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## CLIMATIC CHANGE — MEXICO

### FIRST INTERNATIONAL CONFERENCE ON CLIMATIC CHANGE IN MEXICO, TAXCO 1993

*Guest Editors*

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**CLIMATE CHANGE — MEXICO  
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**PERGAMON**

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## THE IMPACT OF CLIMATIC CHANGE ON PAST CIVILIZATIONS. A REVISIONIST AGENDA FOR FURTHER INVESTIGATION

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This article outlines some of the current discussions regarding climatic change and civilization responses. Recent data from the Near East and Northern Africa on one hand, and from Mesoamerica and the Andean Region on the other, are reviewed and discussed in order to obtain a general picture of issues currently open for debate. © 1997 INQUA/ Elsevier Science Ltd

### INTRODUCTION

In this paper, some personal and undoubtedly controversial ideas will be put forward on the relationship between climate change and early civilization collapses, using some recent research examples (Tainter, 1990). The International Geosphere–Biosphere Programme has proposed the PAGES project for past global changes as one of its core projects (IGBP, 1992). Its goals are the reconstruction of a climatic and environmental history during the glacial cycles of the Pleistocene–Holocene, the assessment of the natural processes associated with climatic change, as well as a detailed climatic history for the last 2000 years. Archaeology, working with close ties to palaeoenvironmental studies (particularly pollen, phytolith, botanical and faunal macrofossils), allows an understanding of those millennia when human societies were affected by climatic, marine, and solar variations, or in those cases where they acted as prime movers in altering their environments.

The study of past global changes (Bradley, 1989; Moss, 1992) is particularly relevant during the last 15 millennia, when Pleistocene human groups underwent significant transformation in their hunting-gathering modes of subsistence, during the passage to the Holocene. From predatory hunting of relatively large herbivorous herds, humans depended on the gathering and hunting of small animals; a phenomenon that modified band size and social organization. Variations in sea-level during glacial and interglacial periods also affected the settlement pattern of coastal groups primarily dedicated to the consumption of marine molluscs.

The so-called 'Neolithic Revolution', in which domestication of plants and animals began, permitted the general sedentarization of groups which had formerly been semi-nomadic. In the Near East, the diffusion of sedentary lifestyles promoted an expansion of settlements in the Negev and Jordanian regions. Many ninth millennium BP village sites, still with complex cooperative systems related to stone, bone, and antler crafts, have been detected and studied in this region.

Nevertheless, the most fundamental human transformation of the environment was the so-called 'Urban Revolution' (Childe, 1973). The growth of great urban developments, one of which covered the central Basin of Mexico, is the hallmark of this type of civilization. These were not however new phenomena. Some ancient cases of early urban developments, their impact on environmental change, and also their fragility with respect to climatic change will be reviewed (Manzanilla, 1993).

### MESOPOTAMIA

Mesopotamia lacked rocks, metals and minerals, and from very early periods, the Neolithic societies of these great deltaic and alluvial plains had to participate in extensive long-distance exchange networks to obtain raw materials ranging from the roughest basalt, for grinding tools, to the gold used in elite art objects for the rulers (Manzanilla, 1986b). The first proto-Sumerian cities of the Lower Mesopotamian plain grew on ancient settlements near the great rivers, elevating their living sites more and more to protect them from floods. The Tigris and Euphrates regimes are erratic; changes in their courses provoked massive abandonment of settlements; catastrophic floods — one of which ravaged Baghdad in 1954 (Buringh, 1957) — destroyed demographic clusters constructed with mudbricks. Flood strata observed in Kish, Shurruk, and Ur (Raikes, 1966) can be explained by meteorological and hydrological factors, as well as tectonics. Changes in exchange routes, so vital for Mesopotamia with respect to the supply of raw materials, also caused site abandonment.

These factors strongly affected the mentality of the inhabitants of Mesopotamia who, unlike the Egyptians, saw nature as a domain of constant and menacing changes, so that humans were always subject to the whims of the gods. Furthermore the inhabitants of Mesopotamia could only occupy this portion of Iraq thanks to the use of irrigation techniques. The cultivated areas were located in the flood basins on both sides of the

riverbanks. Yet shifting channels created dendritic systems on their back slopes that cut minor depressions, inhibiting superficial drainage. This provoked a high level of salty phreatic water and the precipitation of salts on the surface. A part of these salts was brought by rivers and irrigation waters from sedimentary rocks in the mountainous, northern watershed. Another portion of the salts came from marine transgressions or was transported by aeolian agents from the Persian Gulf. When this water evaporated, calcium and magnesium were precipitated in form of carbonates, predominantly sodium. This tends to be absorbed by colloidal clay, resulting in a structureless soil, nearly impermeable to water. Salinization of soils was inevitable.

