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

Rodger Dalman

CHAPTER 2: NOAH'S FLOOD AND CLIMATOLOGY

The Younger Dryas and History

If an old earth position is assumed, the last Ice Age occurred around 18,000 BC. At this time, approximately 30% of the earth's surface was covered with ice.[1] F. Doumenge noted that the Mediterranean Sea was around 120 meters shallower than it is today. The sea was divided into three temperature zones determined by the geology of the sea floor and the sources of the rivers that flowed into the sea. The western temperature zone was cold. Doumenge argued that temperatures in the western Mediterranean resembled current conditions in the North Sea. Penguins, seals, and whales lived in the western basin. The eastern Mediterranean basin was warmer than this.[2] H. E. Wright argued that the north Mediterranean region was dry during the last glacial period, and Europe was covered by tundra.[3]

There has been broad and general agreement about the process by which the glacial ice melted at the end of the last ice age, although there has also been endless debate over the chronology of these events. There is broad agreement that the great ice sheets melted in a series of warm and cold periods.[4] These warm and cold periods lasted anywhere from a few centuries to a few millennia. During warm periods, the glacial ice melted very rapidly, and the ocean level rose rapidly. During cold periods, ice fields began to form once more. These alternating warm and cold periods had a remarkable impact on plant life in the northern hemisphere. During warm periods, tundra plants were replaced by forests over a wide area. During cold periods, the forests died away, and were replaced with tundra plants once more. A decade ago, it was popular to see the first warm period somewhere between 13,000 and 11,000 BC. This warm period was followed by a cold era called the Older Dryas. This cold period ended in renewed warmth and rapid glacial melt. This warm period was called the Alleröd Fluctuation. It ended around 9000 BC and was followed by a thousand years of full glacial cold called the Younger Dryas.[5] After a thousand years, the climate warmed for the last time at the beginning of the Preboreal period.

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1 Karl W. Butzer, "Patterns of Environmental Change in the Near East During Late Pleistocene and Early Holocene Times," in Fred Wendorf and Anthony E. Marks, eds. *Problems in Prehistory: North Africa and the Levant*, (Dallas: SCM Press, 1975), 389.

2 François Doumenge, "The Mediterranean Crises," *UN University Lecture*, #16. Blue whales still inhabit the western Mediterranean to this day.

3 Wright argued that pollen studies near Lake Mirabad and lake Zeribar showed that oak tree pollen appeared no earlier than 9000 BC in the Zagros mountains north of Mesopotamia. H. E. Wright Jr. "Climatic Change in the Zagros Mountains-Revisited," in Linda S. Braidwood, et al, eds. *Prehistoric Archaeology Along the Zagros Flanks*, (Chicago: The Oriental Institute of the University of Chicago, 1983), 506-507. H. H. Lamb argued that regions north of the Mediterranean Sea were a treeless dry steppe before 13,000 BC. He argued that pollen studies demonstrated steppe vegetation especially in northwest Spain, northern Italy, and Macedonia. At the same time, pine forests covered parts of Texas and New Mexico that are now arid high plains. Lamb, *Climate: Present, Past and Future*, 352-354.

4 Barry argued that most of the glacial ice melted in two warm periods: 14,000 BC to 11,000 BC, and 8000 BC to 5000 BC. Roger G. Barry, "The Significance of Global Snow and Ice Cover for Global Change Studies," *GeoJournal* 27 (1992): 294.

5 Neil Roberts, *The Holocene: An Environmental History*, (Oxford: Basil Blackwell, 1989), 53.

In recent years, this pattern has been called into question.[6] While many authors still defend the older chronology, many others now merge the two cold periods. They date the beginning of the Younger Dryas somewhere between 13,000 and 11,000 BC instead of dating the Older Dryas at this time. This can be very confusing. Authors who write about the Younger Dryas are likely to propose start dates for this climate period anywhere within a 4000 year span of time. That is a very wide time span since full glacial cold lasted until 15,000 BC. In general, it is much easier to defend a linkage between the Younger Dryas and Biblical history if the Younger Dryas is dated between 9000 and 8000 BC. While pollen and isotope studies can be argued either way, a more recent Younger Dryas is also much easier to fit into the archaeological record. There is no clear evidence for settled village life anywhere in the world before 9000 BC.

