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The Theory of Evolution, Other Theories, and the Process of Human Colonization of America

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Abstract The theory of evolution contributes to our understanding of the process of peopling of America by providing a powerful framework within which biological and biogeographically oriented questions make sense. This is particularly important since detailed information at the individual level is now becoming available. Additionally, the theory of evolution helps to understand problems of adaptation encountered by the first human explorers of the continent.

Keywords Evolution · Peopling · Exploration · Knowledge · Technology · Movement

Introduction

The timing of the dispersal of humans in the world is derived from the application of evolutionary thought at several levels. Fossil species have been mapped in the different continents, and their timeline provides a history of their geographical success and failure. This distribution can be understood in terms of biogeographical corridors and barriers. By using a large-scale approach, or the models derived from the study of craniofacial (skull) shape variation (González-José et al. 2008) or other classes of biological data (Araujo et al. 2008), we can derive the best support for the position of human entry to America via Beringia since the archaeological evidence from West Beringia is scanty (Goebel et al. 2008).

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Many theories have been proposed to explain the peopling of America, most of them focusing on questions of chronology. Some authors have relied on short chronologies of around 11,000 radiocarbon years for the process of filling America (Martin 1973; Lynch 1980), while others have emphasized a longer process (Bryan 1973). Rarely has the theory of evolution been invoked during discussions of the archaeology of the exploration and colonization of the continent, a result of too little emphasis on human skeletal remains. Our understanding of the peopling of South America has been both determined and limited by the capacity of inductive search models. Basically, for decades, there were two main ways of obtaining information about the first inhabitants of South America. One was the accidental finding of megamammal bones (Montane 1968). The other was the explicit search for caves with deep stratified sediments (Lynch 1980). Both were adequate in producing information but were somewhat limited. Two main biases were identified. The first exaggerates the role of megamammals in past subsistence systems. The second bias exaggerates the role of caves in past settlements. In retrospect, these approaches ignored the fact that some of the major problems concerning the settlement of America involve knowing why settlement happened and how it was accomplished. Given that the search for diversity resulting from the application of these search models was limited, the possibility of recognizing early generalized adaptations was low. This is important, since these are exactly the kind of adaptations to be expected in a recently inhabited land. Given its focus on the search for variation, evolutionary theory offers one way to go beyond those limitations. Research lines along questions of landscape learning by the first human explorers of a region are particularly important (Meltzer 2002).

Evolutionary Theory

The theory of evolution was always attractive for archaeologists (Dunnell 1980). Two common theoretical approaches derived from that theory are human behavioral ecology (O’Connell et al. 1988) and selectionism (Dunnell 1980). Behavioral ecology is “the subset of evolutionary ecology that studies the fitness-related behavioral trade-offs that organisms face in particular environments” (Bird and O’Connell 2006:144). Selectionism, on the other hand, holds that the theory of evolution applies directly to the archaeological record by looking at artifacts and “the behaviors that created them … as being parts of the human phenotype” (O’Brien and Lyman 2000: 392).

Importantly, an archaeologist working under the umbrella of a powerful theory can go beyond the unstated “principles” of cultural studies, thus producing stronger arguments. The multidisciplinary nature of most research questions related to the early settlement of a continent also calls for evolutionary theory as the background against which biological, biogeographical, and archaeological data can make sense. But the people who made the artifacts also need to be taken into account in order to pursue evolutionary significant questions.

Expectations about changes through time in demography and human health, as well as biogeographical questions concerning the distribution of populations in different environments, can be derived from evolutionary theory. The construction of testable hypothesis to explain the variation observed in the archaeological record is a way to pursue this goal.

Biogeography and Archaeology

Questions about biogeography, demography, success, and final fate of populations or demes are basically evolutionary ones, and they require archaeological data to be developed and discussed (Chamberlain 2009). While many demographic questions are answered via proxies like number of sites or rates of occupational intensity, the full use of existing human biological data has not been completely incorporated by archaeologists. For example, the presence of exostosis on bones (Ponce et al. 2008) or the dietary or migrational implications of stable isotopes values on human bones (Borrero et al. 2009) refers to individuals. From a methodological point of view, this information must always be taken into account when compared to other classes of usually averaged archaeological data, like lithics, hearths, or faunal remains. Both the individual and the averaged scales of analysis are important to the task of understanding the peopling of a continent since they complement each other. The main implication for the process of human colonization is that much of the required evidence is coded in human skeletal remains. Questions like what specific kinds of foods were consumed by the initial explorers of a region or what behaviors were used to implement specific adaptive strategies are central in our quest and require the analysis of human bones. Their study will yield a better grip on the process of human adaptation at the individual level, thus providing a wider context in which to discuss other classes of data.

