis and Beringian-Siberian complexes that are either synchronous with or older than Clovis (see Bradley and Stanford 2004: 460–2 for explanation of Clovis trait list)

Clovis traits	*Nenana*[a]	*Tanana*[b]	*Ushki*[c]	*Siberian Upper Paleolithic*[d]
Biface reduction	X	X	X	X
Overshot flaking			X	X[e]
Basal thinning[f]	X		X	X
Large blade cores with acute platform angle, single platform and front				X
Retouched tools from blades	X	X		X
Retouched tools from biface thinning flakes	X	X	X	X
Formal retouched tool types				
Side scrapers	X	X	X	X
End scrapers	X		X	X
Biface knives	X		X	X
Small gravers	X			X
Weapon points	X		X	X
Borers			X	X
Adzes	X			X
Backed pieces				X
Incised stones			X[g]	
Bone and ivory artefacts				
Sagaie (single beveled points)		X?[h]		X[i]
Bi-beveled rods				X[j]
Awls				X
Shaft-straighteners				X[k]
Barbed harpoons				X[l]
Billets				X
Eyed needles		X		X
Atlatl hooks				X?[m]

Notes:

[a]Nenana complex sites including basal components of Dry Creek, Walker Road, Moose Creek and Owl Ridge.

[b]Early Tanana Valley sites including Broken Mammoth, Mead and Swan Point.

[c]Ushki component 7.

[d]Middle and late Upper Paleolithic sites of central and north-east Siberia, 25,000–12,000 ^{14}C yrs BP. Artifact types are relatively common unless otherwise noted.

[e]Ust'-Kova, Berelekh.

[f]Bradley and Standford (2004: 461) dismiss fluting as a special aspect of Clovis technology, instead arguing that it is 'not technically different from other thinning flake removals' except for its placement at the base of a biface.

[g]From Ushki layer 6 (10,400 ^{14}C yrs BP).

[h]Recovered from Broken Mammoth cultural zone 3, about 10,300 ^{14}C yrs BP (Holmes 2001; Yesner 1999).

[i]Numerous single beveled points have been found in Siberian Upper Paleolithic sites; however, they are grooved for the insetting of microblades (unlike those found in Clovis sites).

[j]Yana RHS site has so far yielded three bi-beveled rods (Pitulko et al. 2004).

[k]Shaft-straighteners have been recovered from Afontova Gora-2 (Boriskovskii 1984) and Kurtak-3 (Abramova et al. 1991).

[l]Several late Upper Paleolithic sites in the Baikal region (e.g., Makarovo-2, Verkholenskaia Gora) have yielded barbed harpoons dating to 13,000–11,000 ^{14}C yrs BP (Medvedev et al. 1990).

[m]Maina has produced several small osseous pieces with 'heads' (Vasil'ev 1996) that may be atlatl hooks.

disagree with their interpretation of these differences. We argue that many of the specific differences are behavioral and adaptive, not culturally normative, and that the general similarities indicate *a link between Clovis and the Upper Paleolithic of north-east Asia*.

Unlike the Solutrean and Clovis archaeological records, both of which are reasonably well known at this juncture, the archaeology of Late Glacial north-east Asia is not as well known (Goebel 2004), and thus dismissing it as an origin point of the first Americans is premature. Given time, we are confident that the answers we are searching for are going to be found in Alaska and Siberia, not Europe.

Discussion

Bradley and Stanford (2004: 473) contend that there are an 'overwhelming and diverse number of similarities between Solutrean and pre-Clovis/Clovis'. In point of fact, the similarities are relatively few: concave base bifacial projectile points (but not always); blades (but small in some cases, quite large in others, and not consistently so); overshot flaking (but only in some cases and not consistently); exotic stone (sometimes, but not always), etc. There is less to these similarities than meets the eye.

Bradley and Stanford (2004: 465) consider the similarities between Solutrean and Clovis as an 'extraordinary convergence'. We would agree that there is convergence, but one that is hardly 'extraordinary'. Most – if not all – of the similarities are in functional items, or are so general as to be historically meaningless. Thus, it is not terribly surprising that these two complexes shared to varying degrees the use of bifacially flaked points, blades, exotic stone and heat treating, red ochre, end- and sidescrapers, for all of these are items that to one degree or another occur throughout the Pleistocene world. These are part of the common tool kit of humanity, and not artifacts or traits unique to these two cultures.