Ruddiman and McIntyre argued that between 14,000 and 11,000 BC, the polar weather front and the winter sea ice limit covered the whole north Atlantic from the center of Spain northward. Their evidence for this claim came from the difference between polar and subpolar varieties of plankton found in sea bottom cores from this time period.[7]

Andrew Goudie argued that the Zagros Mountains were covered with glaciers before the end of the last glacial era, and the snow line was somewhere between 1200 and 1800 meters lower than it is today. The mountains below the snow line were cold with bleak steppe conditions. Goudie argued that the mountains were too cold to be occupied before 11,000 BC. Goudie argued that the transition between cool steppe and warm oak-pistachio savannah should be dated somewhere around 9000 BC. Goudie's evidence for this transition came from pollen and lake sediment studies. Emmer and barley also first appeared in the region at this time.[8]

Ruddiman and McIntyre argued that glacial ice sheets in the northern hemisphere had become relatively thin by 11,000 BC. The early phase of rapid ice disintegration had occurred largely by breaking ice bergs from glaciers and melting them in the ocean. Ruddiman and McIntyre argued that after 11,000 BC, sea ice south of 50 degrees latitude was melting rapidly. Ruddiman and McIntyre argued that during these years, the polar weather front retreated to a line loosely from Labrador to Iceland. This brought a very warm period to Europe and the Near East. This warm period is called the Alleröd Fluctuation. There is no way to determine the winter sea ice limits during this period.

The Alleröd Fluctuation may be an ideal candidate for the time period when God created a garden in the land of Eden, and brought to the garden the man that He had created. The Garden of Eden may have been located in the mountains north of Mesopotamia since the Tigris and Euphrates Rivers flowed out of the garden. Before 11,000 BC, these mountains had been barren tundra incapable of supporting a human population. After 11,000 BC, the Alleröd brought warmth to the region, and the area began to resemble a garden. Forests spread rapidly through

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6 K. D. Bennett, "The Last Glacial-Holocene Transition in Southern Chile," *Science* 290 (2000): 325-328.

7 William F. Ruddiman and Andrew McIntyre, "The North Atlantic Ocean during the Last Deglaciation," *Palaeogeography, Palaeoclimatology, Palaeoecology* 35 (1981): 145.

8 Andrew Goudie, *Environmental Change*, (Oxford: Clarendon Press, 1992), 141.

the mountains north of Mesopotamia, and into southern Europe.[9] A wide variety of pollen types appear in soil cores from the Alleröd in the region that the Bible called Eden. This land remained a paradise until Adam and Eve rejected God's covenant. Yahweh decreed that they would be driven from the garden to earn their living with great difficulty on a cursed land.

If this model is accepted, there is no way to know when Adam and Eve revolted against God, or how long they lived near Eden before the Alleröd came to a close. Evidence for human occupation of northern Europe during the Alleröd may come from the Laacher See volcano in the Rhineland. This volcano erupted during the late Alleröd covering the Alleröd era vegetation with ash and pumice. Two human skeletons and several hearths were found below this ash but no evidence for permanent human settlements.[10] The Alleröd Fluctuation may also have marked the beginning of the Natufian hunter/gatherer culture in Palestine and of Neolithic cultures elsewhere. Genesis 4:20 may have born witness to the presence of an early hunter/ gatherer culture. This verse noted that Lamech's son Jabal was the father of those who lived in tents with livestock.

After the end of the Alleröd, the earth became truly a cursed place as Yahweh had promised. The Alleröd was followed by the Younger Dryas, when full glacial cold returned for a thousand years. During the Younger Dryas, much of the forest land north of Palestine died out and was replaced by tundra vegetation once more.[11] The villages that had been formed by Cain's descendants gradually disappeared because of the drought. The Iranian Plateau saw a complete break in human occupation during the Younger Dryas, as did regions like the Azraq basin and the oasis at El Kum.

