Symposium: Catastrophism, Natural Disasters, and Cultural Change

John Grattan and Robin Torrence

The aim of this session is to examine both the short and long-term consequences of extreme natural events on patterns of cultural change. Archaeological theory about the pace and character of cultural change generally focuses on processes which are internally generated and which unfold slowly through time. Since environmental determinism has fallen out of favour, theories about social evolution pay very little attention to external, nonhuman factors nor to random factors. Little or no consideration has been given to the effects of one-off natural disasters. In contrast, a number of theoretical perspectives involving catastrophism, chaos, punctuated evolution, etc. provide a range of alternative views that focus on the effects of random events. One of the goals of the symposium is to assess the value of these theories for explaining the impacts of natural disasters on cultural change.

Through extended discussions following short presentations of case studies representing a very broad coverage in spa chronological and cultural terms, the participants will consider a range of general questions. How and in what ways natural hazards affect human societies? Have natural disasters played an important role in human evolution? Do nat disasters have only short-term, limited effects or should they play an important role within general theories about cul change and human evolution? How does the level of severity of disasters affect the nature of cultural response in var kinds of societies? What is the relationship between societal complexity and cultural responses to natural disasters? simpler societies more resilient in the face of catastrophes than complex societies? In what ways do the short and lor effects of natural disasters differ? Have societies adapted to hazardous environments and if so how?

By bringing together a broad range of case studies from around the world and by taking in the widest possible range periods and disciplines, we expect a varied and lively set of responses to these important questions from both the par and the general audience.

The AD 79 eruption of Mount Vesuvius: Who has been affected?

Penelope Allison

Mt Vesuvius has had numerous eruptions, and the notoriety of the largest and most famous eruption during the early Roman Empire stems mainly from its historical recording, one of the earliest written descriptions of any volcanic eruption. The extensive material record of its effects on human life - in the remains of the towns of Pompeii and Herculaneum, and in the surrounding rural and luxury villas, first revealed to the modern western intellectual world in the early 18th century - can also take credit for this fame.

While this specific eruption had a devastating affect on Campanian society in the 1st century AD, its impact on wider Roman commerce at that time had probably been less dramatic. Nevertheless, it has had a fundamental, and perhaps unwarranted, impact on modern approaches to the socio-economics of the Roman world. It has had a major influence on 18th- to 20th-century European art, culture and sense of identity; and it continues, through this sense of identity, to play important role in the cultural and economic development of the region today.

The eruption of the Santorini volcano and its effects on Minoan Crete

Jan Driessen

In the Second Millennium B.C., an earthquake appears to have triggered a massive eruption of Santorini volcano. The immediate consequences of this eruption on Cretan society during the Late Minoan I period are difficult to identify, although Theran ash has shown up in an increasing number of sites. The long-term effects of the eruption have recently become more comprehensible thanks to a reconsideration of archaeological material. Certain features of the archaeological record, taken in isolation, hardly drew attention in the past. The combined picture, however, results in a pattern underlining a period of stress. Changes in architecture, storage and food-production, in artisan out-put, in the distribution of prestige items, in administrative patterns and in ritual manifestations can be pinpointed. These may and should be translated in disturbances in the political, economic, cult and security-related domains. It is argued that the inability of the Minoans to adapt to changing circumstances caused by the earthquake and following eruption of Santorini led to an increase of crisis-related situations. This culminated eventually in the

widespread fire destructions, which brought the palatial phase of Minoan civilisation to an end and opened the way for the Mycenaean domination of the Aegean.

Under the volcano: Pacific people and their environment

Jean-Christophe Galipaud

This paper discusses the environmental conditions which could have influenced the colonisation of Remote Oceania by Lapita seafarers as illustrated by the recolonisation of lands affected by natural catastrophes in a later period. The rapid colonisation in the Lapita period of the non-volcanic islands of southern Melanesia could have been caused by the desire to escape from a hostile, volcanic environment. The more recent example of Kuwae in Vanuatu shows that mobility and networks of alliances permitted societies to survive catastrophes although these often provoked major changes in traditional land ownership. Oceanic societies are seen here as continually changing since cyclones and volcanic eruptions are as natural a way of life as are war and death.