Three salinization phases have been monitored; the earliest from 4400 to 3700 BP, which provoked the shift of the major centres of power from the south to the centre of Iraq. The consequences of salinization led to the decline of wheat cultivation in the southern plain as this is least resistant to sodium. For a shorter time, barley, a more resistant crop, was the main plant grown, but even this declined and vast areas suffered desertification (Jacobsen and Adams, 1958). The history of Sumer thus came to an end; a history so much based on urban life as a hallmark of civilization. The later history of the region is characterized by a new stage, a dimorphic state including both nomads and sedentary people (Rowton, 1973).

From the viewpoint of climatic change, other factors were added to these anthropogenic and sociopolitical transformations. Recently a group of scholars, who have worked throughout the Near East, have assessed major climatic changes in the region. By the end of the fifth millennium BP, a catastrophic collapse of Early Bronze Age societies from Turkey to India coincided with a severe shift towards a drier climatic era. Volcanic eruptions have also been detected in some regions. Lamentations of famine and drought characterize this epoch. Almost all the cities and towns in western Palestine were deserted (Rosen, 1993). The decreased frequency and amount of rainfall changed the hydrological regime, eliminating the buffering effect of floodwater farming. Primary data for the study of this climatic change comes from pollen, palaeolimnology, oxygen isotopes, and geomorphology (Rosen, 1993). Evaporation and increased salt deposition, decline of oak pollen, wadi incision, and flooding of valley bottoms are some of the phenomena related to this change.

The main issue is why societies failed to adapt to the new situation. In the Near East, there are great fluctuations in precipitation, stream flow, and crop yield from year to year. Rosen (1993) cites some of the predictable measures: diversification of crops and herd animals, food storage, retention and distribution of information on famine foods, transformation of surplus food into non-perishable items of value that can be traded for food in times of stress, and extension of the social network to allow access to food resources from other regions. Rosen notes several factors that may explain why the agricultural sectors of Early Bronze III society failed

to respond successfully to the climatic desiccation at the end of the period:

- (1) state control over surplus production,
- (2) non-diversification of subsistence crops,
- (3) loss of floodwater farming as a buffer; and
- (4) a slow response time on the part of elite managers.

The abrupt aridification of northern Mesopotamia between 4200 and 3900 BP has been well documented by Weiss (1993) and Weiss *et al.* (1993) at Tell Leilan. The effects can be traced in the disruption of pastoral transhumance, a large scale population movement into southern Mesopotamia, and the peculiar military activities of the Third Dynasty of Ur. Weiss *et al.* (1993) argue that at 4250 BP, a considerable increase in aridity and wind circulation, subsequent to a volcanic eruption, induced degradation of land-use conditions resulting in: decreasing per capita yields, displacement of sedentary pastoralists from the Khabur region; the collapse of the Akkadian dry farming; further Akkadian imperial collapse in the south; the invasion of the Gutti and Amorrites into southern Mesopotamia and finally, collapse of Ur III intensive agriculture also in the south. Desertion of various sites was inevitable.

Archaeological indicators of aeolian deflation under drier conditions have also been recorded by Courty (1993), who shows that sequential pedostratigraphic deposits from archaeological sites in northern Mesopotamia, dated by ceramic chronology and radiometry, provide micromorphological evidence for abrupt wind, temperature, and humidity changes coincident with the abandonment of sedentary urban settlements. Furthermore, the climatic shift documented about 4000 BP, has also been detected in the Rajakhstan lake pollen sequences, near the heartland of the Indus civilization in Pakistan, and related to salinization and the collapse of the Harappan civilization (Possehl, 1993). In the Aegean region, the rise of Minoan palaces apparently coincided with climatic and geomorphological changes, as well as with soil erosion and the cultural dislocation of late third-millennium societies (Manning, 1993).