Ruddiman and McIntyre argued that between 9000 and 8000 BC, the polar front returned south all the way to the northeast corner of Spain. This brought nearly full glacial cold to Europe and the Near East. The southern edge of the polar sea ice was only slightly further north during the Younger Dryas than during the full glacial cold. Ocean temperatures returned to glacial cold everywhere beyond of 52/53 degrees north latitude. Arctic ice bergs were very common in the north Atlantic during these years, and the ice rafted ash into the ocean.[12] The Younger Dryas were cold and dry in general, but the aridity became more severe as the Younger Dryas progressed. The degree of aridity changed somewhat from region to region.[13]

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9 During the Alleröd, the ocean surface was still around 40 meters below its current sea level. The Dover Straight between England and France was still dry ground. The flow of sea water from the Atlantic Ocean into the Mediterranean Sea was reduced by 30%. Lamb, *Climate: Present, Past and Future*, 346-348.

10 "Younger Dryas Forces Human Choices," *Geotimes*, (April, 1999), 10. Michael Baales, and Martin Street, "Hunter-Gatherer Behavior in a Changing Late Glacial Landscape: Alleröd Archaeology in the Central Rhineland, Germany," *Journal of Anthropological Research* 52 (1996): 281.

11 H. H. Lamb argued that during the Alleröd, birchwoods became common in England. Pines spread through Germany. Oak and Hazel trees became common in France. Lamb argued that during the Younger Dryas, tundra stretched from northern England to the German plain. Lamb argued that areas of birch and pine may have survived in southern Germany. Lamb, *Climate: Present, Past and Future*, 371.

12 Ruddiman and McIntyre, "The North Atlantic Ocean during the Last Deglaciation," 145.

13 T. J. Crowley, et al, "Group Report: Use of Paleoclimatic Data as Analogs for Understanding Future Global Changes," in J. A. Eddy and H. Oeschger, eds. *Global Changes in the Perspective of the Past*, (New York: John Wiley & Sons, 1993), 64-65.

Europe was completely depopulated during the Younger Dryas. Human occupation continued in the Levant, but only clustered around areas that still had water.[14] Harvey Weiss argued that the Younger Dryas brought a change to the nature of human culture. Weiss argued that before the Younger Dryas, only a hunter/gatherer culture existed. Weiss argued that during the Younger Dryas, it became much harder for people to find food. So they were forced to adapt by developing simple agriculture.[15] Weiss was perhaps oversimplifying the evidence. Genesis recorded that Cain and Able were already engaged in agriculture at the expulsion from Eden. However, the Younger Dryas marked the start of basin irrigation agriculture in the ancient Near East.

There has been quite a debate about the cause of the Younger Dryas. When evidence for the Younger Dryas cold period was first found, it was assumed that this was only a local event in the North Atlantic region. It was assumed that melting sea ice, sea icebergs, and glacial ice simply cooled down the climate like melting ice cubes in a glass of water. In 1989, Fairbanks published a detailed study of the history of coral formations near Barbados. He demonstrated that the rate of ocean level rise after the end of the last glacial period slowed down greatly during the Younger Dryas. During these cold years, the sea surface did continue to rise, but only very slowly. This implied that the Younger Dryas cold could not have been caused only by the melting of glacial and sea ice.[16] The rising sea levels during the Younger Dryas were caused by ice melting in the Antarctic instead of the northern hemisphere.[17]

Shortly after the Younger Dryas period was discovered, it became apparent that this cold period was very wide spread. In 1987, Bard et al studied two ocean bottom cores from the coastal regions of Ireland and Portugal. These cores came from areas 2000 km apart. Yet the cores resembled each other quite closely. Plankton and oxygen isotope studies gave clear evidence for the beginning and end of the Younger Dryas. Both cores dated these climate periods at the same time, which suggested that the Younger Dryas was a uniform characteristic of the whole region. Bard et al dated the Younger Dryas between 9010 and 8390 BC. They described the transition between the Younger Dryas and the subsequent Preboreal period as being "instantaneous." By this they meant that the transition took less than 400 years, which was the finest chronological resolution that their dating methods could provide.[18]