Volcanism, environmental forcing and the archaeological record

John Grattan

During the summer months of 1783 AD toxic gases emitted from the Laki Fissure in Iceland and several Italian volcanoes had a dramatic and severe impact upon the European environment. Toxic gases and aerosols were transported far from the volcanic sources and deposited in sufficient concentration to cause severe damage to human health and a broad range of vegetation. Documentary evidence from Britain, France, Germany, and the Netherlands for these phenomena are presented and discussed. It is shown that the acid fog of 1783 was pan European in extent and may even have extended to North Africa. It is also suggested that gases from other volcanic eruptions may have had an environmental impact in the past, and new data from Malta is presented to support this thesis. As a geohazard air pollution of volcanic origin may have had an impact on ancient peoples and environments but it also poses a modern hazard, "topping up" air pollution of human origin.

Natural disasters and culture change in the Shumagin Islands

Lucille Lewis Johnson

The Shumagin Islands are the easternmost of the Aleutian Islands, located south of the Alaska Peninsula and west of Kodiak Island. The area, located on the margin of the Pacific and North American plates, is affected by many seismic and co-seismic events, which have influenced cultural development in a variety of ways. Land has been suddenly exposed for settlement and gradually buried under the sea again, tsunamis have struck, and the food chain has been disrupted. We have clear evidence of an increase in population following a major episode of uplift; other reactions to disaster have been predicted and influence our research designs.

Earthquakes, tsunamis, and volcanism on the Aleutian Arc: Coping with the inevitable in prehistory

Rick Knecht, Patrick Saltonstall, Gary Carver, Jim Beget and Rick Davis

Catastrophic natural events were a frequent occurrence for the peoples who lived along the coast of the Aleutian Volcanic Arc. From Kodiak to Attu, Pacific Eskimos and Aleuts dealt with earthquakes, tsunamis, and volcanic ashfalls on a fairly regular basis. These were politically complex, village based societies at the time of European contact. Natural disasters in this region typically devastated local groups and/or villages but tended to leave large portions of a territory, at the societal level, relatively unaffected. We argue that these societies were able to cope with episodic stress by maintaining social ties across great physical distances. Their use of boats effectively shrank the social landscape. With boats people could access and utilise areas less impacted by natural disaster. In this paper, sites from the Kodiak Archipelago and Unalaska Island in the Aleutians are examined and the relative impact of tectonics and volcanism on the prehistoric sequence is assessed.

Volcanic impact of Holocene explosive eruptions on natural environment and human societies in Japan, with special reference to the great Kikai eruption

Hiroshi Machida

Tephrochronological and archaeological studies in Japan have demonstrated that many explosive eruptions and associated hazards were significant for changing natural environment and human societies in prehistoric and historic times. Of many Holocene explosive eruptions recognised so far, the 7ka Kikai Akahoy, a tephra eruption, would have been the greatest in the Japan area. This tephra occurs in marine and terrestrial deposits at various localities in southwest and central Japan and adjacent seas. This isochron provides the definite datum plane in the Neolithic archaeological sequence over an extensive area and indicates clearly that a great volcanic hazard occurred in prehistoric Kyushu and adjacent areas. Combined tephrochronological and archaeological studies indicate that a major cultural discontinuity between the pre-tephra (Earliest Jomon) ceramic culture phase and the post-tephra (Early Jomon) phase. It appears that people of pre-tephra Jomon culture in southern and central Kyushu either dispersed to the adjacent areas where volcanic impact was not so severe, or totally perished in the areas of greatest impact. There is plentiful evidence that the tephra fallout and flow and co-earthquake with tsunami induced significant changes in landscape over a vast area with a major decline in natural productivity over the region.

Volcanoes and history: A significant relationship?

