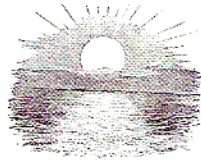


CLIMATE, CATASTROPHE, AND CULTURE IN THE ANCIENT AMERICAS

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Natural systems are neither more nor less stable than human societies. Catastrophes occur and effect changes in both realms. As debates over the environmental and social implications of global warming, abrupt climatic changes, and related topics continue, understanding the relationships between change in human and natural systems in the past takes on ever greater significance in understanding the future. We developed the meeting on which this book is based primarily because we believed that a critical mass of information had been acquired, making a Dumbarton Oaks symposium appropriate and timely for a scholarly audience. But we also felt that the synthetic nature of the papers might reach a larger audience, beyond archaeologists and environmental scientists, who might find valuable lessons to be learned in the resulting publication.

The Pre-Columbian Studies Program at Dumbarton Oaks serves as a medium through which humanistic scholars may interact with more scientifically oriented colleagues. Commonly, Pre-Columbian symposia focus on a temporal or geographical topic and bring together different scholars with their various approaches. Meetings on the Inca, Classic-Period Veracruz, and the Moche of Peru are all examples of this genre. Other symposia are thematic, such as previous meetings on mortuary practices, the sea in ancient America, or human sacrifice. The symposium on which this volume is based, however, was unique in being the most scientifically based meeting held in this format. As co-organizers of the meeting and now coeditors of this volume, we believed that we had a unique opportunity to identify scholars engaged in "hard" science who would be able to present current theories on climate change and its influence and interactions with culture in ways that would make their data and interpretations more accessible to nonspecialists (Mayewski, Maasch). We also included authors who employ more traditional social science and humanistic approaches to these issues (Roscoe, Kiracofe and Marr, Sheets, Wilkerson). Other papers are written by archaeologist-paleoclimatologist teams (Richardson

and Sandweiss, Billman and Huckleberry, Moseley and Keefer, Yaeger and Hodell). Most of these teams have worked together for years, but we take some credit and great pride in bringing together a Mayanist, Jason Yaeger, and a paleoclimatologist working on the Yucatan Peninsula, David Hodell; although these scholars had not previously worked together, they have crafted a single paper that is a model for the nuanced integration of archaeological and paleoclimatic data.

Earth and weather scientists are increasingly able to discuss climatic and related events in the past with greater and greater accuracy. We therefore believe that all students of the past will gain from greater knowledge on the current status of such data and the information derived from it, regardless of an individual scholar's views on the degree to which natural phenomena influence culture. We hope that the chapters in this volume will help to provide this information as well as offer substantive information and food for thought on how climate, catastrophe, and cultures interacted in the past.

The chapters in this volume offer diverse perspectives on climate, catastrophe, and culture in the ancient Americas while at the same time presenting only a small sample of a great number of studies recently accomplished or currently under way. Indeed, when we first began to develop the list of speakers we soon found that there were many potential contributors who could offer substantial and insightful contributions to the meeting. After some discussion and difficult choices, we decided to focus the meeting on the role of the El Niño phenomenon in producing catastrophic events, while adding selected examples of other phenomena to enrich and diversify the volume.

Although neither this collection of articles nor those in any other compendium could fully cover current knowledge on climate, catastrophe, and culture, the discussion of the original papers at the Dumbarton Oaks conference in 2002 and the resulting chapters do stimulate several observations about the state of research on human-environment-climate relations in the Pre-Columbian past and the study of these issues.

First, we were impressed by the great successes that can be achieved by true interdisciplinary research. Granted, the term *interdisciplinary* has become a catchphrase of academia over the last decade. Unlike many fads, however, this one has roots in broad scholarship and has attracted significant funding. For instance, the National Science Foundation has increasingly emphasized and promoted "interdisciplinary programs, programs that are supported by multiple Directorates at NSF, and programs jointly supported by NSF and other Federal agencies" <www.nsf.gov/pubs/2003/nsfo3574/nsfo3574.txt>.

Interdisciplinary work can be professionally risky for, to be fully effective, scholars must be willing to venture into fields beyond their expertise. In this light, we designed this symposium to demonstrate that students of El Niño and other catastrophes in Pre-Columbian America do engage in such interdisciplinary efforts, to great effect. Among the authors we find not only archaeologists with a variety of topical and geographic specialties, but also a social anthropologist, an architectural historian, an epidemiologist, and geologists working on ice-core records, climatology, earthquake hazards,

fluvial geomorphology, and paleolimnology. The results of the kinds of interactions exemplified by this group move us closer to understanding the effects of catastrophe on human societies and point us toward future research programs.