The ultimate cause of the Younger Dryas should probably be sought outside of the earth's climate system. If the Younger Dryas had been caused simply by a breakdown in the earth's heat distribution system, other regions of the earth would have warmed greatly while the

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14 Jonathan Adams, "Did Indo-European Languages Spread before Farming?" http://sarasvati.simplenet.com/aryan/Indo2.html.

15 Harvey Weiss, "Beyond the Younger Dryas: Collapse as Adaptation to Abrupt Climate Change in Ancient West Asia and the Eastern Mediterranean," in G. Bawden and R. Reycraft, eds. *Confronting Natural Disaster: Engaging the Past to Understand the Future*, (Albuquerque: University of New Mexico Press, 2000).

16 Cronin, *Principles of Paleoclimatology*, 218-219.

17 R. B. Alley, et al, "Holocene Climatic Instability: A Prominent Widespread Event 8200 yr Ago," *Geology* 25 (1997): 483-486.

18 Edouard Bard, et al, "Retreat Velocity of the North Atlantic Polar Front During the Last Deglaciation Determined by ^{14}C Accelerator Mass Spectrometry," *Nature* 328 (1987): 791-794.

northern hemisphere cooled. That does not seem to have been the case. The Alleröd and the Younger Dryas periods greatly affected climate conditions across most of the world, although not all areas were affected at exactly the same time or in exactly the same way.[19] Evidence for the Younger Dryas has been found in Africa, China, New Zealand, the South Atlantic, South America, North America, the Near East and Europe.[20] While the Younger Dryas may have been caused by something outside the earth's system, the transitions between climate periods occurred too rapidly for this explanation to be sufficient. Several recent studies have noted that the earth's climate system remains relatively stable until pushed beyond some threshold. Then the whole climate system changes radically and very abruptly indeed.[21]

Noah's Flood and the Younger Dryas/Preboreal Transition

Climatologists claim that sea levels rose rapidly after the end of the Younger Dryas. In the next 2000 years, the sea level rose over 40 meters. The Persian Gulf shore moved north by several hundred meters per year.[22] Ruddiman and McIntyre argued that between 8000 and 7000 BC, the polar front was pushed back all the way to the mouth of the Labrador Sea. The earliest sub-polar mollusks appeared at Baffin Island around 7725 BC.[23] In a 1989 study, W. Dansgaard,

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Cockcroft, Wilkinson, and Tyson argued that even South Africa knew much colder temperatures between 10,000 BC and 8000 BC. M. B. Cockcroft, M. J. Wilkinson, and P. D. Tyson, "The Application of a Present-Day Climatic Model to the Late Quaternary in Southern Africa," *Climate Change* 10 (1987): 171.