## EGYPT

The severe aridification that produced the Saharan desert, and also the Negev and Jordan deserts, during the eighth to sixth millennia BP, strongly affected sedentary life by making it impracticable except in sites where perennial water sources were present. The Saharan lacustrine basins of the Early Holocene were converted into oases surrounded by deserts, and the groups of fishermen, gatherers, hunters and herders were obliged to migrate to the only permanent source of water; namely the Nile river (Manzanilla, 1982, 1986a; Butzer, 1994). Out of this fortunate congruence of groups of different origins, one of the most outstanding civilizations of ancient times, that of Egypt, emerged about 5000 BP.

The mixing of groups of different origins gave rise to a heterogenous society in its beginnings, which soon became organized with a mixed economic base focused

on the cultivation of grain and leguminous plants, the breeding of cattle and pigs, the gathering of fruits, river fishing, and hunting of herbivores and aquatic fauna. The Nile was a key factor because it offered a unique system of hydrology, communication and settlement.

In Prehistoric times, elephants, wild cattle, antelopes, zebras, white rhinoceros, oryx, wild ass, ostrich, and giraffes roamed alluvial grazing lands, wadis, and desert plateaus. Analyzing rupestral, low relief, and figurine representations, Butzer (1980) showed a first faunal discontinuity around 5500 BP, with the decline and later disappearance of elephant and giraffe from the Nile Valley around 4700–4500 BP (Leclant and Huard, 1980).

Wilson (1964) characterized Egypt as a civilization without cities, due to the fact that population was never congregated into large demographic aggregates, as in the case of Mesopotamia, but was more or less homogeneously distributed along the Nile margins.

Unlike Mesopotamia, Egypt had mineral resources in the Eastern and Western Deserts that directly bordered the Nile Valley. From the earliest periods, Egypt turned inwards, displaying a sense of self-sufficiency and security, as a land of cosmic equilibrium, governed by a god on earth. As lord of Upper and Lower Egypt, the pharaoh was the repository of a dual monarchy, an expression of a peculiar Egyptian manner of understanding the world in dual terms, that is, in terms of a series of pairs of balanced contrasts, in an unchangeable equilibrium: valley–delta, agricultural land–desert, heaven–earth, east bank–west bank of the Nile.

While in Mesopotamia the wide open plain resulted in separatist tendencies, in Egypt the unification of the pharaonic state was a relatively easy undertaking due to the monosystemic character of the Nile Valley. While Mesopotamia was an easy prey for invading groups, Egypt had natural desert frontiers that isolated the area.

The lack of urban centres in Egypt removed the contrast of rural and urban sectors that was so characteristic of Mesopotamia. Information flow along the Nile, between the central government and the provincial administrations, favoured a network of relationships without cities, which were in part unnecessary due to the absence of market exchange.

Bard (1993) proposed that the first state collapse in Egypt, during the late fifth millennium BP, was related to climatic change, possibly exacerbated by the socio-political pathologies of the Old Kingdom. "Given a greatly increased population during the Old Kingdom, lower agricultural productivity as a result of disastrously low Nile floods and less floodplain land under cultivation caused widespread famine and anarchy" (Bard, 1993). The collapse of centralized control provoked political fragmentation. Butzer (1976, 1984) has also re-examined various texts that refer to catastrophically low Nile levels between 4250 and 3950 BP. As Malek (1986) has stated, "The worsening climatic conditions, in particular repeated low Niles, would have been a serious blow to Egypt's economy... The area of fields under cultivation diminished, the size of the harvest decreased, and the numbers of livestock were reduced."

Of course this was only one factor within a more complex process of social and political disintegration that included the collapse of centralized authority and administration, the gradual shift in the ownership of land from the central authority to cult and temple establishments, Egypt's inability to maintain its influence outside its borders (Malek, 1986), the social revolution that preceded the First Intermediate Period (Castañeda-Reyes, 1992), and so forth. As Malek states, "The worsening of climatic conditions, unfortunately, came at a time when Egyptian administration was no longer in a position to react, and so it delivered the decisive blow".

At present, the monosystemic character of the Nile Valley stimulates the proliferation of gastrointestinal diseases and generalized water contamination. With the construction of the Aswan Dam, not only has the local microclimate changed, favouring cloudiness and disastrous rainfalls where there was desert before, but the annual Nile flood has been eliminated, which had been the basic condition for the permanence of the Egyptian tradition across five millennia, and thus eliminating the natural fertilization of the agricultural lands.

