

ALTENBERG SEMINARS IN THEORETICAL BIOLOGY

Winter 2005/2006:

Evolutionary Archaeology

**Hörsaal 1, Biozentrum, Althanstrasse 14,
6.15 p.m.**

The Program at a glance:

27 October 2005

Daniel O. LARSON (Department of Anthropology, California State University, Long Beach)

["Evolutionary Archaeology and Modularity: An Alternative Perspective for Archaeological Science"](#)

1 December 2005

Bruce Winterhalder (UC Davis)

["Seven Reasons to Remain a Forager During the Early stages of Prehistoric Agriculture"](#)

15 December 2005

James L. Boone (New Mexico)

["Surviving the Titanic: Social Strategies for Survival Through Natural Disasters and their Implications for Long-Term Population History"](#)

12 January 2006

Michael J. O'Brien (Columbia, Missouri)

["Constructing and Using Cultural Phylogenies"](#)

26 January 2006

[Stephen Shennan](#) (London, UK)

"Neutral Evolution and the Archaeology of Cultural Drift."

The topic

Evolutionary Archaeology

Archaeology is usually defined as the scientific study of past human cultures by analyzing the material remains (traditionally sites and artifacts, now increasingly also ancient human DNA) that people left behind. As a body of methods and techniques that are applied to the study of material culture, archaeology belongs plainly to anthropology, which has culture at its core (FOLEY and LAHR 2003), although this intimate relationship is not always reflected in institutional settings, especially in Continental Europe.

Most contemporary views of culture include an evolutionary dimension. For instance, BINFORD (1972) regards culture as "all those means whose forms are not under direct genetic control which serve to adjust individuals and groups within their ecological communities," whereas DUNNELL (1982) considers that evolutionary biology provides an explanatory framework for cultural change, but that it cannot "be applied unamended and uncritically to cultural phenomena, be they ethnographic or archaeological" (quoted in GIACOBBE 2005; cf. HURT and RAKITA 2001).

Evolutionary theory has been relevant to archaeology since its inception in the mid-19th century with the classification of cultural stages by Sir John LUBBOCK, among others. It is true that Franz BOAS (1858-1942), the "father of American anthropology," criticized the prevalent theories of sociocultural evolution of TYLOR, MORGAN, and SPENCER. Yet this was not because he rejected evolutionary theory per se, but because he took Darwin seriously.¹ In addition to attacking the cultural evolutionists' cavalier use and interpretation of data, the BOAS school challenged the then dominant belief in orthogenesis, a teleological process in which change occurs progressively and unilinearly (cf. Lamarckism) regardless of natural selection. (MORGAN, SPENCER, and TYLOR had little to say about the actual processes and mechanisms of change.) BOAS suggested instead that what appear to be patterns or structures in a culture were not a product of conscious design, but the outcome of mechanisms (such as diffusion and independent invention) that produce cultural variation, shaped by the social environment in which people live and act. To some extent, current debates within archaeological theory continue to reflect these old tensions, as this seminar series will document. The neo-evolutionary theories of V. GORDON CHILDE (1892-1957), Leslie WHITE (1900-1975), and Julian H. STEWARD (1902-1972) provided a synthesis of the original concepts of classical cultural evolutionism, the German Historical school, and the functionalist approach of British social anthropology. The thoroughly materialistically oriented CHILDE contributed the idea of revolutions in human economy, WHITE the concept that universal (human) evolution is the consequence of the technical capture of energy ("culture evolves as the amount of energy harnessed per capita per year increased, or as the efficiency of the instrumental means of putting energy to work is increased"). STEWARD's cultural ecology was concerned with demonstrating that evolution occurs along parallel lines (multilinear evolution) that are determined by differential environmental adaptation. Much of the New Archaeology of the 1960s, which aimed to shift the emphasis of archaeologists' work from mere description to explanation (in particular, to answering "why?"-questions) and even prediction (e.g., RENFREW 1973), had roots in cultural ecology. Lewis BINFORD, who is often credited for beginning the New Archaeology, considered that WHITE's approach laid the theoretical framework for a "logico-deductive science of culture," allowing for the formulation of general laws concerning cultural systems. As GIACOBBE (2005) notes, the New Archaeology "had its own dichotomy in WHITE's uni-linear evolution and STEWARD's multilinear evolution." In BINFORD's own systemic view, the unit of evolutionary relevance is an organizationally integrated biological system. What is measurable with the present methodological and theoretical sophistication is "the rate of change of formal attributes of artifacts and certainly not the rates of evolution." For BINFORD, the objectives of general evolutionary research are the "determination and explanation of the successive transformations of culture through its several stages of overall progress" (quoted in GIACOBBE 2005). A Spencerian, not a Darwinian view of cultural evolution was thus the primary basis of the integration of evolutionary archaeology into the New Archaeology.

