The Analysis of Cultural Transmission

Culture and the Evolutionary Process. ROBERT BOYD and PETER J. RICHERSON. University of Chicago Press, Chicago, 1985. viii, 331 pp. $29.95.

Anthropologists have insisted for many years that human societies are different in kind from those of other animals because of the corpus of knowledge and beliefs called culture. Though the concept of culture has been a mainstay of anthropology's claim of disciplinary autonomy, there has been until recently almost no explicit dynamical theory or even formalism describing cultural transmission. It seems to have taken the challenge from biologists like E. O. Wilson and Richard Alexander to prod students of culture to generate explicit models of cultural transmission like the models describing Mendelian transmission that unified evolutionary biology in the early decades of this century.

The volume under review is an attempt to provide an analytic framework for describing some of the dynamics of cultural transmission and its interaction with genetic transmission. Many of the examples are forced and some of the exposition is awkward and opaque, but nevertheless an explicit formal notation and set of definitions are developed for modeling the joint evolution of cultural entities and of genes controlling the way in which these are transmitted among individuals. This is a major contribution to the human sciences.

The distinction between social learning and all other kinds of learning is central to the authors' perspective. Social learning by direct imitation or direct teaching by conspecifics is at the heart of cultural transmission. An organism using a social learning rule saves much time and effort compared to an organism that accomplishes the same thing by other methods such as trial and error or contemplation and insight. Widespread cultural transmission within a species can lead to a corpus of traits that follow dynamics similar to those worked out by population geneticists for Mendelian traits. There are analogues of selection, mutation, and genetic drift, but the set of mechanisms and models is richer because of new possibilities not known in genetics, like blending inheritance, transmission from children to parents or between siblings, conflict between teachers and parents, and many others.

There are potential costs of social learning. If the environment fluctuates then the imitator may acquire a phenotype inferior to that of a conspecific who figures out the local optimum phenotype by trial and error. The social learner may also be systematically manipulated and deceived by his or her models for social learning. In response to such forces genetic evolution may favor organisms whose social learning propensities are tempered in various ways. The authors describe possible consequences of this process in chapter 4. They suppose that a (genetically transmitted) parameter sets the balance between social and individual learning and proceed to study how such a parameter would evolve in different kinds of environments and under different assumptions about the relative costs of the learning mechanisms. In this way they have defined and made explicit the central issues and problems in the study of cultural transmission.

The authors reformulate and clarify the nature-nurture debate by splitting nurture into culture and environment. A trait like first language is ordinarily acquired culturally, by cheap, simple social learning. Other traits may be environmental, in the authors' terminology, which means that an individual uses more costly learning mechanisms like trial and error and insight learning to set his or her behavior. An example might be an individual's choice of occupation formed only after examination and contemplation. The trichotomy of genes, culture, and environment leads, in chapter 5, to a valuable discussion and classification of extant global theories of human social behavior.

In the remaining chapters the authors present a diversity of models describing possible dynamics of traits determined simultaneously by genetic transmission, cultural transmission, and various learning biases. Biases are classified as direct (modify the trait to achieve some goal), indirect (do it the way generally successful conspecifics do it, for example), and frequency-dependent (do it the way most conspecifics do it, for example). There is a staggering array of possibilities of how complex systems of transmission work and how they evolve. The authors develop a number of models, but they barely scratch the surface of the issues raised by their formalism.

The diversity of the empirical studies the authors discuss is impressive, from dialects on Cape Cod to the demographic transition. Some of the applications are more convincing than others, but their approach suggests for each one a number of further hypotheses subject to test. The applications can be read separately from the algebraic treatments by those who wish to avoid the mathematical development.

Language does not serve science very well as an analytic device. (This property of language is itself an interesting consequence of human evolution.) J. B. S. Haldane said that if someone could not use something in an equation then he did not really know what it meant, and Haldane's principle accounts for the universal use of mathematical notation in the sciences. The most important accomplishment of this book is the explicit algebraic representation of a rich meaningful set of unambiguous processes with which to study cultural transmission.

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Prehistory in Peru

Early Ceremonial Architecture in the Andes. CHRISTOPHER B. DONNAN, Ed. Dumbarton Oaks Research Library and Collection, Washington, D.C., 1985. viii, 289 pp., illus. $15. From a conference, Washington, D.C., Oct. 1982.

Forty years ago the Preceramic Period figured little, if at all, in the conceptual framework of Andean prehistorians. Since then, field investigations have shown that the earliest monumental architecture in the New World was built in Peru, predating the Olmec achievements in Mexico and Peru's own Chavin art style by a millennium. The first large architectural complexes were raised in the Central Andes between 2500 and 1500 B.C., drawing upon thousands of years of local cultural developments.

