Preface

PREFACE•

The current volume brings together papers presented at the AGU Chapman Conference on "Climates, Past Landscapes, and Civilizations," held in March 2011 in Santa Fe, New Mexico. We wish to thank all participants and organizers of the conference and are grateful to all contributing authors, reviewers, and editorial staff who have helped to produce this book. The meeting was attended by more than 100 scientist-scholars and journalists across the fields of Earth sciences, anthropology, and archaeology, with the overarching goal of enhancing the cross-disciplinary dialogue on the history of complex interrelationships between humans and their environment. Discussions, thematic group sessions, and answers to individual questionnaires revealed differences among disciplines on the design, methodology, and interpretation of research, but also pointed out a strong collective interest to develop collaborative pathways towards bridging any perceived disciplinary divides.

Research on the history of interactions between humans and the environment is intrinsically interesting to diverse audiences, and thought-provoking for the wider public. The fate of past cultures also presents us with completed complex experiments that provide a wealth of data for exploring models of the resilience and sustainability of coupled socio-environmental systems. At a time when climate change, over-population, and scarcity of resources are increasingly affecting our ways of life, the lessons of the past provide multiple reference frames that may be valuable for informing our future decisions and action plans. Despite this wide interest and investigational potential, collaboration across disciplines is uncommon, and adequate funding to explicitly support this style of interdisciplinary research remains scarce. The two broad fields of inquiry, Earth sciences and archaeology, have distinct customs and rhythms of publishing and discussion of new ideas and hypotheses is mostly accomplished within non-overlapping professional societies. Consequently, Earth scientists and archaeologists experts in these fields analyzing the same phenomena at different temporal and spatial scales, rarely overlap effectively in planning and executing their research. Information outside each of these disciplines is used at a level below its potential and in the process, the complexity of phenomena is diluted. Solutions to bridging this divide are not simple but not beyond reach and may include a wider presentation of existing interdisciplinary research to multiple stakeholders and funding agencies, cross-disciplinary working groups within professional societies and dedicated meetings. Further progress may requitre integration and standardization of databases, and establishing new organizations dedicated to interdisciplinary research on coupled socio-environmental systematics. Both the differences and convergence of opportunities discussed during the Chapman meeting are reflected in the current volume and in other conference papers published since 2011 in the open literature.

The Early Anthropocene Hypothesis provided a larger context for presentations at the meeting. The centerpiece of this hypothesis, proposed by paleoclimatologist Bill Ruddiman in a series of papers since 2003, states that humans began to exert an influence over global climate thousands of years ago when early agricultural activities released greenhouse-gas emissions (see Ruddiman, this volume and references therein). While archaeologists have always been concerned with the interactions between past cultures and their environment, the global scope and fingerprint of these interactions suggested by the Early Anthropocene Hypothesis introduces a new level of complexity in Earth sciences and provides a path for future interdisciplinary research. In the

introduction to the present volume, Ruddiman argues for an increased role of archaeology and anthropology in validating competing models of land use. Novel use of historical information on social organization and resources, regional and global assessments of the scale and spatial distribution of past societies, as well as better criteria for discriminating between anthropogenic and natural landscapes are just a few elements that are critical for advancing this goal. Along similar lines, Cadzow (this volume) argues for research about the primary drivers of long term environmental impacts such as hunter-gatherers and agriculturists rather than focusing only on major sites or civilizations. The impact of these "unsung" societies, although more diffuse, may have left a more profound (and not necessarily harmful) fingerprint on landscapes and ecosystems.

The overlap of human agency and natural climate change on landscapes and ecosystems is often confounding and in many cases it may be difficult to disentangle. The extinction of Pleistocene megafauna and the termination of the Clovis lithic technology/culture during the Younger Dryas is one example of such complex phenomena that has elicited an active debate recently. In this volume, Boslough and colleagues present new data and argue against a recent hypothesis that proposed that a large impact or airburst caused simultaneous climate cooling, extinction events, and cultural changes at the Younger Dryas around 12.9 ka.

Although broad trends of climate changes can be detected and isolated, high-resolution records together with increased spatial coverage are revealing new, relevant aspects for the socio-environmental systems at fine scales. Along this line, Berkelhammer et al. (this volume) present a high resolution speleothem record of the monsoon regime from northeast India, and document for the first time the 4.2 ka climate event on the Indian Subcontinent against which the re-organization of the Indus Valley (Harappan) civilization may be assessed. A high-resolution climate reconstruction by Aharon and colleagues (this volume) from a speleothem from DeSoto Caverns in Alabama addresses the role of instability rather than singular climate events on the fate of Mississippian Chiefdoms in the Southeast United States.