Stuart W. Manning

Although volcanic eruptions are dramatic and violently destructive locally, during the Holocene they have in general had little long-term, significant impact on European human history. If you were in Pompeii or Herculaneum in A.D.79, you were in trouble - if not, it mattered little. However, a few periods over the last 5,000 years when there seems to have been a marked increase in global volcanic activity might offer exceptions to this general rule. In some cases, such as the 17th century B.C., scholars have noted a coincidence of evidence for volcanic activity and systematic cultural change, especially in the eastern Mediterranean region. It may further be argued that in the appropriate circumstances even a relatively minor climatic change could create a crisis situation in a pre-modern context. In exploring whether mid-second millennium B.C. volcanic activity was linked with significant historical effects, however, we encounter a key theoretical problem given current paradigms and datasets: volcanic eruptions are specific 'point' events in the past, whereas the archaeological record reflects a palimpsest of events and processes. The paper will discuss how bringing these together is inherently problematic as they represent fundamentally different facets of historical reality.

Lake Constance transgressions as the cause of abandonment of the Arbon-Bleiche 2 Early Bronze Age lacustrine village

Francesco Menotti

The lake-dwelling chronology in the Alps stretches from the Neolithic to the Early Iron Age but the entire phenomenon is not seen as continuous. There are in fact periods when the lakeshores were abandoned and subsequently reoccupied, a pattern dependent on cultural as well as environmental factors with climate playing a crucial part. The northern Alpine region shows a marked discontinuity along most of the lakeshores; two relevant breaks in lakeshore occupation are known within the northern Alpine region Bronze Age. The first occurred between the 24th and the 20th centuries BC, and the second from the 15th to the middle of the 13th century BC. The Early Bronze Age site of Arbon-Bleiche 2, situated on the southern shore of Lake Constance, was abandoned immediately before the second major occupational gap in 1508 BC. Two other Early Bronze Age sites on the German part of Lake Constance, follow a similar chronology in occupation, both being abandoned in the last decade of the 16th century BC.

A possible cause of abandonment is discussed in this paper using an environmental approach related to an abrupt change of climatic conditions which resulted in an increase of the lake levels which forced prehistoric populations to leave the proximity of the lake shores. Following the implications of sedimentological analyses, the transformation of the Bronze Age landscape caused by the lake water invasion will be simulated with the help of GIS computer programs and the slow process of landscape transformation graphically displayed as it might have happened at the time.

Narrating a disaster

Klaus Neuman

In September 1994 the Rabaul volcano in Papua New Guinea erupted. At least five people fell victim to the erupting volcano and a nearby town and about a dozen villages were almost completely wiped out. Very soon after the beginning of the eruption, competing narratives about the cause and course of the event emerged. They were written down, told, sung, and painted. In my paper, I compare and contrast some of these narratives: by survivors, volcanologists, primary school students, journalists, relief workers, and others.

The end of the Bronze Age by large earthquakes

Amos Nur

Twentieth century geophysical data about the geography of active tectonic faults especially at geological plate boundaries, the location of earthquakes, the geography of ground motion intensity, and earthquake frequency-magnitude statistics in the eastern Mediterranean show that most of the sites that collapsed at the end of the bronze age must have experienced destructive earthquakes repeatedly in their past. Recent and historical evidence shows that these massive earthquakes reoccur every few hundred years in bursts, or "storms" of large events that sweep across broad portions (500 to 2000 km in length) of the eastern Mediterranean, and over short periods of time (ca. 50 years). This suggests that large earthquakes could have (and probably did) contribute to the physical and political collapse of the centres of civilisation at the end of the Bronze Age. This probably began by an earthquake storm that unzipped the plate boundaries in the eastern Mediterranean between 1225 BC to 1175 BC. The earthquakes in this ca. 50 year long storm could have rendered many of the urban centres militarily vulnerable, thus inviting attacks which in turn may have led to the political and social collapse of the centres, followed by a dark age of recovery and rebuilding.

