

internal strife, destructions, large-scale movements of people, and depopulation evidenced in the historical sources and archaeological remains.⁴⁷

Carpenter's theory was rejected at the time by most archaeologists and historians because there was little direct evidence to support it. Even today many scholars casually dismiss it from consideration. For example, in a discussion of causes that might have led nomads to become sedentary in Palestine during the Iron I period, Israel Finkelstein lists climatic changes among a number of possible political, social, and economic factors. But he rejects this possibility with the terse remark that "there is, at present, no evidence of any climatic change at the time under discussion."⁴⁸

If most historians and archaeologists have found no evidence for a climatic change at the end of the Late Bronze Age, it is probably because they have not looked very hard. It is natural for social scientists and archaeologists to be more comfortable evaluating *human* factors—invasions, revolutions, economic problems, social unrest—than they are with the kinds of physical evidence studied by climatologists. Over the past two decades, however, an increasing amount of material from a variety of sources has indicated that there probably *was* a climatic change that took place between approximately 1300 and 950 B.C.

The earth's climate is a closed system. What happens in one area is related to what is happening in other areas around the globe.⁴⁹ It has been shown, in fact, that in modern times there has been a very close correlation between moisture trends in Europe and those in the Near East. Whenever Europe has been dry, the Near East has also been dry, and whenever Europe has become wetter, so has the Near East.⁵⁰ Thus, evidence for a period of major climatic change that affected the eastern Mediterranean can be sought in Europe—and even throughout the northern hemisphere—not just in eastern Mediterranean lands. Such evidence comes from study of a number of climatic indicators (like pollen, tree rings, or lake levels) that reflect past climatic conditions. Then the climatic changes thus indicated are dated by use of radiocarbon dating, tree-ring chronology, other scientific dating methods, or by correlation with archaeological deposits or written material of known date.

Tree rings are excellent indicators of climatic changes. Trees develop wide growth rings in times when the weather is favorable (that is, when

47. Carpenter 1966: 59-66.

48. Finkelstein 1988: 345.

49. See Lamb 1982: 11-16.

50. Butzer 1958:136; Bintliff 1982: 143-144; Neumann and Parpola 1987: 162-163.

temperatures are mild during the growing season and moisture is abundant and narrow ones in periods when the weather is persistently very cold or dry. Since the tree-ring sequence developed from the long-lived bristlecone pine trees of the White Mountains in California covers the past 7,000 years, periods of major climatic change in historical times *can* be precisely dated. A series of narrow tree rings between c. 1300 and 1000 B.C. clearly indicates a change in climate during that time, but whether the change was to colder or drier weather (or both) has not been determined.⁵¹

Evidence from Europe, Asia, and Africa shows that the climatic change indicated by the bristlecone pine tree rings was not just confined to the White Mountains of California or to the Western Hemisphere. For example:

1. The levels of lakes in Switzerland and Central Europe began declining between about 1400 and 1300 B.C., reaching their lowest point about 1000/950 B.C.,⁵² which indicates a dry period in Europe during that era. Since the correlation in moisture trends between Europe and the Near East is high, the Near East was also very likely experiencing drier weather during this period.

2. Studies of radiocarbon-dated changes in various European peat-bogs have also indicated periods when the European climate changed from wet to dry. An era of cool, wet climate prevailed from c. 2000 until c. 1400 B.C. A drier period seems to have followed until c. 900 B.C., when once again a change to cooler, wetter conditions prevailed.⁵³ (The radiocarbon dates used to determine these chronological limits have a standard deviation of about ± 100 years. They are thus in agreement with the dates given above for the period of declining water levels in Swiss lakes.)

3. In the Swiss Alps both pollen evidence and glacier stratigraphy indicate a cool climate between c. 1500 and 1150 B.C. and between c. 800 and 700 B.C., with a warmer phase in between (c. 1150-800 B.C.).⁵⁴ (These radiocarbon-derived dates should be used with the caveat mentioned above. It should also be noted that in the Near East cool periods are generally rainy and warm ones are generally dry.)

4. Studies of glaciers in the Himalayas and Karakorum show that in those Asian mountain ranges glaciers advanced between c. 1750 and 1150 B.C. and between c. 750 and 150 B.C. and that the glaciers retreated

51. Lamb 1982: 25-26. Since there is much evidence from other parts of the northern hemisphere that this period was generally *warmer* than usual, the narrow rings probably indicate an extended period of very dry conditions.

52. Brooks 1949: 300; Joos 1982: 50; Neumann and Parpola 1987: 166-167.

53. Barber 1982: 107-110 (note especially p. 110).

54. Bintliff 1982: 148.

between c. 1150 and 750 B.C.⁵⁵ This evidence basically agrees with that derived from study of glacial movements in the Swiss Alps and indicates that the warmer climate between c. 1200 (\pm 100) and 800 (\pm 100) was not just confined to Europe.