The purpose of the conference held at Dumbarton Oaks in 1982 and the resulting book, here under review, were to assess and explore aspects of the new synthesis on the origins of Andean civilization. The effort has been a success, notwithstanding minor editorial faults in the book and the lack of a map showing all sites discussed. No comparable treat-

ment of early Peru exists, and this collection presents such a diversity of data, methodological approaches, and synthetic statements that it may serve both as an introduction to the topic and as a resource for advanced scholars for years to come. The focus on architecture helps to unite a diversity of sites and approaches, and many topics other than architecture are discussed in the volume.

A prefatory discussion by Gordon Willey on the contribution of the late Junius B. Bird to Andean archeology was not part of the conference, but its inclusion is apt in view of Bird's seminal role in identifying and exploring the Preceramic Period and a host of related topics. The opening paper, by Michael Moseley, provides a historical overview of studies of early Peru and lays out the major points of current discussion and debate. Then follow new or revised presentations on specific sites, summaries of recent investigations or work in progress, and general conceptual schemes for understanding the early architecture. Richard Burger's concluding remarks review the collection and highlight contrasting approaches and problems yet to be resolved.

The sites under discussion were huge constructions made of tons of stone, adobe, and fill formed into platform mounds, circular sunken plazas, terraces, and other public works. It is generally agreed that large numbers of people were mobilized to build the structures: Thomas Patterson estimates that a minimum of 6.7 million person-days were needed to construct the principal pyramid at the Huaca La Florida, consisting of more than a million cubic meters of material. Dozens of such sites have been identified in Peru, the majority in the coastal desert, where research has been concentrated. Carlos Williams proposes a sequence of constructions on the central coast in which the plan of architectural centers was elaborated on the form of a U. Donald Lathrap argues that this shape was a symbolic representation of the jaws of a great cayman god, derived from a tropical forest, Mother Culture for Nuclear America. A number of complexes, however, such as those discussed by Robert Feldman, Lorenzo Samaniego *et al.*, Kazuo Terada, and others do not conform to the U plan. Though some regional stylistic patterns are emerging, much still needs to be done. The early prehistory of entire coastal valleys is often known only in outline, and vast tracts of the highlands and tropical forest remain unstudied. Rogger Ravines's paper on Jequetepeque reveals heretofore unknown architectural formats that, owing to flooding by an irrigation dam, may never be known in detail.

Understanding the diversity of architectural styles is complicated by the relatively poor chronological controls available for comparing them. This problem is made acute by the fact that the sites under discussion span the time from the late Preceramic Period through the Initial Period, when ceramics, true weaving, and other technological and social innovations appear in the archeological record. Future research must resolve this difficulty. The sociopolitical and economic roles of sites are also not well known. It is generally assumed that ceremonial activities were carried out on temple tops by relatively few people while large crowds congregated in ancillary areas. Some ceremonial themes seem to be widespread as evidenced by similar architectural forms, but there are also sharp differences. Burger and Salazar-Burger note that a "Little Tradition" may have been carried out at small centers contemporaneous with the monumental sites. The fact that the large complexes themselves went through periods of expansion and reorganization, as detailed in William Conklin's article on Huaca Los Reyes, suggests that their roles also changed through time.

But what else occurred besides ceremonies is uncertain, as are the nature and sizes of resident populations and support groups. Debate has also focused recently on the relative importance of maritime and terrestrial resources for coastal centers and the kinds of plant foods that may have supported the societies represented by the architectural centers. As Burger notes, however, the increasing recognition of large numbers of such sites outside of the coast suggests that these developments occurred interregionally. Indeed, Terence Grieder and Alberto Mendoza suggest that La Galgada, on the dry western slopes of the Andes, may have owed its prominence to its role as a link in exchange networks between coast and highlands.

The book thus shows how far researchers have come in delineating the origins of Peruvian civilization and points to the directions that must be followed in the future. Like the very buildings that are discussed, the new synthesis is a major remodeling of an old structure, and new developments are yet to come.

Section of eastern retaining wall, Cerro Sechin, Casma Valley, Peru. The carvings on the wall show "a procession of dignified, fully garbed personages" emerging from a central doorway and marching toward a stairway opposite. "Between these personages . . . lies a jumble of disarticulated human remains. . . . The meaning of this 'garish mosaic' . . . can be supposed to refer to sacrificial activities related to concepts of power and fertility. . . . At the same time, it may have served as testimony to the obtention and preservation of political supremacy." [Photograph by Lorenzo Samaniego from the paper by Samaniego *et al.* in *Early Ceremonial Architecture in the Andes*, courtesy of Dumbarton Oaks Research Library and Collection]

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