Robert C. DUNNELL is one of the principal proponents of the Darwinian or "selectionist" branch of evolutionary archaeology, for which Michael O'BRIEN and, at one level, Stephen SHENNAN are the spokespersons in this seminar series. They argue that cultural change as documented in the archaeological record can best be explained in terms of the direct action of natural selection, drift, and possibly other Darwinian processes on heritable variation in artifacts and behavior (DUNNELL 1978,

1989; HURT and RAKITA 2001). These archaeologists have revolutionary ambitions: "those who espouse a selectionist approach are in a struggle for the attention of the profession. It is our goal to effect a complete paradigm shift within archaeology, not simply to amuse ourselves with academic debates" (O'BRIEN and HOLLAND 1995). Their program dismisses all past explanations of cultural change as unscientific and favors "blind," Darwinian explanation of changes in artifact frequencies without any recourse to human agency, decision making, or behavioral reconstruction instead. Contemporary with the articulation of this program has been the introduction into archaeology and ethnography of evolutionary or behavioral ecology (represented by James BOONE, Bruce WINTERHALDER, as well as Stephen SHENNAN in these seminars), which aims to explain behavioral and cultural change as forms of phenotypic adaptation to varying social and ecological conditions, "using the assumption that natural selection has designed organisms to respond to local conditions in fitness-enhancing ways" (BOONE and SMITH 1998). The primary conflict between these two programs centers on fundamental differences in the way they view the role of (behavioral) phenotypic variation. These differences have consequences in terms of explanatory scope, empirical application, and theoretical conclusions (Daniel LARSON seminar). Will the utility of using Darwinism in archaeology have been demonstrated in the end? Maybe "the grand statement of Darwinian archaeology still eludes us" (JEFFARES 2005).

Note

1. In an unpublished lecture (see LEWIS 2001), BOAS wrote: "Although the idea does not appear quite definitely expressed in DARWIN's discussion of the development of mental powers, it seems quite clear that his main object has been to express his conviction that the mental faculties developed essentially without a purposive end, but they originated as variations, and were continued by natural selection. This idea was also brought out very clearly by WALLACE, who emphasized that apparently reasonable activities of man might very well have developed without an actual application of reasoning."

References

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DUNNELL RC (1978) Style and function: A fundamental dichotomy. *American Antiquity* 43: 192—202.

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Abstracts and biographical notes

Daniel O. LARSON

(Department of Anthropology, California State University, Long Beach)

**Evolutionary Archaeology and Modularity:
An Alternative Perspective for Archaeological Science**

Thursday 27 October 2005

Abstract

Recent accomplishments in developmental and evolutionary biology provide an important alternative perspective for an emerging archaeological science. Specifically, evolutionary research incorporating concepts of modularity can advance our understanding of dual-inheritance or gene-culture coevolutionary theory. It is presumed that variability in both human gene modules and cognitive modules structures were subject to natural selection resulting in the evolution of new cognitive patterns, which in turn, caused greater potential genetic variability and evolvability. Understanding evolutionary processes associated with cognition will provide deep insights into ultimate causation of human evolution. Research domains that focus on determining how the brain works and evolved with regard to human perceptions and problem solving will predictably result in substantial reorientation of human evolutionary theory.