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Mel A. Reasoner, and Margret A Jodry, "Rapid Response of Alpine Timberline Vegetation in the Younger Dryas Climate Oscillation in the Colorado Rocky Mountains, USA," *Geology* 26 (2000): 51. Stephen C Porter, "Chinese Loess Record of Monsoon Climate during the Last Glacial-Interglacial Cycle," *Earth Science Reviews*, (June 2001): 115. "A Head Start on Cooling," *Science* 289 (2000): 833-834. Rewi M. Newnhem, and David J. Lowe, "Fine-Resolution Pollen Record of Late-Glacial Climate Reversal from New Zealand," *Geology* 28 (2000): 759. Gunhild C. Rosqvist, et al, "Late Glacial to Middle Holocene Climatic Record of Lacustrine Biogenic Silica Oxygen Isotopes from a Southern Ocean Island," *Geology* 27 (1999): 967. Rainer Zahn, "Fast Flickers in the Tropics," *Nature* 372 (1994): 621-622. Gerald H. Haug, et al. "Southward Migration of the Intertropical Convergence Zone through the Holocene," *Science* 293 #5533 (2001): 1304. L. G. Thompson, et al, "A 25,000-Year Tropical Climate History from Bolivian Ice Cores," *Science* 282 (1998): 1858-1864. Mark A. Maslin, and Stephen J. Burns, "Reconstruction of the Amazon Basin Effective Moisture Availability over the Past 14,000 Years," *Science* 290 (2000): 2285-2287. David B. Madsen, "A High-Elevation Alleröd-Younger Dryas Megafauna from the West-Central Rocky Mountains," *Intermountain Archaeology* 122 (2000): 100-113. Zicheng Yu, and Ulrich Eicher, "Abrupt Climate Oscillations During the Last Deglaciation in Central North America," *Science* 282 (1998): 2235-2238. Atle Nesje, "Younger Dryas and Holocene Glacier Fluctuations and Equilibrium-Line Altitude Variations in the Jostedalsbre Region, Western Norway," *Climate Dynamics* 6 (1992): 221-227. D. Kroon, et al, "Century- to Millennial- Scale Sedimentological-Geochemical Record of Glacial-Holocene Sediment Variations from the Barra Fan (N.E. Atlantic)," *Journal of the Geological Society* 157 (2000): 643. W. Shotyk, et al, "History of Atmospheric Lead Deposition Since 12,370 ^{14}C yr BP from a Peat Bog, Jura Mountains, Switzerland," *Science* 281 (1998): 1635-1640.

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W. H. Berger and L. D. Labeyrie, eds. *Abrupt Climatic Change: Evidence and Implications*, (Boston: D. Reidel, 1987).

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T. J. Crowley, et al, "Group Report: Use of Paleoclimatic Data as Analogs for Understanding Future Global Changes," in J. A. Eddy and H. Oeschger, eds. *Global Changes in the Perspective of the Past*, (New York: John Wiley & Sons, 1993), 64-65.

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Ruddiman and McIntyre, "The North Atlantic Ocean during the Last Deglaciation," 145.

J. W. C. White, and S. J. Johnsen studies the transition from the Younger Dryas to the subsequent Preboreal period. They argued that this transition may have occurred at 8770 BC give or take 150 years. This is more than 700 years earlier than the date suggested by Ruddiman and McIntyre for the same transition. Dansgaard, White, and Johnsen argued that this transition appeared as a sudden shift in all of the parameters that they studied, including heavy isotope studies, chemical trace element studies, acidity studies, and continental dust studies.[24]

It is important to note how rapidly this transition occurred. It is truly striking how rapidly the Younger Dryas began and ended. The transitions between warmth, full glacial cold, and renewed warmth may have been less than a decade. Recent studies have suggested that the Younger Dryas may have resulted in part from changes in the Great Conveyor, the broad system of deep and shallow ocean currents that carry warm equatorial water into the North Atlantic basin.[25] Only minor changes in the sea's salinity and temperature may have had a huge impact on the direction of the deep ocean's currents.[26] These ocean currents in turn have an enormous impact on climate conditions world wide.[27]

R. B. Alley et al discussed the transition between the Younger Dryas and the Preboreal periods. They used as their evidence a study of the GISP2 ice core from Greenland. Alley et al argued that the Younger Dryas ended very abruptly. They claimed that the transition took at the outside less than fifty years. They argued that dust concentrations in the ice core suggested that the Younger Dryas may actually have ended even more rapidly than that. Dust concentration in the ice core suggested that the Younger Dryas may have shifted to the Preboreal climate in less than twenty years. Finally, they studied snow thickness evidence from the ice core. The evidence from snow thickness suggested that the Younger Dryas/Preboreal transition may actually have occurred in as little as a year or two. After this transition, the amount of annual snowfall doubled. They added that the same kind of ice core evidence suggested that the transition from the Oldest Dryas to the Bölling/Alleröd warm period may also have occurred extremely

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24 Dansgaard, White, and Johnsen, “The Abrupt Termination of the Younger Dryas Climate Event,” 532.