5. Pollen studies in Kashmir indicate that the monsoon rains declined in volume about 70 per cent from c. 2000 B.C. to about 1500 B.C. They then remained at a low level until the beginning of the Christian era.⁵⁶

6. The decline of the monsoon also seems to have had serious consequences in Africa. Lake Rudolf and Lake Victoria were at high levels shortly before 1300 B.C. However, their levels dropped after that date.⁵⁷ Since Lake Victoria is one of the primary sources of the Nile River, its level obviously would have affected the height of the Nile floods in Egypt. The decline of the monsoon, which also feeds the Nile's other sources, would have reduced the waters further.

7. In concert with glaciers in Asia and in Europe, the glacier on Mount Kenya in Africa advanced in the years before c. 1300 B.C. and after c. 540 B.C., but was inactive or retreated in the interval between the beginning of the thirteenth and the end of the seventh centuries B.C.⁵⁸

These and other indications of climatic change in Europe, Asia, and Africa during the time in question are persuasive, but there is also evidence to that effect from the Near East itself. Study of a number of different types of paleoenvironmental data—such as water levels and sedimentation rates in Lake Van, Persian Gulf sediments, and pollen samples from various areas—has enabled P. A. Kay and D. L. Johnson to estimate the Tigris-Euphrates streamflow over the past 6,000 years. The rivers seem to have been generally high between c. 1450 and 1300 B.C. After that their streamflow dropped rapidly, reaching its lowest point c. 1150 B.C. In the years just after c. 950 B.C. the streamflow rapidly rose to high levels once more.⁵⁹

The Nile's annual flood levels were also well below normal for much of the twelfth century B.C. The reduced discharge of the Pelusiac branch of the Nile allowed its mouth to silt up and caused the city of Per-Ramesses to be abandoned during the Twenty-first Dynasty (c. 1070-946 B.C.).⁶⁰ And during the reign of Ramesses X (c. 1108-1098 B.C.) Lower Nubia, the area just south of the first cataract, became desiccated due to the Nile's low

55. Neumann and Parpola 1987: 167.

56. Bryson and Murray 1977: 107-111; Bintliff 1982: 149; Lamb 1982: 29-30.

57. Neumann and Parpola 1987: 167.

58. Neumann and Parpola 1987: 167.

59. Kay and Johnson 1981; Neumann and Parpola 1987: 164.

60. Butzer 1976: 29.

levels.⁶¹

Finally, a study of wood charcoal from archaeological sites in the area just north of the Negeb in Israel indicates that at the end of the Late Bronze Age there was a change from Mediterranean to Saharan vegetation. This change in vegetation seems to indicate a shift from a relatively moist climate to a much drier one.⁶² While the study made no allowance for the possible importation of wood from other regions, the validity of its conclusions is not likely to be affected, since such imports into this area were probably not very extensive.⁶³

All of this evidence indicates a shift to a warmer (and, in the Near East, a drier) climate around the thirteenth and twelfth centuries B.C. When combined with textual references to grain shortages and famine, and with archaeological indications of population decline, it seems absolutely clear that a large climatic change was a major cause of the disturbances at the end of the Late Bronze Age. Some climatologists have even tried to identify the specific weather pattern that would have brought drought to most, but not all, areas of the eastern Mediterranean. They argue that a weather pattern like that of the winter of 1954-1955 fits the archaeological evidence and that such a pattern must have been dominant during the winters for most of the thirteenth and early twelfth centuries B.C.⁶⁴ Others think that the frequent recurrence, over a number of years, of a specific pattern of wet and dry areas is unlikely.⁶⁵ But it is clear that, while the weather patterns may have varied somewhat from year to year, the general trend in the eastern Mediterranean for at least a century and a half (c. 1300-1150 B.C.) was to drier conditions. This trend seems to have moderated somewhat in most areas during the latter half of the twelfth century B.C. and to have reversed itself in the tenth century B.C., when cooler, moister weather returned.

It was the growing frequency of drought—and the crop failures and hunger it brought with it—that set in motion the internal strife, warfare, plague, piracy, destruction of cities, decline in population, inflation, and population movements that weakened or destroyed the Bronze Age civilizations of the eastern Mediterranean. Obviously, this climatic change must have hit Palestine as well as other parts of the Near East. The widespread

61. Romer 1984: 167.

62. Bintliff 1982: 147 describes the contents of an unpublished paper by N. Lipschitz, *et al.* given at the 1979 International Conference of Climate and History at the University of East Anglia.

63. Neumann and Parpola 1987: 165.

64. Bryson, Lamb and Donley 1974; Bryson and Murray 1977: 3-17; Weiss 1982.

65. Neumann and Parpola 1987: 163.