

When the Rains Failed: Studies in Climatology and the Biblical Text

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Table of Contents

CHAPTER 1: STUDYING CLIMATE CHANGE

Introduction

Evidence for Climate Change

CHAPTER 2: NOAH'S FLOOD AND CLIMATOLOGY

The Younger Dryas and History

Noah's Flood and the Younger Dryas/Preboreal Transition

CHAPTER 3: GENESIS 1-11 AND MESOPOTAMIAN HISTORY

Post-Flood History

Uruk and a Tower to Heaven

CHAPTER 4: PROBLEMS WITH CLIMATOLOGICAL INTERPRETATION

Empirical Problems with the Climate Change Model

Exegetical Problems with the Climate Change Model

CHAPTER 5: ISRAEL'S PATRIARCHS AND CLIMATOLOGY

Abraham and a Famine in the Land

Isaac and a Famine in Palestine

Joseph and the Famine Years

CHAPTER 6: THE EXODUS AND CLIMATOLOGY

The Sea Crossing Debate

The *Yam Sûph*, and the Red Sea

A Proposed Location for the Exodus

CHAPTER 7: CLIMATE CHANGES AFTER THE CONQUEST

Climatology and the Sea People

Climate Changes after the United Monarchy

Conclusion

CHAPTER 1: STUDYING CLIMATE CHANGE

Introduction

Palestine was located on the edge of a semi-arid region and climate conditions in the land were always somewhat tenuous. Droughts and famines struck Palestine periodically, and these droughts were often interpreted as Yahweh's judgment on Israel's sins. Occasionally, textual and archaeological evidence has been found for famines recorded in the Biblical text. Ancient records like this are now being augmented by an increasing academic interest in climate change. The last few decades have seen an increasing a concern over global warming. Research has explored the process by which both global and regional climate conditions have changed in the past and how climate conditions are likely to change in the future.¹

Evidence for Climate Change

The most popular method for dating past climates has been the analysis of plant material from the past. Plant materials used in climate change studies have included tree rings and pollen grains found in ancient sediments. Chronological years have been found by counting tree rings back into the past. Climate conditions can then be studied by comparing the individual tree rings. The width of a tree ring is closely related to amount of rain that falls in each year. S. C. Porter discussed one interesting application of tree ring studies. He noted that glacial moraines can sometimes be dated with dendrochronology when trees are buried in the moraine. This provides a chronological context for the maximum glacial advance that produced the moraine. Glacial moraines are the long, winding dirt and stone hills that are pushed in front of a glacier as it moves forward. When glaciers retreat, they simply melt away and leave the moraines behind. So moraines usually mark the furthest limit of glacial advance.²

Another form of arboreal evidence is based on the presence of tree pollen in soil cores. Trees are quite sensitive to climate change. For example, oak trees today are seldom found north of Canada's border with Minnesota. During the last glacial period, oak trees were seldom found

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Climate change studies can be rather confusing at first. A wide variety of dates are often proposed for the same event or climatic period. Each proposed chronology reflects the characteristics of the specific site studied in the book or article. Authors also use different kinds of dates. Authors use dates BC, bc, BCE, or BP. BC dates are chronological dates (Before Christ). Dates bc are radiocarbon dates which may be quite different from chronological dates. BCE dates are identical to BC dates. BCE stands for Before the Common Era, and it is seen as being more politically correct than Before Christ. BP dates are Before the Present. When reading BP dates, it is helpful to check the publication date of the book or article (although BP dates are usually approximations anyway). Radiocarbon dates must be converted to calendar dates with the use of calibration curves, and there are several different (and inconsistent) calibration curves in use. As dates for past events approach the last glacial age, radiocarbon dates may differ from chronological dates by nearly a thousand years. Unfortunately, many authors do not indicate which set of dates they are using. To avoid confusion, most dates in the rest of this book will be converted from BP dates to BC dates by simply subtracting 2000 years from the date. No attempt will be made to reconcile chronological years and radiocarbon year. When checking the sources used in this section, it should be remembered that most of the authors use a BP dating system instead of a BC dating system.

2

Stephen C. Porter, "Glaciological Evidence of Holocene Climatic Change," in T. M. L. Wigley, M. J. Ingram, and G. Farmer, eds. *Climate and History: Studies in Past Climates and their Impact on Man*, (Cambridge: Cambridge University Press, 1981), 90.

north of South Carolina. So the kind of tree pollen found in a region testifies to the climate at that time. Beyond that, trees of any kind will not grow north of a specific latitude, and the tree line changes somewhat with climate conditions. North of the tree line, there is only tundra. The tree line is determined by the amount of sunlight available, the climate conditions, and the elevation of a site above sea level. The tree line in any period gives somewhat limited evidence for the climate conditions at the time.³