## THE ANDEAN REGION

One of the phenomena that has attracted attention with regard to past global changes is the Southern Oscillation of El Niño (ENSO). El Niño events, whose impact affects the Pacific coast, caused severe problems for Peruvian pre-Inca societies; either disastrous droughts or catastrophic rains. Since the Formative Horizon in the Cupisnique Valley of Peru, there is evidence for strong El Niño events, with consequent changes in subsistence and settlement patterns. Domestic middens dated between 3300 and 2300 BP have been analyzed; the tropical molluscs, crustaceans, and fish were associated with warm water incursions. The consequent effects on the biological chains in the Peruvian cold current, and disturbances to the shore fishing technologies (Elera *et al.*, in Ortlieb and Macharé, 1992) were serious.

Later, the strong rains and floods had a considerable effect on the Chimu agricultural system, so that intensive cultivation strategies were adopted, particularly raised-fields (Moore, 1991). In coastal Peru, El Niño events reduced mollusc populations that constituted the main source of protein for Prehispanic states. Other responses of the Chimu state were the construction of irrigation systems in the Moche Valley and the agricultural expansion into other coastal valleys (Moore, 1991). Flood strata are found in some coastal sites of northern Peru, such as Batán Grande, from Chimu times (Moseley, 1987). Craig and Shimada (1986) correlate a catastrophic El Niño event with these sediments and with ethnohistorical narrations in which the end of the Naymlap dynasty is related to strong rains and catastrophic floods.

Urban phenomena in the Andean Region developed in two regions, the Peruvian valleys and coast, on the one hand, and the Bolivian high plateau, on the other. In the Peruvian valleys, different ecological and altitudinal

floors were exploited by the same community due to their autarchic organization. Thus, access to resources from the tropical forest, from the high valleys, and from the coast, was obtained by means of colonies, without the participation of markets. Thus, with some exceptions, there were no real urban centres in these valleys.

The Bolivian high plateau is exceptional for various reasons: Lake Titicaca allowed intensive cultivation in raised fields, a system probably inaugurated by the pre-Inca civilization of Tiwanaku (Kolata, 1986) in response to climatic change. There also were copper mines, a fact that favoured the emergence of metallurgic centres. Unlike the Peruvian valleys, the Bolivian high plateau is a vast open area that housed the first urban phenomenon, the Tiwanaku civilization, the capital city of which had an area of 400 hectares (Ponce Sanginés, 1981). Like the Mesoamerican urban centres, it housed non-farmer specialists.

Our recent research at Tiwanaku has revealed massive human and camelid offerings at Akapana, the site's main pyramid, about 1100 BP (Manzanilla, 1992a). We have suggested that this ritual behaviour may have been related to a strong drought that Paulsen (1976) proposed between 1400 and 1000 BP for the Andean Region. Recently, Ortloff and Kolata (1993) have proposed a model to explain the disintegration of the Tiwanaku state, between 1000–900 BP. This model takes into consideration radical climate changes, evidence from the Quelccaya ice cap data (Thompson *et al.*, 1984), and also palynological records of Lake Titicaca. These record drought conditions which would have provoked the deterioration and ultimate abandonment of the Tiwanaku agricultural systems (Ortloff and Kolata, 1993). On the other hand, Browman (1993) and others have disputed the coincidence between drought conditions and the collapse of civilization.

Thompson *et al.* (1985) presented 1500 years of palaeoclimatic information from two ice cores from the summit of the Quelccaya ice cap in southern Peru. Annual variations have been identified by the study of visible dust layers, oxygen isotopes, microparticle concentrations, conductivity, and the identification of historical ash layers (Thompson *et al.*, 1986). These cores provide "...information on general environmental conditions including droughts, volcanic activity, moisture sources, temperature, and glacier net balance". The records indicate extended dry periods between 750 and 690 BP, that may have begun in 840, 1430 and 1390 BP (Thompson *et al.*, 1985).