Analogies

The challenges to integrating data from fields like genetics, paleoecology, archaeology, and paleontology are exacerbated by the lack of living analogues for Late Pleistocene animals, plants, and ecosystems. In this context, actualistic research is a basic tool that cannot be ignored. The support of a strong theory is fundamental in this discussion. For example, paleontologists select phylogenetically related species to generate analogues useful in discussing animal paleobehavior, and paleoecologists use taxon-free approaches to understand the organization of past ecosystems. Basic evolutionary issues like the changing interaction between carnivores, herbivores, and humans (Martin 2010) can also be explored in this way.

In addition, the interpretation of archaeological data raises the problem of analogies. Ethnography and, more specifically, ethnoarchaeology provide ways to test methodological instruments that archaeologists can use to interpret the past. People working on human behavioral ecology seek information about modern hunters’ goals and the cost and benefits associated with different exploitation strategies. This knowledge generates basic methodological weapons for the task of modeling the past. For example, behavioral ecology has been used to support hypotheses about the importance of megamammals in the hunter-gatherers’ breadth of diet or their social organization. This theory suggests that the hunting of large mammals can be deduced through the relative importance of body mass and status (O’Connell 2000). On the other hand, ethnoarchaeological work among the Hadza indicates that the combined action of differential discard of large bones at kill sites and the selective removal of bones by scavengers may induce a false appreciation of the role of large mammals in the diet (O’Connell et al. 1988). Using this knowledge, it is no longer possible to defend the idea that the presence of large mammal bones at early sites is representative of whole cultural systems.

The Settlement of America: The Role of Knowledge

As for the history of human colonization of America, there are several evolutionarily relevant properties. *Homo sapiens* is the only hominin species implicated in the exploration and colonization of America. We know that the earliest explorers of America probably possessed the technologies required to be successful in a variety of environments, including at least hunting and knapping skills as well as shelter, insulation, and navigational technologies. This does not mean that the relevant strategies, tactics, and techniques were all in use at any particular time but that a wide spectrum of sleeping technologies existed among those early populations. Also, a number of co-technologies probably existed, the best example being the use of lithic knapping techniques on bones in places where rocks are absent or scarce, or the capacity to select alternative raw materials. Adaptations to cold climates, like the use of bones or dung for fuel or intensive exploitation of animal resources, are classic examples of existing but rarely used recipes of action.[1]

We can only speculate about ancient peoples' rules for learning and transmission of information, but it can be argued that their recipes of action should have included a wide spectrum of technologies. The issue of acquisition of knowledge about new resources during colonization has recently attracted considerable attention (Borrero 1994–95; Meltzer 2002; Rockman 2009). The gathering of locational information is sometimes said to be easy (Nami 1994), but this is not always the case. One common process based on learning by trial-and-error is known as guided variation (Boyd and Richerson 1985:95–97). Indeed, new land is exactly the place where this kind of learning strategy is expected to be important. It certainly does it at a cost, since this process opens the door to mistakes. The possibility always existed that some sleeping technologies constituted Trojan horses, and maladaptation can be the result. Trial-and-error is an expensive but necessary tactic, since it is difficult to be conservative when you are exploring new lands.

Cultural transmission also needs to deal with resources of high and low transference value, a variable that surely affected the process of colonization. Botanic knowledge can be considered specific for certain areas and thus of low transference value to other vegetational zones. On the other hand, knapping techniques or hunting tactics can be considered of high transference value since they can easily be applied to different sets of rocks or animals with similar economic anatomies in different regions.

The acquisition of knowledge about distribution of sessile resources appears to be straightforward, only involving the discovery of locations where they are available. However, since some of those resources are affected by cycles like El Niño/La Niña, the rhythms of resource recolonization would be known by people only after decades. This is critical knowledge required to exploit several resources of the Pacific Coasts of South America. Other cycles are involved as well, like the recovery rates of areas affected by earthquakes and tsunamis or volcanic eruptions.

Early Settlement and Cultural Generalization

In studying the process of incorporation of new lands, it is difficult to focus on models derived from the assessment of optimal strategies, since these don't always yield the expected outcome. On the contrary, mistakes and difficulties are one expected result of the first encounter with new sets of resources. Starvation and misery were necessary constituents of long-term adaptation to new lands. Suboptimal strategies and tactics were probably in use most of the time, including the exploitation of low-ranking faunas or scavenging (Borrero 1999). This goes against long-held scenarios of humans colonizing America and finding a fauna with no defenses against predators (Martin 1973). Recent research on this issue concluded that "As for the premise that the naive succumbed en masse to past human hunters, speculation is plentiful but facts are few" (Berger 2008: 258). Thus, it is questionable to conclude that the earlier explorers easily become full-time specialists in large mammals, as envisaged by many scholars (Martin 1973; Lynch 1980).