What is striking is not the 'overwhelming number' of similarities, since the similarities are neither numerous nor overwhelming, but instead the large number of differences between Solutrean and the American assemblages. We lack in the Americas any significant record of antler points and spearthrowers, cave painting, bas relief and engraving, or portable art (engraved stone, bone and ivory), beveled antler points, bone needles, atlatls, backed bladelets, perforated animal teeth and shells, the variety of hafting designs (bipointed, shouldered, corner-notched, stemmed), true burins, etc. Most striking of all, no unique or diagnostic Solutrean artifact has ever been found in North America. In effect, it appears as though cultural amnesia was instant and total, the moment these groups made landfall. If there was a Solutrean landfall, someone did a fine job hiding the evidence.

Apparently, genetic amnesia set in as well. If we assume that Solutreans were the ancestors of Clovis people who, in turn, spread across the continent and were ancestral to later groups, then the genetics of Native American peoples ought to be swamped by European genes. They are not. Native Americans have five major haplogroups in mtDNA, two in the non-recombining portion of the Y chromosome. All of these markers are shared with Asian groups – and that includes mtDNA haplogroup X, which Stanford and Bradley (2002) earlier highlighted as a critical genetic link between America and Europe, but which has recently been spotted in groups living in the Altai region of Mongolia (see the evolving discussion in Brown et al. 1998; Merriwether 2002; Schurr 2004; Smith et al. 1999).

For that matter, all the major markers in Native American nuclear DNA (immunoglobulin systems and the like) have affinities with Asia, not Europe (Cavalli-Sforza et al. 1994). It is perhaps telling that in this iteration of the Solutrean connection the genetic evidence has been quietly dropped by Bradley and Stanford.

Of course, there are those who argue, based on apparently distinctive skeletal morphology of some early specimens (e.g. Jantz and Owsley 2001, 2003), that unrelated, non-Native American groups were in Late Glacial North America, but subsequently vanished without a genetic trace. There is reason to doubt that claim (Powell and Neves 1999), but if it was true and if there was a European descendant population in the Americas, their genetic markers ought to appear in the ancient DNA of those non-Native American skeletons. So far, none has (Merriwether 2002; Schurr 2004).

As for those ancient physical remains, there is nothing in Native American teeth, ancient or modern, that points to a European ancestry (Turner 2002). And there is considerable debate over whether ancient skulls are non-Native American or show affinities to Pleistocene European crania (Jantz and Owsley 2001, 2003; Powell and Neves 1999; Steele and Powell 2002; Van Vark et al. 2003). But the sample of such is extremely small – just a dozen or so spread over some 3000 years of latest Pleistocene and (mostly) Early Holocene time; none is anywhere near pre-Clovis in age. Given that, and the evolutionary effects of genetic drift among colonizing populations spread thinly over a vast landscape (Powell and Neves 1999), this evidence is for the moment largely irrelevant to discussions of where the first peoples in the Americas came from. Worse, in light of the controversy over the supposed 'Caucasoid' appearance of the early Holocene age Kennewick skeleton (Chatters 2000; cf. Fiedel 2004), allegations of a European settlement of the 'New World' preceding the arrival of Asian peoples inevitably take on a political character with real-life implications in the post-NAGPRA atmosphere of tension between Native American peoples and anthropologists, as well as in the realm of on-going land-rights disputes throughout the US and Canada.

Davis (1928) urged his fellow geographers and geologists to consider the implications of outrageous theories, because, in the process of examining them, flaws in the received wisdom would become clear. There is little doubt that Bradley and Stanford (2004) are correct in their observation that the archaeological record from north-east Asia is frustratingly silent on the matter of the first Americans. But there are ample reasons why that is so, tied to the relative archaeological invisibility of small, highly mobile populations (Bettinger and Young 2004), and the comparatively small scope of research that has been carried out in this region of the world. The absence of evidence in this region is not evidence of the absence of pre-Clovis progenitors.