A second observation we have drawn from the conference and the editing of this volume is the difficulty of proceeding from collation to correlation to causation. Collation involves showing that events occurred simultaneously. Correlation, in formal terms, means demonstrating that events of interest co-vary in a statistically significant way. Causation means showing that outcomes are the necessary result of specific conditions and processes—that differences have occurred that make a difference, as social anthropologists sometimes put it. Chapters in this volume point out some of the difficulties as well as partial solutions to this problem.

Working with our natural-science colleagues, we are increasingly able to achieve collation: to demonstrate that particular climatic or environmental events are coincident in time with cultural change. Paul Mayewski gives us the tools to use polar ice-core data to reconstruct certain aspects of global climate that may have impacted past societies at particular times and places. For much of the time humans have been present in the Americas, this record has decadal or better resolution. Research by Mayewski and others has demonstrated that some of the most significant changes in global climate occurred over incredibly short spans, perhaps a few years to a few decades. An example would be the radical warming at the end of the Younger Dryas about twelve thousand years ago (Taylor et al. 1997). Collating the ice-core record with the archaeological record thus requires not only an understanding of climate dynamics but also considerable refinement in the dating of archaeological phenomena. Radiocarbon dates must be calibrated to calendar years, but even then, achieving decadal or better resolution in most New World prehistoric sites will remain a dream for years to come. As Jason Yaeger and David Hodell point out, chronologies built on radiocarbon dates, ceramics, or calendrical texts (the three principal dating methods for the ancient Americas) all present challenges to effective collation that are further complicated by the time-averaged nature of archaeological deposits.

Kirk Maasch's discussion of El Niño dynamics approaches the problem from the opposite direction: by showing how El Niño plays out in different regions of the Americas, he provides criteria for seeking El Niño's signal in the archaeological and coincident natural records of each region. At the same time, he points out another problem in collating records: not all El Niño events behave the same way or leave the usual signal in a given locale, and sometimes non-Niño processes can deposit a Niño-like signal in the absence of the phenomenon, a false positive as it were. To ensure proper interpretation of the climate record, we need to employ a multiproxy approach, to triangulate possible paleo-events with as many independent data sets as possible. To do so requires collaborating with many different specialists.

Several of the chapters offer case studies in collation as well as clues to causation. James Richardson and Daniel Sandweiss's summary of research on Mid-Holocene coastal Peru points to temporal coincidence between

changes in El Niño frequency and the construction of monumental religious architecture. Coastal cooling in the northern half of Peru and the onset of El Niño with long recurrence intervals took place at 5,800 cal yr BP, shortly before ancient Peruvians began building temple mounds, while an increase in El Niño frequency at about 3,000 cal yr BP coincides with the abandonment of coastal large-scale constructions for several centuries. Although these hypotheses of climatic change came originally from the remains of biological organisms in archaeological sites, both are now well supported by multiple independent data sets as well as some climate-modeling exercises. The beginning and end of the phase of early monumental construction on the Peruvian coast are now fairly well documented, while the implications of bioindicators have been reconfirmed several times.

Can we go beyond collation in this case? The intriguing temporal coincidence was license enough for Richardson and Sandweiss and for Paul Roscoe to consider interpretive scenarios involving environmental, climatic, and social factors. Because these scenarios are consistent with what we know about conditions, events, and human behavior from both the ethnographical and archaeological record, they can guide future research even though we recognize them as stories rather than histories. If we were to wait until we had full agreement on every aspect of the paleoclimatic and cultural records before venturing an interpretation, we would have a long wait and very dull meetings.

Given that we cannot interview ancient informants about their perceived motivations nor observe their actual behavior directly, in these as in other attempts to suggest prehistoric causation, there are caveats. In the northern highlands of Peru, where direct effects of El Niño are muted, temple mounds have a similar start date but different form. In addition to climate, other factors changed throughout the central Andes after 5,800 cal yr BP: populations seem to have grown, many more domesticated plants came into use, and interregional interaction may have increased. The degree to which climatic change influenced these events is uncertain although, in general, catastrophic events do not appear to have played significant roles. Should we then throw out the Niño with the bath water? We suggest that the answer is no, so long as scenarios such as those proposed by Richardson and Sandweiss and Roscoe are used to orient our data collection and future interpretation rather than as explanation.