The measurements of the annual accumulation of snow layers, where thin layers indicate lower rainfall, show a significant change in mean moisture levels beginning after 1000 BP (Ortloff and Kolata, 1993, p. 200). Oxygen 18 measurements indicate a rise in the mean annual temperature of between 0.5 and 1°C between 600 and 1000 AD, during the period leading up to what in Europe is designated the Medieval Warm Epoch. Palynological and palaeolimnological research in Lake Titicaca supports the ice cap data for climate change. Thus, Ortloff and Kolata (1993) hypothesize that "...climate change in

the form of persistent lowered precipitation in the post-AD 1000 period was the mechanism that triggered the collapse of Tiwanaku's agricultural base and ultimately the disintegration of the state itself". They also established relative vulnerability classes for various agricultural technologies in different regions of the Tiwanaku state. In the presence of extended drought conditions, "...there is a definite temporal sequence of extinction of agricultural systems based on their vulnerability class" (Ortloff and Kolata, 1993). They also note a dramatic redistribution of population in the Tiwanaku hinterland characterized by de-urbanization, as well as a shift to increasing emphasis on camelid pastoralism to replace lost food resources.

In the Amazon and Caribbean regions, the El Niño event causes drought periods, the extension of savannas, and the isolation of forest refuges (Dueñas in Ortloff and Macharé, 1992). Occupational hiatuses have been observed in the Lower Xingú during the first centuries AD, between 1200 and 1000 BP, and lastly, between 800 and 500 BP (Perota in Ortloff and Macharé, 1992).

In the Andean case, the frequent incidence of climatic disturbances associated with the El Niño (Thompson *et al.*, 1984) phenomenon or with broader climatic changes appears to have provoked changes in settlement patterns, demographic rearrangements, changes in food practices, architectural reconstructions, adoptions of flood control technologies, and agricultural intensification, as well as ideological changes. Lumbreras (1988) proposed that the ritual exchange of the *Spondylus princeps* bivalve (also known as *mullu*, in *quechua*), a mollusc directly related to the warm El Niño currents, served as a climatic indicator to determine rain and drought cycles. The Andean oracle priests used the *mullu* and the observatories as prediction instruments.

## THE BASIN OF MEXICO

The lacustrine basins of the Mexican neovolcanic axis are ideal settings for palaeoclimatic studies and their effects on past human communities, as well as human-induced environmental changes. Sedimentary series in the Pátzcuaro, Zacapu, Hoya de San Nicolás and Lerma basins have been successfully analyzed by Metcalfe *et al.* (1989, 1991) to determine Quaternary climatic variations. Magnetic susceptibility, major cations, total phosphorous, carbon/nitrogen, carbon 13, oxygen 18, diatoms, pollen, and charcoal content have been quantified in these sequences and in the Basin of Mexico (Lozano-García, 1989; Metcalfe *et al.*, 1989, 1991; O'Hara *et al.*, 1993; Caballero-Miranda, 1997). In particular, disturbances have been observed that were due to the adoption of maize cultivation as main subsistence strategy during the Preclassic Horizon (Metcalfe *et al.*, 1989). In Lake Texcoco in the Basin of Mexico, deforestation due to agricultural field preparation techniques determined the change from pine-oak forest communities to Chenopodiaceae-Amaranthaceae and grass communities. These



were the first human-induced changes in the periglacial environment, in Preclassic times.

None of the transformations was so critical as the impact of the urban growth of Teotihuacan. One of the major preindustrial examples of urban phenomena, Teotihuacan was a planned, multi-ethnic city, 20 square kilometers in area, serving as a manufacturing, exchange, and pilgrimage centre for all the central highlands. It inaugurated a new era in the settlement history of the Basin of Mexico, with a clear separation between rural and urban sectors. The backcountry was occupied by small farming villages and some secondary centres. To find another urban centre, one had to go beyond the ranges ringing the Basin. From this time on, the process of urban growth ultimately culminated with the megalopolis that now covers a vast area of the Basin of Mexico.

The emergence of Teotihuacan as an urban centre was due to a combination of factors: the arrival of demographic surpluses caused by the eruption of the Xitle and Popocatepétl volcanoes (Martin del Pozzo, 1997), the existence of a concentration of springs in the southwestern portion of the Teotihuacan Valley, the presence of obsidian deposits, the proximity of the Texcoco lake system and its favourable location along the easiest access route from the Gulf Coast to the Basin of Mexico. At that time, white-tailed deer, different species of rabbits and hares, together with bear lived in the nearby forests and plains. They were extensively hunted by the Preclassic and Classic inhabitants of the Teotihuacan Valley.