Armageddon's earthquakes

Amos Nur

Archaeoseismology, the commingling of geological information with archaeological evidence and historical writings, is most effective for sites that are geologically well understood, extensively excavated, and rich with written records. Armageddon, meaning mount Megiddo in Hebrew is perhaps the most fascinating example for such a site, situated at the only mountain pass that permitted passage of chariot traffic to Egypt. Megiddo's strategic topography is due to active faults that created the prominent Carmel-Gilboa mountain range that cuts obliquely across Israel. The easiest passage through this range is at Megiddo. Because these faults are seismogenic, earthquakes are indirectly responsible for Megiddo's importance.

But these earthquakes are also responsible for Megiddo's repeated destruction. The evidence includes collapsed buildings, regional devastation, and crushed skeletons. Linking war and earthquakes at Armageddon is found also in the Bible [Revelation 16] "And he gathered them into Armageddon and there was a great earthquake such as was not since men were upon the earth…And the great city was divided, and the cites of the nation fell." The famous Apocalypse may have been a retrospective prophecy based on a historical earthquake, perhaps during an actual battle. Megiddo's earthquake and archaeology mix exemplifies how geological and earthquake evidence must be used to better understand archaeology.

When the sky turns black and the rain turns to ash: cultural responses to volcanic disasters in the lowland tropical forests of Papua New Guinea

Christina Pavlides

Archaeological research in the lowland tropical rainforests of West New Britain, Papau New Guinea has explored the relationships between four far reaching and undoubtedly devastating tephra events and changes in the technological organisation of flaked stone assemblages during the Holocene period. Despite the random and unexpected nature of these natural disasters, a linear progression in economic organisation can be observed. Each Holocene cultural episode entailed a new technological configuration in which resources were used to their best advantage and the landscape visualised in a different way. It is argued that the volcanic events affecting the rainforest region resulted in mainly short-term problems for local inhabitants whilst also conferring other long-term advantages. Some of the short term effects of volcanism, including damage to plant and animal resources and the

destruction of gardens and wild plant stands, can be compared to the long term necessity of having to develop alternative and more robust economic pursuits, social strategies and buffers. Considered in this way random catastrophic events appear to have formed an advantageous backdrop for the process of linear evolution in this region, thereby providing a forum for long and short-term cultural responses to natural hazards.

Volcanic winter in the Garden of Eden: The Toba super-eruption and the Late Pleistocene human population crash

Michael R. Rampino and Stanley H. Ambrose

The Toba eruption (~73,500 yr BP, Indonesia) was the largest explosive eruption of the last few hundred thousand years. Several lines of evidence suggest that Toba caused a 'volcanic winter' with possible abrupt regional coolings of up to 15^{o}C, and global cooling of 3 to 5^{o}C for several years. Ice-core data suggest that Toba may have contributed to the initial severe cooling of a millennium-long cold event, suggesting involvement of climate feedback responses such as ocean cooling, and increased sea ice and snow cover. Botanical studies and model simulations suggest that the local and regional effects of the predicted post-Toba cooling would have been disastrous for vegetation, destroying most cold-sensitive plants, and temperate and sub-arctic forests as well as causing severe drought in the tropical rainforest belt and in monsoonal regions. These results constitute a global ecological disaster, with expected reductions in standing crops of plants and animals especially in the tropics that may be detectable in high-resolution palynological records, coral reefs, and ice cores.

Human genetic studies indicate that sometime prior to ~50,000 years ago human population suffered a severe population bottleneck (possibly only 3,000 to 10,000 individuals), followed eventually by rapid population increase, technological innovations, and migrations. The climatic effects of the paroxysmal Toba eruption could have caused the bottleneck. The severely reduced and isolated populations surviving this cataclysm in small refugia in Africa and Eurasia would have undergone genetic drift and local adaptation, resulting in rapid racial differentiation, and the event might have been a catalyst for the technological innovations and migrations that followed.