And in anticipation of the argument that what's good for Iberia ought to be good for Siberia, and that we should demand of the earliest sites in North America strong similarity to Late Glacial north-east Asian assemblages, we agree. However, the appearance of Solutrean on these shores would have been archaeologically instantaneous: Bradley and Stanford (2004: 472) envision the process happening in real time, over a group's lifetime. Thus, our earlier argument that we ought to see clear and unequivocal evidence of their arrival here. Yet, groups coming out of north-east Asia area would have been under no such time constraints; their movement into and through the Americas could have taken place over centuries, even millennia (Bettinger and Young 2004), over which time their

distinctively north-east Asian toolkits could have changed in subtle or significant ways. There should, of course, be echoes of that earlier technology present in pre-Clovis and Clovis assemblages, and indeed we think there are. And we think those echoes are far more compelling than the faint and illusory sounds of the Solutrean.

Conclusion: moving beyond advocacy

Bradley and Stanford's case is based largely on the supposedly 'amazingly similar' technologies of Clovis and Solutrean. Given the preponderance of the evidence, not to mention Occam's Razor, we are obviously highly skeptical of a Solutrean–Clovis connection. But, as we have also argued, the critical comparison is not between Solutrean and Clovis, but instead between Solutrean and pre-Clovis. One can hypothesize that by Clovis times many of the Solutrean elements of the culture could have vanished (Fig. 1A). And it is also fair to say that, like the north-east Asian archaeological record, the pre-Clovis archaeology of North America is still, at best, not well known. Thus, it must be concluded that further research into pre-Clovis will yield evidence on this issue (though not, we suspect, in favor of a Solutrean ancestry).

Although the onus of responsibility is on those who claim an outrageous hypothesis, not those who are skeptical of it (Davis 1928), in the interests of moving beyond criticism and of empirically resolving this particular outrageous hypothesis, let us identify some specific types of evidence that would be both necessary and sufficient to make a compelling case for a trans-Atlantic colonization of North America by Solutreans in pre-Clovis times:

1. There must, of course, be evidence in eastern North America of pre-Clovis archaeological assemblages that are reliably dated to at least 17,000 ^{14}C yrs BP, if not earlier (a necessary, but not sufficient condition of a Solutrean origin).
2. There should be present within the earliest of those pre-Clovis assemblages numerous stylistically and functionally distinctive and unique Solutrean artifacts, such as lithic laurel and willow leaf shouldered, stemmed and corner notched points, burins, backed bladelets, osseous points, needles, wands, spatulae, etc.
3. In the absence of the occurrence of such Solutrean-specific forms, arguments for historical relatedness based on lithic technology or functional tool classes will have to be based, as Collins and Lohse (2004:182) insist, on comprehensive and detailed comparative analyses. As they say, 'superficial, literature-based comparisons will not suffice' (Collins and Lohse 2004: 183).
4. The earliest of those pre-Clovis archaeological assemblages should also, of course, include specific types of portable works of art and ornaments characteristic of the Solutrean, wrought in stone, bone and ivory.
5. Caves and rockshelters clearly associated with pre-Clovis living sites (or art directly attributable to this period) should include paintings, drawings, engravings and/or bas reliefs of Solutrean style.
6. Finally, ancient DNA recovered from human remains dated to pre-Clovis (and perhaps even Clovis times) should contain distinctly and exclusively European nuclear and non-nuclear (mtDNA and Y chromosome) genetic markers.

These are some of the specific kinds of data necessary to make the case. Obviously, the interpretative claim that Solutreans were able or likely to make the trans-Atlantic crossing would be enhanced by evidence that Solutrean groups in northern Spain, and pre-Clovis groups in eastern North America, had deep-sea adaptations indicative of a capability to cross and subsist on the North Atlantic.

Until and unless such evidence is forthcoming, it is scientifically far more reasonable – given the extraordinary barrier presented by the North Atlantic Ocean during the Last Glacial Maximum and the six millennia separating Solutrean and Clovis – to maintain the traditional trans-Beringia model for the first peopling of the Americas. And we acknowledge that much further research remains to be done on such questions as the human settlement of north-east Siberia and Alaska, the timing of viability of the Canadian 'ice-free corridor', and the mode of human travel to the southern end of South America.

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Note

1 Cleyet-Merle (1990: 41) is incorrect in attributing seal remains to the Solutrean period in Tito Bustillo Cave in Asturias; only late Magdalenian levels have been dug in this site, and two of them did yield seal remains: 2 astragalii in one and a humerus fragment of a new-born in another (Altuna 1976: 189).

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