25 Dan Seidov, et al, eds. *The Oceans and Rapid Climate Change: Past, Present and Future*, (Washington DC: American Geophysical Union, 2001).

26 Broecker argued that the earth's climate system resists change until it is pushed beyond some threshold. Then it leaps suddenly into a new pattern. Broecker discussed especially how the great ocean currents could change their course. Wallace S. Broecker, "The Biggest Chill," *Natural History* 96 (1987): 74-82. William S. Broecker, "Global Warming on Trial," *Natural History* 4 (1992): 6-14. R. Muscheler, et al. "Changes in Deep-Water Formation during the Younger Dryas Event Inferred from 10Be and 14C Records," *Nature* 400 (2000): 567. Carsten Ruhlemann, et al, "Warming of the Tropical Atlantic Ocean and Slowdown of Thermohaline Circulation during the Last Deglaciation," *Nature* 402 (1999): 511.

27 Seidov, *The Oceans and Rapid Climate Change: Past, Present and Future*. Broecker argued that around 9000 BC, the ocean currents stopped bringing warm water north. Almost immediately, the average temperature in Europe dropped 12 degrees. This resulted in the Younger Dryas, which Broecker argued lasted for 800 years. Broecker, "Global Warming on Trial," 6-14.

rapidly.[28] If the transition between the Younger Dryas and the Preboreal occurred in a very short time period, this transition may be a good candidate for the source of Noah's flood.

What would have been the water source for Noah's flood? Transitions from cold to warm periods have often been accompanied by substantial rainfall.[29] Basin irrigation cultures living on the valley floors could have been destroyed by flash floods roaring down the river valleys. Such local floods would have occurred simultaneously in many places, and could have brought an end to the entire culture. There is rather strong evidence that massive flooding did indeed strike the ancient Near East during the Younger Dryas/Preboreal transition. The evidence for this flooding begins with the North Atlantic Oscillation, or the NAO. Heidi Cullen and Peter deMenocal studied the relationship between the North Atlantic Oscillation and the amount of water that flowed through the Tigris and Euphrates valley. The name "North Atlantic Oscillation" described the rather permanent, year round presence of a low pressure region in the atmosphere near Iceland, and high pressure regions near the Azores and the eastern Mediterranean basin. These pressure zones tend to strengthen and weaken at the same time. They give the climate of the North Atlantic a bipolar structure. As these pressure zones strengthen, weaken and wander, they have a great impact on climate conditions in eastern North America, Europe, the Mediterranean basin, and the Near East.

As the high pressure zone near the Azores weakens, warm moist air flows into Europe and the Mediterranean basin. In the winter, this warm moist air creates strong rains in the Mediterranean region. These rains move as far to the east as the headwaters of the Tigris and Euphrates Rivers, and greatly increase stream flow throughout Mesopotamia. Cullen and deMenocal concluded that the Atlantic Ocean was the primary source for the moist air which eventually fell as rain and flowed down the Tigris and Euphrates Rivers.[30] This climate system can still be seen in the Near East today. Rainfall in Israel occurs largely in the winter. Israel sees an average annual rainfall between 500 and 900 mm of rain. Less than 1mm of rain falls during the summer months, and only in the northern part of the country. During the summer months, the Persian Gulf Trough dominates the region. This is a low pressure region that extends from the

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Alley et al noted that there was a sharp change in ice layer thickness at a depth of 1,678 meters. They dated these layers at 11,640 " 250 years before 1950. They identified this date as the end of the Younger Dryas. They noted that this depth also marked a major change in the ice isotope concentration and dust concentration. R. B. Alley et al, "Abrupt Increase in Greenland Snow Accumulation at the End of the Younger Dryas Event," *Nature* 362, #6420, (1993): 527.