Where will the evidence come from for ultimate causation of human evolution? It is proposed that it will be found in comparative studies between our brain structure (different cognitive mechanisms) and those of our closest primate relatives. It will also derive from research concerned with reconstructions of interactive / integrative gene modules. It is possible that cognitive modules may be found in brain structures that could be characterized as anticipatory cognitive modules. It is hypothesized that such modules may have evolved rapidly in humans under conditions of coevolution involving changing complexities of culturalization in language, use of symbols, signaling, new dimensionality in social relationships and gene modules. The gene or possible gene modules for anticipatory cognition were the result of random genetic mutations and once present, the effects on coevolution were profound. Theoretical components and research results from many fields will be used to support these statements. Natural selection operating on genes, phenotypes, kin groups, and perhaps groups under different selective natural and constructed niche environments will also be considered. The archaeological record for the last 6 million years will be examined for periods of gradual and punctuated environmental and cultural events.

The global archaeological community predominantly rejects an evolutionary archaeology built upon Darwinian theory. Many argue that evolutionary archaeology is framed as an unacceptable metaphor and is wrongly critical of human intentionality and a Lamarckian perspective. The intellectual and social dimensions of modern archaeology are briefly reviewed for contextual reasons and an attempt is made to understand the strong resentments to the use of Darwinian theory. Despite the critics and limited support for evolutionary archaeology, this relatively new field has offered significant contributions leading to insights into natural selection, human evolution, and diachronic change in the structure of cultural transmission systems.

To advance the theory of human evolution we need to imagine what kinds of evidence from research in developmental and evolutionary biology would provide evidence of change in the cognitive patterns in humans through time. Particularly neurobiology, neuromapping, and other neurosciences will be critical in this endeavor. Archaeology's role will be to locate and identify change in the archaeological record that may evidence changes in cognitive patterns directly with ancient DNA and indirectly from artifacts' morphology and function, settlement structure, demographic studies, and reconstruction of selective physical and social environments to name a few.

Insights into proximate causation of how and why people make particular decisions under particular contingencies will continue to come from anthropology, sociology, political science, economics, and psychology – that is, they will continue to describe decision-making and intentionality factors.

An understanding of the evolutionary processes of human cognitive patterns will have profound impacts on medicine, mental health, language acquisition, cultural cooperation and conflict, and

beyond. Statements presented here are not necessarily novel and dangerous ground exists for those who dare to step outside their own discipline's boundaries, but the presentation is offered in the hope that a new interdisciplinary approach that includes scientific archaeology will emerge with a strong foundation in developmental and evolutionary biology and cognitive research.

Biographical note

Daniel O. Larson completed his PhD in the Department of Anthropology at University of California Santa Barbara (1987) with an interdisciplinary emphasis. He is presently Chair and Professor in the Department of Anthropology, California State University at Long Beach (CSULB) where he and his colleagues (H.Neff, C. Lipo, and M.Cannon) have created a special program in the application of evolutionary theory in archaeological sciences. In addition, faculty from CSULB departments of Biological Sciences, Geological Sciences, Chemistry and Physics have formed the Institute for Integrated Research in Materials, Environment, and Society (IIRMES) which is designed to embrace and extend existing interdisciplinary research collaborations between faculty and students. His publications and interests include Darwinian theory, philosophy of science, evolution of complex societies, cognitive evolution, evolutionary ecology, dendroclimatic reconstructions, quantitative methods, chemical analyses of archaeological materials, and geophysical applications in archaeology. His regional interests are the American Southwest, U.S. Great Basin, California, Africa, and Europe.