Yaeger and Hodell also point to variability in the record of cultural and climatic change in their study of the Terminal Classic Period on the Yucatan Peninsula. Though droughts occurred, each region had a unique history as well as a unique version of the events often glossed as the Maya Collapse. Yaeger and Hodell outline the difficulties in achieving sufficient temporal collation for explanatory purposes. They conclude that climatic change was undoubtedly an important factor in many of the social transformations that occurred during this time but that neither social nor climatic change was uniform or unicausal. They also call for greater consideration of the possible benefits of climatic change for some groups under some circumstances; Roscoe, Payson Sheets, and Brian Billman and Gary Huckleberry elaborate on the same point in different contexts.

The chapters by Michael Moseley and David Keefer and by Sheets are case studies, each with a significant advantage—they deal with point catastrophes that can be tied directly to specific moments in the archaeological record. For El Niño studies in particular, this is an area where we can do more, especially working in an interdisciplinary mode. As seen in the Moseley and Keefer study, in the paper by Billman and Huckleberry, and in work by geologists Lisa Wells (e.g., 1987, 1988), Michel Fontugne et al. (1999), and others, El Niño-generated floods sometimes deposit a recognizable sedimentary signature in or on overlapping archaeological strata. On the Peruvian desert coast, in later sites with mud-plastered floors or walls, El Niño-derived rainfall can lead to erosion tracks and even footprints (e.g., Sandweiss 1995). At the late Pre-Hispanic site of Túcume, in the Lambayeque valley on Peru's north coast, a small entry temple was reconstructed five times through the course of about five centuries (Narváez 1995). Each reconstruction followed a rainfall event that left archaeological indicators.

Harold Rollins and his colleagues have demonstrated particular alterations in the macro- and microstructure and in the stable isotope geochemistry of mollusk shells that survived El Niño (e.g., Rollins et al. 1987), and Andrus et al. (2002) have recently done the same for fish otoliths. Found in archaeological contexts, these bioindicators can demonstrate the presence of El Niño at specific moments in the past. Recently, Andrus, Hodgins, and Sandweiss have begun to work with radiocarbon in mollusk valves as an indicator not only of the presence but also potentially of the intensity of El Niño events (Andrus et al. 2005). Others such as Elera and colleagues (1992) have identified El Niño events from short-term changes in faunal assemblages from midden deposits. Tree rings may eventually provide similar indicators of specific events. In short, we have a number of known and potential approaches to placing El Niño in direct association with archaeological deposits, as long as we know what to look for. With more cases we can move more quickly from collation to correlation.

Although the Moseley and Keefer study of the Miraflores event is a case of collation, it is hard to deny likely correlation with, and even a causal link to the downfall of the Chiribaya culture. S. Jeffrey K. Wilkerson's paper brings home the destructive power of catastrophic floods, their potential to cause cultural change, and some of the processes by which this change can ensue. Some time ago, Sheets discussed the possible influence of population movements from the Maya highlands to the Peten in the Classic-Period florescence as a result of volcanic activities. In the Osmore case, detailed by Moseley and Keefer for southern Peru, style change is dramatically in evidence in the apparent total elimination of the Chiribaya style and its replacement with another style, apparently of highland origin. Thus we are sensitized to the fact that an art style can evolve not only in a battleship-curve mode, quietly fading in popularity, but can also be dramatically changed or eliminated due to catastrophe. It would be worthwhile to look for other examples in the archaeological record.

Sheets's analysis of volcanic impacts on Central and Mesoamerican societies also illustrates the utility of direct physical association between the indicators of catastrophic events and the archaeological record. He has

amassed enough cases that we might be able to consider correlation between natural processes and cultural change—except that in some of the cases, there was no archaeologically apparent cultural change.

The lack of observable cultural change after catastrophe in the archaeological record leads us to a third observation on the relationships between sociopolitical organization and responses to catastrophic events as well as to slower-paced processes of environmental change. Sheets's concept of "scaled vulnerability" is critically important and well illustrated by his case studies. In the book *Floods, Famines and Empires: El Niño and the Fate of Civilizations*, Brian Fagan (1999) has made a similar point concerning climatic variation at the El Niño scale: small, mobile, egalitarian groups of foragers have more options than do large, sedentary societies when faced with sudden (or progressive) downturns in resource availability. In other words, social organization, economy, and population density can act as both constraints on and enablers of human responses to environmental catastrophes—as Sheets, Roscoe, Yaeger and Hodell, and Billman and Huckleberry argue in their articles here and elsewhere. Of course, employing this principle requires controlling all three variables effectively, which is often easier to attempt than to attain.