Sea level changes represent a cumulative and more gradual aspect of global climate variability, often with profound local effects on culture. Landscape formation in coastal settings is tightly constrained by sea level variability, leading to the progressive development of habitability niches. Amorosi and Morelli (this volume) have analyzed the fate of Neolithic Cardium Pottery culture in the Mediterranean. Rollet (this volume) discusses river dynamics and estuary development during the advent of large scale irrigated rice agriculture in the Fuzhou Basin of China.

Regional complexity requires synoptic reconstructions of climate changes and associated landscape responses for in-depth examination of their links with cultural events. High-resolution geospatial imaging, areal expansion of paleoenvironmental databases, their integration with archeological meta-information and scenario-based modeling of coupled socio-environmental systems are increasingly applied to advance these research directions. Maemoku et al. (this volume) couples high-resolution terrain models with estimates of river flow and chronologies of eolian landforms to provide constraints on the interpretation of the Ghaggar-Hakra Valley as the lost, legendary Sarasvati River of the Indian Vedas. A common mechanism for regional climate change in the West Asia and Indian monsoon domain is proposed by Staubwasser (this volume), after analyzing the last 5000 years of reconstructed Indus river outflow and water column stratification in the Red Sea. In a related study Lemmen and Khan (this volume) model the

transition to agriculture in the Indus Valley region, taking into account the biophysical forcing factors as well as socio-technological innovation, migration, population and subsistence changes. The modeling approach by Berking and colleagues (this volume) employed downscaling of atmospheric general circulation model (GCM) results to investigate the rise and fall of the city of Naga along the middle Nile of Sudan during the first millennium BCE.

The cause-effect relationships between climate and human history are often non-intuitive, and multidisciplinary approaches are required to reconstruct them. An unexpected relationship between climate and the Siberian Scythians is revealed by Panyushkina (this volume), who posits a decrease in habitation in the Altai Mountains during warmer climate intervals that may have increased mobility, and possibly resulted in the development of transhumant pastoralism. In contrast, the civilizing value of prehistoric climatic stress leading to acculturation, social complexity and relocation is discussed by Nicoll (this volume) who analyzes the effect of droughts on the Neolithic culture at Nabta Playa, west of the Nile Valley, and the rise of the Pharoanic culture in Egypt. Force and McFadgen (this volume) explain that active tectonics plays a crucial role in landscape development over long time scales by providing diverse environments , and also through creative destruction events that accelerate the development of cultural complexity.

A wide array of archaeobotanical, geoarchaeological, and philological data are synthesized by Riehl et al. (this volume) to analyze the multiple drivers that have controlled the transformation of agricultural systems in northern Mesopotamia. A combination of environmental reconstructions, archaeological methods, and evidence from historical documents is also employed by Thurston and Plunkett (this volume), who reconstruct the "invisible" history of human activity under continuous pasture cover in Northern Ireland. In a review of resilience to storms in Caribbean island communities, Cooper (this volume) highlights the importance of examining cultural lifecycles from a long-term perspective that brings forward the capacity for rapid recovery rather than strategies for robust resistance to disasters. Development of novel proxies, monitoring and dynamical reconstructions are advocated in this volume: Baade discusses irrigation-linked anthropogenic soils in two contexts where their identification contributes substantially to our understanding of regional cultural developments – the high Himalaya and coastal Peru. This paper contributes to the growing body of literature that recognizes that sediments must be recognized as important components of the archaeological record; Draut et al. address arid landscapes with Aeolian elements; and Gatti and Oppenheimer address extreme events such as the Youngest Toba eruption, using a modeling method to better constrain the distribution of ash from the eruption while noting that the environmental effects remain largely unquantified due to the low resolution of the proxy measures.
.

Continuing the discussions started at the conference and in accord with many points raised in other papers in this volume, Aimers (this volume) discusses dynamic models of cultural development for the Maya, and underscores the need for close collaboration between Earth scientists and archaeologists. The broad spectrum of cultural responses to climate and landscape change ranges from collapse to transformation, and may include abandonment, redistributions and reorganizations of settlement patterns, recalibration of food procurement strategies, trade network development, migration and colonization, architectural changes, and technological

transitions. Research design should approach this complexity with an open mindset that moves beyond deterministic, processual assumptions about civilization collapse toward understanding the resilience strategies involved in past cultural transformations under interlinked external and internal stressors.

One key issue that emerged at the conference as a particularly important focus going forward is the need for developing increasingly precise and sensitive chronologies for both paleoenvironmental and archaeological data. This is important at both the "site" of the archaeology, as well as at the regional scale. Furthermore, it is imperative that archaeologists, geologists, and environmental scientists working within the same region increasingly collaborate in data collection, assessment, and synthesis. This will help temper disciplinary biases, and allow opportunities for new observations and theoretical developments based upon a better understanding of the complexities of human-environment interactions.