On the historical role of earthquakes and of other natural phenomena in the Eastern Mediterranean

Stathis C. Stiros

The decline or destruction of ancient cities and civilisations in the Eastern Mediterranean has often been assigned to earthquakes, volcanic eruptions and other natural phenomena. The destruction of the Minoan world by the Theran eruption; the decline of the Mycenean world following earthquakes and sea-level rise; the loss of Helike due to earthquakes, subsidence, and tsunami; or the correlation of cultural peaks and lows with climatic oscillations are the most glossy examples. A detailed examination of these cases indicates that the proposed causative relationship between natural phenomena and historical events is due to biased, exaggerated or incomplete data and speculations. Yet, sometimes earthquakes did trigger social unrest which may have caused the decline of cities; seismic coastal uplifts put harbours out of use; hydrological changes caused by earthquakes or sea level rise led to the abandonment of springs and wells and hence of whole sites; over-exploitation of woods and wild fires led to the abandonment of mines, the loss of cultivated ground, and abandonment of sites. Hence, natural phenomena certainly had important direct historical impacts, but at a local scale only. In contrast, their catalysing and indirect role was important only when natural resources were limited and the social organisation in crisis.

Do disasters really matter? A long-term view of volcanic eruptions and human responses in Papua New Guinea

Robin Torrence

Most research into the role of natural disasters in prehistory focuses on single outstanding events and their relatively immediate consequences. In contrast, recent work in West New Britain, Papua New Guinea has examined the long-term consequences of 12 stochastic catastrophes (volcanic eruptions) with varying degrees of severity on patterns of cultural change during the past c.10 000 years. Ethnography and oral history suggests that the societies living in the vicinity of an active volcano, which has erupted at least 5 times in the past 500 years, have made adjustments that have enabled survival in this hazardous environment. At the time of European contact population sizes were low and since groups had been frequently displaced, there was much competition and rivalry over large areas of unoccupied land. The prehistoric record presents a different picture with complete abandonment over vast areas for relatively long periods after each of 3 events between 6,000 and 1,100 years ago. The purpose of the paper is to

examine the factors that have caused these variations in human responses to volcanic eruptions and to consider the role of random events in structuring the long-term history of this region.

Disaster archaeology in Japan

Satoru Shimoyama

The relationship between volcanic disasters and prehistory has long been studied in Japan. Early in this century it was realised that because Jomon and Yayoi pottery were stratigraphically separated by known tephras from Mt. Kaimondake, they formed a chronological sequence. In the 1970's the massive eruption of Kikai caldera was considered to have had a major impact on culture change, but only recently has archaeological research been carried out to study in detail exactly how societies reacted to this event. It is important that in addition to the natural science reconstruction of an event, archaeological research is also carried out to study how people in the past assessed and adapted to this disaster. By considering the example of recent work at the Shimuregawa site, I will demonstrate how archaeological research aimed at reconstructing how people assessed and adapted to a volcanic event can contribute to a new theory about the role of disasters in cultural change.

Volcanic disasters and historical contingency: the prehistoric record of differential response to volcanic eruptions in Western Ecuador

James A. Zeidler and John S. Isaacson

This paper examines settlement data for cultural sequences in several river valleys of the western Ecuadorian lowlands for purposes of (a) comparing valley-wide settlement processes and their social, economic, and political contexts, and (b) demonstrating fundamental differences in developmental trajectories. Rather than viewing all sequences as uniform trajectories of increasing social complexity along a continuous evolutionary path, we argue that certain regional sequences were either truncated or interrupted due to the variable short-term and long-term effects of volcanic eruptions, which blanketed portions of the western lowlands. Based on recent compositional analyses and stratigraphic correlations of volcanic tephras derived from numerous archaeological sites, we suggest that vast areas of the western lowlands were subjected to extensive volcanic airfalls from at least four eruptions originating in highland Pichincha and Cotopaxi Provinces. Preliminary studies indicate that cultural responses to these tephra fallouts vary in relation to the intensity and timing of the event, as well as the complexity of socio-political organisation and subsistence adaptation of the peoples occupying their path. These differential responses highlight the importance of historical contingency in shaping the archaeological record of prehistoric settlement process as well as the complex interaction between cultural systems and their environment.