Selected publications

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Bruce WINTERHALDER
(*Department of Anthropology and
Graduate Group in Ecology, University of California Davis*)

"Seven Reasons to Remain a Forager During the Early Stages of Prehistoric Agriculture"

Thursday 1 December 2005

Abstract

Recent archaeological research suggests that human populations continued to hunt-and-gather for thousands of years after beginning the use of plant domesticates. This kind of mixed economy is rare in the ethnographic literature on foragers and horticulturalists; its persistence for millennia in the early stages of agricultural origins is inexplicable under much current theory. I will cite models and concepts from human behavioral ecology and, more specifically, from foraging theory, which may help us to explain this novel, prehistoric mode of production. The population ecology of the domesticates themselves, environmental instability, temporal discounting of subsistence options, and institutional mechanism of risk-manage under changing economic regimes are among the more interesting of these possibilities.

Biographical note

Bruce Winterhalder (PhD Cornell University 1977) is Professor in the Department of Anthropology and in the Graduate Group in Ecology at the University of California, Davis. He has previously been Associate Professor in the Department of Anthropology at the University of North Carolina at Chapel Hill. Dr. Winterhalder has conducted field work on foraging strategies of boreal forest Cree in Ontario, and agropastoral tactics and ecology among Quechua peasants in highland Peru. The forthcoming volume, "Behavioral Ecology and the Transition to Agriculture," of which he is the co-editor, is the first collective effort by archaeologists and ethnographers to use concepts and models from human behavioral ecology to explore one of the most consequential transitions in human history: the origins of agriculture.

Selected publications

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James L. BOONE
(*Department of Anthropology, University of New Mexico*)

**Surviving the Titanic:
Social Strategies for Survival Through Natural Disasters and their
Implications for Long-Term Population History**

Thursday 15 December

Abstract

Recent advances in the study of human population dynamics led to two general conclusions regarding long-term human population history:

- (1) The near-zero growth rates that have prevailed through much of prehistory are likely due to long-term averaging across a periods of relatively rapid local population growth interrupted by infrequent crashes caused by density-dependent and density-independent factors; and
- (2) The marked increase in population growth rates during the Holocene might best be explained in terms of changes in mortality due to the dampening or buffering of crashes rather than significant increases in fertility.

This lecture will focus on the role of emerging social inequality in regulating human population growth in the Holocene. Drawing on costly signaling theory, it will explore more specifically the evolution of altruistic behavior in the face of recurrent catastrophes. Differential survival data from the Titanic disaster of April 15-16, 1912 will be used to support the argument.

Biographical note

James L. Boone (MA, 1977, and PhD, 1980 State University of New York, Binghamton) has been Associate Professor of Anthropology at the University of New Mexico, Albuquerque, whose faculty he joined in 1987. He was involved in archaeological excavations projects at Qsar es-Seghir and other medieval period sites in northern Morocco (1977-80). He has been a NSF postdoctoral fellow in Lisbon (1980-81), a visiting assistant professor in the Department of Sociology and Anthropology at New Mexico State University (1981-82), a research associate at the Population Research Center, University of Texas at Austin (1983-84), and Curator of Collections in the Texas Archaeological Research Lab at the same university (1984-87). His area interests are Western Europe, North Africa, and the Mediterranean region, and his topical research interests include human evolutionary ecology, family structure and population process, long term population processes, the evolution of status seeking behavior, and the behavioral ecology of conspicuous consumption.

Selected publications

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Michael J. O'Brien
(*Department and Museum of Anthropology, University of Missouri-Columbia*)

Constructing and Using Cultural Phylogenies

Thursday 12 January

Abstract

Phylogeny refers to the genealogical history of any group of things, be they organisms, manuscripts, languages, or anything else that changes over time by means of an ancestor passing on material to an offspring. Phylogeny should be an important issue in both anthropology and archaeology because of their focus on history — that is, on questions about how and why people and their cultural trappings change in certain ways over time. These are evolutionary questions, just as in biology questions about organismal change over time are evolutionary. Not surprisingly, some of the methods that have been devised to examine historical (evolutionary) questions in biology have significant value for the study of cultural phenomena. The transference of methods from biology to anthropology is based on a growing recognition that artifacts, language, and other aspects of culture are phenotypic features in the same way that shells, nests, and bones are phenotypic in the organismal world.