It is interesting that the first Teotihuacan urban centre was constructed on top of a volcanic flow that covered the northern part of the valley, sparing the alluvial plain to the south for farming. Yet, the urban growth eventually spread onto the alluvial plain, with a loss of economic self-sufficiency. In addition, the buildings of the city were plastered with stucco (a form of calcium carbonate) which implies an immense demand for fuel to burn the requisite lime, so that adjacent pine and oak forest would have suffered severely (Manzanilla, 1992b). Calculations by Barba (1994) show a volume of lime plaster only for domestic purposes (the apartment compounds) of 700,000 m<sup>3</sup>, and the amount of energy needed for the transformation of limestone into lime of  $4.12 \times 10^{11}$  kcal (more or less the energy produced by a nuclear electric station over 33 days). We should add the use of wood for ceramic production, domestic hearths, and roofing of the buildings. Such a scale of destruction of the vegetation cover must have caused soil erosion. Probably at the end of the Teotihuacan era, by 1300 BP, the aridification of the Mezquital Valley in Hidalgo also caused the migration of Otomí hunter-gatherers to the south, contributing to the city's destruction. This epoch is partially coincident to the Mediaeval Warm Period.

On the basis of climatological inferences, García (1974) suggested that, in 1300 BP, an intensive drought in the Basin of Mexico coincided with the worsening of social and political conditions in the Teotihuacan civilization — a situation that can be compared with the

Egyptian Old Kingdom and the Andean Tiwanaku collapses. This possible drought coincides with the frequent El Niño Phase mentioned for 1300 BP.

The rural-urban migration towards Teotihuacan was a massive phenomenon, probably exceeding the system's capacity for integrating groups of different origins and interests. Human-induced environmental changes could be modelled using this example.

Our ongoing project at the Teotihuacan Valley is directed to three main goals:

- (1) Understanding the natural environment and resources available for the Teotihuacan urban centre, and their changes through time. Particularly important is the establishment of a data base of plants and animals present in the region through the Preclassic, Classic, and Postclassic horizons, as well as during colonial and present times.
- (2) Early phases of urban development, the excavation of a system of tunnels by the Teotihuacanos to obtain construction materials, and its further use for storage and ritual.
- (3) The analysis of anthropogenic changes of the environment, as well as the presence and effect of climatic changes and volcanic activity, particularly towards the close of the Teotihuacan era.

Since 1987, we have undertaken geological, geophysical, soil, pollen, phytolith, palaeobotanical, faunal, chemical, and archaeological research to address these issues. We are currently analyzing results derived from excavations and hope to have a series of <sup>14</sup>C, as well as obsidian hydration and thermoluminescence dates to establish the timing of the natural and cultural transformations within a solid chronological framework. We are also coring the nearby lacustrine basin of Apan, on the northeastern margin of the Basin of Mexico, and a large stratigraphic sequence in Metepec, Valley of Toluca (to the west) in order to obtain a climatic sequence for the last 15 millennia, in areas not disturbed by the Prehispanic urban developments.

## FINAL REMARKS

In conclusion, I would like to suggest that different options have been expressed in regions where the urban revolution first took place. These distinctive choices were predicated by particular conditions of resource distribution. Yet many of these systems exceeded their own capacities for management and integration, as well as the capacity of the bonding of technology to the environment. Soil salinization occurred due to irrigation, deforestation of neighbouring slopes, over-exploitation of water sources, soil erosion, inefficiency of the social system to harmonize groups of different origins, the increasing power of provincial systems (versus the loss of importance of central authority); all phenomena that accompanied the earliest urban centres and eventually contributed to their demise. However three periods of major climatic change also emerge as provocative research problems. The first two affected the Near East

and northern Africa; one in the seventh millennium BP, producing the desertification of the area, and the second, around 4000 BP, provoking the collapse of Early Bronze Age societies. Petit-Maire (1991) has also cited another severe aridification phase that may have lead to the decline of the Roman Empire, in North Africa, the sub-Saharan and Near Eastern empires, and the Silk Road. The third period mainly affected the Middle Horizon societies in Mesoamerica and the Andean regions, about 1300–1000 BP. The collapse of urban societies in the central highlands of Mexico, the Maya area, and the Bolivian high plateau can be traced in order to examine the effects of climatic change on societies that already had severe impacts on their environments.

Finally, it is interesting to note that the only example of a tradition that endured for three millennia was a non-urban case, namely ancient Egypt.

These suggestions, as stated in my opening remarks, evidently are controversial. Each, however, is striking in its own right and the apparent coincidences are intriguing. If nothing else, they provide a challenging agenda for further, systematic research.

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