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The Ohm and Wetter rivers in Germany saw annual flooding at the end of the Younger Dryas. Hanneke Bos, "Aspects of Late Glacial-Early Holocene Vegetation Development in Western Europe," http:\\www.bio.uu.nl/~palaeo/Research/Lateglac/ lateglac.htm.It is clear that the Younger Dryas brought severe drought to Sub-Saharan Africa. The end of the Younger Dryas brought much rainfall to the region. Lake levels in Ethiopia and Afar reached their highest levels around 600 years after the end of the Younger Dryas, then fell rapidly. David Neev and K. O. Emery, *The Destruction of Sodom, Gomorrah, and Jericho: Geological, Climatological, and Archaeological Background*, (New York: University Press, 1995), 115.

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Heidi M. Cullen and Peter B. deMenocal, "North Atlantic Influence on Tigris-Euphrates Streamflow," *International Journal of Climatology* 20 (2000): 853-863. D. Pozo-Vázquez, et al, "An Analysis of the Variability of the North Atlantic Oscillation in the Time and the Frequency Domains," *International Journal of Climatology* 20 (2000): 1675-1692.

Asian Monsoon low through the Persian Gulf and northward through the Aegean Sea and Turkey.[31]

The North Atlantic Oscillation is important because it demonstrates that Atlantic Ocean temperature variations have a direct impact on weather patterns across the ancient Near East. Even a relatively mild change in North Atlantic Ocean temperature can affect temperature and moisture levels in the air, and can send flooding down the Tigris and Euphrates basins. However, the Younger Dryas/Preboreal transition was accompanied by far more than normal flooding. During this transition, the Great Conveyor currents suddenly began bringing warm equatorial water into the North Atlantic. This happened when the whole region was still locked in near glacial cold. The warm water flowed past the Atlantic coast of Africa, and it flowed into the Mediterranean basin. This warm water produced huge clouds of evaporated water. These clouds struck the cold air masses in the northern hemisphere, and dropped as rain. A vast amount of rain fell on the whole region until Europe and the Near East warmed enough to stabilize the climate system. It might actually have taken 40 days and 40 nights for the climate system to stabilize.

This is more than simply conjecture. One of the hot topics of research in recent years has been the presence of thick sapropel layers in sediment on the floor of the eastern and western Mediterranean Sea basins. A total of 12 sapropel layers have been found at different levels in cores from the Mediterranean Sea floor. The Mediterranean Sea sapropel layers were discovered in 1952. As is always true with hot topics, the sapropel layers have been interpreted in a number of ways.[32] One of the more interesting studies of sapropel layers in the eastern Mediterranean basin was written by M. Rossignol-Strick et al.

Rossignol-Strick et al described a thick sapropel layer that appeared in sea bottom core samples across the eastern Mediterranean Sea. They argued that radiocarbon dates for sediments above and below this layer have dated it at the transition between the Younger Dryas and the subsequent Preboreal period. They dated this transition sometime between 8500 and 8000 BC. Rossignol-Strick et al explained how sapropel layers were formed. Sapropel layers were layers of black, pelagic mud that contained a great deal of marine organic material. They were formed in transitions to warm periods when large amounts of fresh water flowed into the sea. The fresh water created a low salinity water layer that remained on top of the normal sea water instead of mixing with it. This happened because the heavily salted water had greater density. During the summer months, the surface water evaporated. This thinned the water layer. The two layers eventually mixed in the winter when the surface water cooled. This increased its density and it down welled into the heavily salted layer.

The layer of low salinity surface water prevented oxygen from being transported into the deep, heavily salted water on the sea floor. When the deep salt water layer was cut off from oxygen, it eventually stagnated. Many marine organisms died, and were replaced with high salt tolerant and stagnation tolerant species. The water's oxygen depletion prevented decomposition, and a thick black layer of sediment was created. Rossignol-Strick et al suggested that this thick sapropel layer was created at the end of the Younger Dryas because the transition to a warmer

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Hadas Saaroni and Baruch Ziv, "Summer Rain Episodes in a Mediterranean Climate, the Case of Israel: Climatological-Dynamical Analysis," *International Journal of Climatology* 20 (2000): 191-194.