Much is opaque in the archaeological record; put another way, despite the optimism forty years ago, there seems to be a lot of human behavior that is not encoded in the archaeological record. For instance, more than twenty years ago, one of us (Sandweiss) found that an eighty-year trajectory of landscape alteration in coastal Honduras had operated in tandem with the local land-tenure system to alter social structure. The resulting changes would have left little if any material trace. Without prior knowledge of the traditional land-tenure rules, these changes could not be interpreted even were they recognized. And it took several months interviewing live informants before he could even ask the right questions!

The complex ways in which people react to changes in their environment mean that not all climatic change and not all catastrophes are bad for everyone. Sheets makes this point in his discussion of the variable response to volcanism, as do Billman and Huckleberry in their discussion of the agricultural impact of El Niño floods in the different valleys of the Peruvian north coast. Drawing on the work of Sandweiss and Richardson (1999; Sandweiss 1996), Roscoe stresses the latitudinal gradient in El Niño impacts along the Peruvian coast, noting that for each event there is usually a point north of which the constraints imposed by El Niño outweighed the opportunities the event offered for political entrepreneurs, while to the south the reverse obtained. Similar to Yaeger and Hodell, these authors have pointed to the opportunities that "catastrophes" may provide for political entrepreneurs.

Knowing the right questions is critical to pursuing these issues. All of the chapters in this book raise specific as well as general questions about prehistoric human-environment interaction and point to ways to answer them. James Kiracofe and John Marr's paleoepidemiological hypothesis is a case in point. They resurrect an issue long thought resolved and implicate El Niño along with imperial policy in nothing less than the downfall of the

Inca empire, potentially mitigating the “Black Legend” of Spanish destruction in the New World. That El Niño brings disease to the coast of Peru and Ecuador, along with flooding, plagues of insects, snakes, crop rot, and social and economic disruption is well known by now. Those dealing with the effects of the 1982–83 or 1997–98 events are certainly aware of these facts, as are regional historians concerned with climate. Until now, however, no one thought to pursue the prehistoric impact of El Niño on epidemic disease, and there have been only a few studies on the effects of epidemics on empire.

The Kiracofe and Marr chapter also points toward another source of useful information in understanding El Niño and the fate of Andean and other civilizations: the ethnohistoric record. The instrument record for El Niño covers little more than a century, so historic and ethnohistoric sources are critical in gaining a longer-term perspective on events and social consequences to use as analogies in interpreting archaeological evidence. By 1978, when William Quinn and his colleagues used Peruvian and Ecuadorian historical data to make the first modern chronology and rating of El Niño events that have occurred since the Spanish Conquest, archaeologists had already evinced considerable interest in the potential explanatory power of El Niño (e.g., Parsons 1970). Quinn et al.’s (1978) concern was principally climatological, and some of their specific attributions have been challenged. With modifications, however, the revised Quinn et al. (1987) chronology remains the standard against which other proxy records for the last 450 years are judged, for instance, the Nile River discharge record (Eltahir and Wang 1999; Quinn et al. 1992). For the human response, ethnohistoric sources have been tapped but by no means exhausted. A case in point is the first major El Niño event of the Post-Columbian period, which devastated northern Peru in 1578. Huertas Vallejos (1987, 2001; see also Copson and Sandweiss 1999) has published and commented on the extant portions of a Spanish colonial administrative document detailing the effects of this sixteenth-century event in northern Peru.

A related approach to studying the human reaction to El Niño or similar events is conducting research in ethnoarchaeology: to look at what happened to particular sites during recent, documented events and try to recover material correlates of the environmental processes and linked human behaviors. There are few such studies for El Niño in the Andes. For the project that resulted in his co-authored article on subsistence strategies in Late Pre-Ceramic Peru (Quilter and Stocker 1983), Terry Stocker interviewed a number of local fisherman in the central coast village of San Bartolo regarding their observations prior to El Niño events. Informant interviews by Sandweiss and historical records indicate that in the Saña Valley on Peru’s north coast, the coastal village of Lagunitas had three different locations during the twentieth century, with the move from one to another precipitated by El Niño flooding. There are surely many more such sources to be tapped to enrich our studies of how earlier inhabitants of the Americas responded to catastrophes. In the present volume, the careful observations made by Wilkerson during massive flooding in Veracruz and in its aftermath are a case study of ethnoarchaeology that, while done under duress, will have many implications for future research in the region and beyond.

Many of the points we raised above are true for any scholarly endeavor. Finding new questions to ask leads to new answers and also to new questions. In raising new questions, we must be sensitive to the fact that analogy is not explanation but offers us interesting ways to think about our subject matter. Interdisciplinary studies almost always are advantageous in examining complex phenomena, but they are difficult to carry out for a variety of reasons. These issues are true for every field, whether it be searching for water on Mars or determining who wrote Shakespeare's plays. The study of past human behavior carries its own special burdens for investigators, however.