Shelter and insulation technologies were available and used by the first American populations under a variety of conditions. The evidence varies from the use of caves, to postholes marking some type of roof at coastal sites, or more sophisticated markers of open-air shelters. Then, the observed spatial discontinuity of human settlement in America has more to do with demography and human selection of attractive places for installation. In sum, it can be argued that there was a ranking of environmental patches and that people made decisions about where and how to move based on varying criteria.

Movement and Organization

Circulation for humans and animals was not difficult in South America (Dillehay 2000). The exploration of Tierra del Fuego, a continental island that was discontinuously connected with Patagonia (McCulloch and Morello 2009), is a good example. Both biogeographic theory and carrying capacity considerations based on the lack of appeal for humans of the recently emerged lands of the land bridge suggest that the evidence for the early colonization of Tierra del Fuego can be modeled as logistic and discontinuous.

[1] "Recipes of action" refers to the raw materials, tools, and facilities employed; describes the sequence of actions used in the technological process; and considers the rules used to solve problems that may arise (Schiffer and Skibo 1987: 597).

The first human groups in the region probably traversed quickly through the land bridge, since there is nothing to suggest that it was even moderately rich in biotic resources.

Another important consideration is that people were not constantly dispersing. At a global scale, there are places which were never colonized by hunter-gatherers, like Svalbard island, too remote in the ocean (Bjerck 2000), or places in the hinterland—like many plateaus—which were ignored or just traversed. Other places were used by people for less than one generation and then were abandoned for centuries, and finally, there are places inhabited for several generations. The conclusion is that to be on the move is not necessarily an intragenerational process. Different models of terrestrial hunter-gatherer displacements are recognized (Binford 1982), and only late in history the use of skis, sledges, or other technologically assisted means was added. The well-known "leapfrog" pattern that allows for movement to distant places does not apply to the process of exploration, since it requires the existence of previous knowledge (Rockman 2009: 55). This pattern is practical only to people already familiar with the new place.

When moving, humans need an organizational framework that allows for information flux between logistical groups/individuals and the source populations. This framework should be flexible enough to allow for full independence under certain circumstances while maintaining biological viability. The reasons for human movement can be manifold. The lack of knowledge about local resources is many times a critical variable behind movement. Food shortages related with seasonal or larger cycles like El Niño–La Niña should also be taken into account, since even starvation can be a motor for human movement (McGhee 1997). In-depth studies of the limited collections of human skeletal remains (Mena and Reyes 1998) will be necessary to discuss starvation or difficulties in adaptation.

Judging from the comparatively low frequencies of artifacts in the lower levels at early sites of South America, it follows that human populations were small and dispersed at the end of the Pleistocene (Borrero 1999). If we consider the climatic and environmental instability of the late Pleistocene (Clapperton 1993), we must conclude that many populations were probably barely viable at that time. It is conceivable that there were failed adaptations during the initial human colonization of South America. A predictable result derived from these conditions is that early settlement must have been discontinuous at the continental scale.

Conclusion

There are still no answers regarding why the process of human colonization of America took place. Some of the potential answers may be related to the demography of the early settlers of northeast Asia, but the information is insufficient for a thorough discussion. A slow process of dispersion of generalized foragers into America that started sometime after the Last Glacial Maximum produced a discontinuous coverage of the new landmass. The process of learning the distribution of resources and the ecological rhythms of the new lands was probably one reason behind this discontinuity. In rejecting the concept that the early settlers specialized in megamammals, it now seems important to search for alternative economies, "especially those oriented toward the exploitation of low-risk and scattered resources" (Borrero 2006: 20). This and other insights result from using evolutionary theory to search for variation in the archaeological record, a framework that can make sense of data from multiple disciplines at several spatial and temporal scales.

The main contribution that the theory of evolution has made to archaeology relates to the tempo and mode of human radiation (González-José et al. 2008). And there are claims that more substantial contributions can be made (i.e., Dunnell 1980; O'Brien and Lyman 2000). It is exciting to treat artifacts as part of the phenotype, but questions about the appropriate units of analysis or the distinction between homologies and analogies continue to plague applications. Also, we still await improvements in the observational language used by archaeologists interested in the application of evolutionary theory. Importantly, a bigger role for the full use of information derived from human bones is required. We still need to cash in on those very rare and rich repositories of information at the individual level, and we must try to pursue demographic issues no matter how difficult this task is.

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