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See the discussion in Gert. De Lange, et al, “Sapropels and Palaeoceanography (SAP): Palaeoceanographic, Palaeo-climatic. Palaeo-environmental and Diagenetic aspects of Sapropel Formation in the Eastern Mediterranean (MAS3-CT97-0137),” http://www.geo.unimib.it/Conisma/SAP1.htm.

climate regime caused great river floods to pour a very large amount of fresh water into the Mediterranean Sea. They noted that this sapropel layer was formed at the beginning of the African Rainy Period which lasted from 8000 to 6000 BC.[33]

François Doumenge discussed the most recent sapropel layer on the floor of the Mediterranean Sea. He proposed a date for this layer at 6000 BC, which is 2000 years later than the date proposed by Rossignol-Strick et al. Dougmenge associated this sapropel layer with Noah's flood. He argued that heavy rains fell in the Middle East, in the Nile river basin, and in the East African Rift valley. These heavy rains increased the Nile river runoff until it resembled the current flow of the Amazon River. Doumenge argued that so much rain fell in the region that a surface layer of low salinity water between 15 and 20 meters deep covered the surface of the Mediterranean Sea. He argued that all life below this low salinity layer died for lack of oxygen. He claimed that the heavy rainfall lasted between 40 and 60 years.[34]

Further evidence for this flooding might come from a study published by Andre Goudie. He described a very important event that happened around 9000 BC. That event was the demise of many of the mammals in the world. Goudie noted that a massive reduction in mammal species occurred at some point after 13,000 BC, and that the reduction in species may have centered around 9000 BC. This mass extinction affected especially the big game animals. There remains a strong debate over whether this mass extinction of mammal species was caused by human action or environmental change.[35] It is not impossible that this massive extinction may have resulted from climate changes associated with the Younger Dryas and the transition to the Preboreal period.

A memory of this time may well have been preserved in flood accounts both in Genesis and across the region. The account would also have been preserved in Job 22:15-17. This passage described rebels who lived before Noah's flood. It notes that their foundations were washed away by a river. The massive floods would have destroyed evidence of previous human habitation across much of the ancient world.

It is fair to ask how river valley floods could have lasted for so long. After all, it could be expected that the flood would pour downhill and flow out of the valley. The real history of Mesopotamia may not have been that simple. During the Younger Dryas, drought conditions converted the Tigris and Euphrates rivers from meandering rivers to braided streams with marshes and lakes. The braided rivers had many channels separated by small islands. The channels were very shallow, and were filled with sediment. The channel paths changed constantly. Mesopotamia as a whole had only a slight downhill slope after the Euphrates emerged from the Syrian highlands at Hit, and the Tigris passed the contemporary village of Tikrit. So a vast flood that covered the whole valley would have taken a very long time to drain southeast to the sea. Even the limited Missouri and Mississippi valley floods of 1993 took over a month to fall back to normal levels. The Missouri valley floods filled the whole river valley. The flooding at the end of the Younger Dryas would have been far more extensive, and would have filled Mesopotamia for a much greater time period.

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33 Martine Rossignol-Strick, et al. "After the Deluge: Mediterranean Stagnation and Sapropel Formation," *Nature* 295 (1982): 105-110.

34 Doumenge, "The Mediterranean Crises."

35 Goudie, *Environmental Change*, 140-143.

Yahweh promised in Genesis 8:20-22 that He would never again curse the ground because of man's sins.[36] As long as the earth remained, seed time and harvest, cold and heat, summer and winter would never cease. After the flood, climate conditions have been rather unstable at times. Several cold and dry periods have occurred, but the earth has never again fallen into a full glacial cold like the Younger Dryas.

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The covenant sign of Noah's covenant was the glory rainbow that covered the earth in Gen. 9:12-17. This glory bow reappeared in Ezek. 1:28 as the glory that surrounded God's throne. So the sign of God's covenant may be God's presence in His creation. This rainbow has been interpreted in various ways. See: Laurence A. Turner, "The Rainbow as the Sign of the Covenant in Genesis IX 11-13," *Vetus Testamentum* 43 (1993): 119-124.