The impulse to explain human variation as the result of geographical conditions or natural processes has been with us since at least the time of Hippocrates' (460–377 BC) treatise *On Airs, Waters, and Places*. At the other end of the spectrum of causality, free will has been cited to explain why humans do what they do since the Garden of Eden. More recently, the New Archaeology, with its emphasis on culture as a form of adaptation, trended toward mechanistic, deterministic explanatory modes while Post-Processual archaeology has veered toward the other extreme, seeing human agency as trumping environmental determinism. Granted, individual arguments have been more subtle than either of these two generalized statements, but these do seem fair enough to characterize trends.

In organizing the symposium and editing this volume, we have been sensitive to the extremes of the bell curve of explanatory modes. Archaeology has great resources in tracking change but the nature of its data often makes causation, especially the working of human agency, very hard to discern. We realize that human decisions often conflict with what might appear to be "rational" choices, using the criteria of Western science. For example, Fagan's (1999) argument that small, egalitarian bands have more options than do larger societies with greater investments in immovable, large-scale infrastructure, is only true in a generalized way. In fact, small societies may have their own constraints imposed from within, based on an internal logic that is hard to assess from the outside and at a distance. The ultimate issue is how flexibly a society adapts to new and changed conditions, not its size or a generalized notion of "egalitarianism," per se.

Catastrophism is a "big picture" in more ways than one, whether we are referring to a theory of culture change or a specific event that affected human lives. Such events are, by definition, large-scale, short-term, and, quite often, dramatic in their effect on the landscape and the people who dwell in it. Even in the face of an erupting Vesuvius, however, some people have more options to escape disaster or, sometimes, even turn a profit out of it, than do others. Thus, sociocultural factors always are at play in the face of "natural" events. The anthropology (and archaeology) of disaster is a growing field (e.g., Hoffman and Oliver-Smith 2002; Bawden and Reycraft 2000).

In studying reactions to catastrophes, we are focusing on case studies of how humans, in general, react to sudden events. There are probably as many ways to react to events as the events themselves. We may posit, however, that there are three major approaches to catastrophes (see also Sheets, this

volume, on Burton et al.'s [1978] stages of Loss Absorption, Loss Reduction, and Radical Action). The first is flight—abandonment of the area affected by the event in question. The second is adaptation, in which changed conditions are recognized and people reconfigure their strategies for survival and prosperity in this new context. A third approach might be termed restoration, in which attempts are made at regaining material and sociocultural losses in order to reestablish, as much as possible, pre-disaster conditions. How well archaeologists and other scientists are able to identify such strategies is hard to assess. What we might term neo-catastrophism is in its infancy. Such a field recognizes the complex interplay between culture and environment as continuous. It is multidisciplinary incorporating both contemporary events and the record of ancient ones.

From the nineteenth through the twentieth centuries, catastrophism, in one variation or another, has been pitted against evolutionism in its gradualist mode. Geologists and evolutionary biologists, by and large, have rejected this binary opposition and recognized that past change includes periods of both drastic, rapid change and more slowly evolving processes. In our own lives we have witnessed slow cultural processes, such as the economic and political growth of China. We also have seen relatively slow developments capped by very rapid change, such as the slow decline and then quick collapse of communism in the former Soviet Union and Eastern Europe. We also have witnessed what appear to us as slow environmental degradation (which actually is quite rapid in geological terms) and dramatically short changes brought on by environmental disasters that occurred on huge scales, such as the December 26, 2004 Indian Ocean tsunami.

Several authors demonstrate that El Niño patterns are far more irregular than previously thought. This point is as sobering as the message that other environmental changes are equally erratic, at least from our small-scale human perspective and relatively short chronological vita. A number of inferences may be drawn from this volume which may be relevant to national and international environmental policies and other matters; we leave it to individual readers to draw such conclusions as they see fit. For academic purposes this volume teaches that neither a simplistic return to catastrophism nor a complete denial of the role of natural forces in the affairs of humans can explain large-scale changes in the past. Human societies are rarely the passive victims of natural forces, but they also are not completely immune to them. To explain many small- and large-scale changes in the past, we must look to both nature and nurture and their interactions.

The scope of this book and the conference are limited in their ability to raise the questions and explore the issues presented above. Many other case studies, theoretical issues, and methodological considerations could not be included due to space and time limitations. We and all the participants do hope and believe, however, that by raising these issues we will contribute to discussions of human-environmental interactions in our own fields and in the greater realm of scholarly discourse.

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