Tree pollen is not the only kind of pollen used in climate change studies. Most plants grow only within a limited range of climate conditions. So the kind of pollen found in a soil core testifies to the climate when the soil was formed.⁴ Pollen studies are often used to study soil core layers. These soil cores may be taken from dry land, peat bogs, lake bottom sediments, or ocean floor sediments. Pollen studies have played a key role in the debate about the Younger Dryas. The most important tundra plant in Europe is *dryas octopetala*. When a soil core level contains exclusively *dryas* pollen and no pollen from warmth loving plants, it is fair to assume that the region knew very cold weather when the soil was formed.⁵ In New England and Atlantic Canada, climate change has been studied by noting increases in alder, spruce, and birch pollen. These trees can tolerate cold weather. They replace warmth loving trees like oak and ash as the climate cools. So the kind of pollen used in dating depends on the region studied. When a soil layer contains pollen from oak trees, the assumption is made that the layer was formed during warmer years as forests once more spread across the region.

Evidence for climate change is often found by studying plankton in ocean bottom sediment layers. Plankton is made up of tiny plants and animals in the oceans. Plankton is the base for almost all food chains in the ocean, and it is the source for much of the earth's free oxygen. The kind of plankton that appears in sediment cores gives strong evidence for the ocean temperature when that kind of plankton lived. Different forms of plankton are found in different ocean temperature regions. One species of plankton is especially important for climate change studies. It is called *N. pachyderma*. This kind of plankton resembles an amoeba with a shell. It takes two forms, a left-coiling form and a right coiling form. The left-coiling form only grows in water that is colder than 10 degrees centigrade. In water that is colder than 5 degrees centigrade, it becomes the dominant form of plankton. This cold loving form can make up almost 100% of the plankton in the Arctic Ocean. The right-coiling form of this plankton appears only in warmer water. So the form of this plankton found in a sea bottom core gives rather good evidence for the temperature of the surface sea water when the sediment settled to the bottom.⁶

Another popular form of climatological evidence comes from isotope studies. Most commonly, isotope studies are conducted with deep ice cores from Greenland and Antarctica.

3

Frank Oldfield, "Late Quaternary Vegetational History in South West France," *Pollen et Spores* 6 (1964): 166-167. Timothy F. Ball, "Historical Evidence and Climatic Implications of a Shift in the Boreal Forest Tundra Transition in Central Canada," *Climatic Change* 8 (1986): 121-134.

4

Grace S. Brush, "Pollen Analyses of Late-Glacial and Postglacial Sediments in Iowa," in E. J. Cushing and H. E. Wright Jr., eds. *Quaternary Paleoecology*, (New Haven: Yale University Press, 1967), 99-115. S. I. Saad and S. Sami, "Studies of Pollen and Spores Content of Nile Delta Deposits (Berenbal Region)," *Pollen et Spores* 9 (1967): 467-503.

5

Donald T. Rodbell, "The Younger Dryas: Cold, Cold Everywhere?" *Science* 290 (2000): 285-286.

6

Thomas M. Cronin, *Principles of Paleoclimatology*, (New York: Columbia University Press, 1999), 210-211.

Evidence for climate change can be gained by counting the annual freeze layers in ice cores, and then analyzing the isotopes found in both ice and air bubbles contained within each ice layer.⁷ Climate information can be gained from these studies because heavier water molecules like $^1\text{H}_2^{18}\text{O}$ and $^1\text{H}_2^{16}\text{O}$ evaporate more slowly from the water surface and condense more rapidly into rain than normal $^1\text{H}_2^{16}\text{O}$ water molecules. The result is that increased amounts of heavier isotopes appear in rain water that falls during warmer temperatures. The isotope concentration in water, ice, or sediment is called its δ -value. Dansgaard, White, and Johnsen noted that an increase of 5% of $\delta^{18}\text{O}$ corresponds to a temperature increase of 7 degrees centigrade. Shackleton and Opdyke studied a sediment core from the equatorial Pacific Ocean floor. They found O^{18} evidence for ten different glacial periods in that past.⁸ Many other forms of evidence have also been used to study ancient climates. All of these forms of evidence have clear limitations. A study of the limitations of these methods must remain beyond the bounds of this book. Climate change studies in general will have only limited appeal to those who are committed to a very young earth on the basis of their exegesis. However climate change studies may provide an interesting model for those who are willing to entertain one of the old earth options for interpreting Genesis 1-3. This model may also provide a useful evangelistic polemic for reaching people who are committed to an old earth position.

7

E. J. Steig, et al, "Synchronous Climate Changes in Antarctica and the North Atlantic," *Science* 282 (1998): 92-95.

8

J. White, et al, "How Reliable and Consistent are Paleodata from Continents, Oceans, and Ice?" in J. A. Eddy and H. Oeschger, eds. *Global Changes in the Perspective of the Past*, (New York: John Wiley & Sons, 1993), 75-76. W. Dansgaard, J. W. C. White, S. J. Johnsen, "The Abrupt Termination of the Younger Dryas Climate Event," *Nature* 339, #6225, (1989): 532. H. H. Lamb, *Climate: Present, Past and Future* 2 (New York: Barnes & Noble, 1977), 310.