Biographical note

MICHAEL J. O'BRIEN received his PhD from the University Texas at Austin in 1977. He is Professor of Anthropology and Associate Dean of Arts and Science at the University of Missouri. His main areas of research focus on the integration of evolutionary theory into archaeology. Some of his earlier work, undertaken in the late 1980s and early 1990s, involved creating a groundwork for that integration. This built on the earlier work of Bob DUNNELL, Bob LEON-ARD, and Tom JONES. Of his collaboration with Lee LYMAN he says that "[his] ideas on evolution and archaeology (not to mention the history of American archaeology) are so intertwined with my own that it's impossible to state with any certainty exactly which one of us thought of what." Lately O'BRIEN has concentrated on the use of phylogenetic methods, especially cladistics, in archaeology. The argument has been made that cultural evolution is anagenetic (in a straight line) rather than cladogenetic (branching), a notion he does not support. He also counters the argument that because culture involves horizontal as opposed to strictly vertical transmission, cultural phylogeny is too reticulate to be understood by phylogenetic methods: This pessimistic view overlooks the fact that much of nature is reticulate, which has not caused naturalists to throw up their hands in defeat.

Selected Publications

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Stephen J. Shennan
(*Institute of Archaeology, University College London*)

Neutral Evolution and the Archaeology of Cultural Drift

Thursday 26 January

Abstract

The theory of neutral evolution proposes that most molecular differences in the genomes of different individuals have no effect on their fitness: they are selectively neutral. It follows that the main factor affecting their frequencies over time is genetic drift, a statistical sampling effect arising from the fact that in a finite population even if there is a fixed probability, say 50%, of an event occurring, the actual number of such events is likely to be higher or lower than exactly 50%. In the genetic case, since each generation is derived from the one before, over the generations the repetition of these sampling processes will result in some molecular variants increasing in frequency while others go extinct. The mathematics of these processes is well understood and depends entirely on the mutation rate and the effective population size. Such neutral, or nearly neutral, genetic variation, because it is unaffected by selection, provides a basis for reconstructing population histories.

Archaeologists have long proposed that there may be a cultural analogue of genetic drift; in other words, that the changing frequencies of certain cultural attributes may simply be the result of repeated sampling effects because those attributes have no functional or selective significance. This was the basis of the distinction made by the archaeologist Robert DUNNELL between 'style' and 'function' in artefacts. In the 1990s NEIMAN showed how mathematical drift models derived from population genetics could be applied to analyzing the changing distribution of cultural variants, following earlier work that had modeled variation in bird song in this way.

The talk will describe these cultural drift models and a number of archaeological case studies using them that have been carried out by myself and others. It will be argued that drift models provide an important null hypothesis for identifying departures indicating cultural selection. Where the drift models do fit the data well they offer a powerful explanatory tool because they imply that the cultural pattern observed is explicable in terms of just two parameters: effective population size and innovation rate. Just as genetically neutral variants provide a basis for reconstructing population histories, culturally neutral variants provide insights into histories of cultural interaction.

Biographical note

Stephen J. SHENNAN (BA, 1971, and PhD, 1975, University of Cambridge) has been Professor of Theoretical Archaeology (1996–) at University College London. He has been Deputy Director (2003–05) and is currently the Director of UCL's Institute of Archaeology. He is also the Director of the AHRB Centre for the Evolutionary Analysis of Cultural Behaviour. From 1976 to 1996 he held various appointments, from research fellow to professor, at the University of Southampton.

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