MID AND HIGH LATITUDE FLORA DEPOSITED IN THE GENESIS FLOOD PART I: UNIFORMITARIAN PARADOX

MICHAEL J. OARD*

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Abstract

Paleofloras from mid and high latitudes indicate a warm, equable climate for the "Mesozoic" and "early Tertiary." Especially interesting are the warm-climate "forests" and subtropical fauna found on Axel Heiberg and Ellesmere Islands near 80°N latitude. Computer simulations indicate the Cretaceous and early Tertiary climate would be quite cold in winter at high latitudes and at mid latitudes within continental interiors. Several possible explanations for this uniformitarian paradox are reviewed and shown to be inadequate. This presents another contradiction to the uniformitarian paradigm in which it has been suggested that there was a temperate and long lasting "Tertiary" period.

Introduction

Fossilized trees, leaves, sticks, cones, and fruits, indicating a mild temperate to tropical climate, have been known from mid and high latitudes since the mid 1800s (Hickey, West, Dawson, and Choi, 1983). This warm-climate flora has been dated from the upper Devonian through the early Tertiary of the geological time scale (Creber and Chaloner, 1984). (I do not subscribe to the uniformitarian time scale, which is based mainly on dating from the fossil floras and faunas. Periods and eras are used for discussion purposes only.) The temperature indicated by the fossil floras is cooler in the late Tertiary, although temperatures remain significantly warmer than at present (Chaney, 1959; Hills and Ogilvie, 1970; Funder, Abrahamsen, Bennike, and Feyling-Hanssen, 1985; Clutter, 1985; Matthews, 1987; Cronin and Dowsett, 1993).

Since about 1980, sigificantly more paleofloras, as well as paleofaunas, have been discovered at high latitudes of both hemispheres. Even dinosaurs have been unearthed in Antarctica and near the Arctic Ocean in Alaska and Canada (Oard, 1995). Scientists are also analyzing the wood from fossil "forests" in more detail to learn about the paleoenvironment (Christie and McMillan, 1991a). At the same time, general circulation models of the atmosphere are becoming more sophisticated and being applied to Cretaceous and early Tertiary paleoclimates (Walker, 1993).

It is the purpose of this article to briefly describe the climatic implication of the paleofloras from mid and high latitudes. Special emphasis will be placed on the detailed analysis of the vertically stacked leaf and "forest" layers on Axel Heiberg Island in the Canadian Archipelago. The results of improved climate simulations for presumed past climates will be described. Part II of this article will present a creationist hypothesis to account for the uniformitarian paradox.

Climatic Implications from Mid and High Latitude Paleoflora of Western North America

Fossil wood, leaves, fruits, and cones are common at mid and high latitudes worldwide from the late Mesozoic to the early Tertiary (Creber and Chaloner, 1985). The late Tertiary is assumed to be a time of gradual cooling from the warm Cretaceous Period to the Ice Age. So locations that have cooler-climate floras, not associated with the warm-climate floras or index fossils from an earlier period, are often pigeonholed into the late Tertiary climate "bin." Evidence for this is indicated by the many instances where dates have changed from one period to another based on newer information or reanalysis. For instance, some flora have jumped from a brief warm period in the Miocene back to the warm Eocene or Paleocene, and vice versa (Axelrod, 1966; Wolfe, 1980, p. 318; Schweitzer, 1980; Axelrod, 1984, p. 106; Wolfe and Wehr, 1987). If the cool-climate paleofloras cannot be relegated to the late Tertiary, they are assumed to either occupy a short cool period in an otherwise long warm period, or to have grown at high altitude and been mixed with warm flora during mountain floods.

Warm-climate floras are abundant in western North America. For instance, Wolfe (1977) has documented an early Tertiary paleoflora from Alaska north of 60°N that contains palms, swamp cypress, mangroves, climbing vines, and other plants that now inhabit a warm, if not tropical climate. The characteristics of the leaves, based on comparisons between modern plants and the climate, such as the size and whether the leaf margin is smooth or toothed, also favor warmth (Wolfe, 1978, 1985, 1993). Cool climate plants also found in the area are assumed to occupy a cool period within the warm early Tertiary (Wolfe, 1985).

Wolfe believes the overall evidence points to an early Tertiary subtropical to nearly tropical paleoclimate in southern Alaska. Not only that, this same climate can be found throughout the remainder of Alaska, British Columbia, the United States, and Siberia (Wolfe, 1977, pp. 42, 45). The climate was also highly equable, which means there was little or very slight seasonal or diurnal change in temperature (Wolfe, 1978, p. 697).

The northwestern part of the United States is well known for its many Tertiary paleoflora sites (Beck, 1945; Chaney, 1959; Wolfe, 1968, 1971, p. 28; Meyer, 1973; Manchester, 1981, 1987; Wolfe and Wehr, 1987). Ginkgo Petrified Forest State Park at Vantage, Washington, records over 200 species of trees from the area. The paleofloras are found within basalt interbeds associated with pillow lavas. One of the trees is the Ginkgo tree (Figure l), which is a common fossil across the Northern Hemisphere over much of Mesozoic and Tertiary geological time. It was thought extinct for many years until found growing in China.

The most unusual aspect of Ginkgo Petrified Forest State Park is that trees and plants range from subtropical, such as *Eucalyptus*, to cool temperate, such as spruce and birch (Coffin, 1983, p. 213). This strange

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*Michael J. Oard, M.S., 3600 7th Ave. South, Great Falls, MT 59405.

Figure 1. Ginkgo tree growing in creationist Ed Nafziger's back yard in Ephrata, Washington, near Ginkgo Petrified Forest State Park. Although originally found living in China, it obviously has a greater climatic range.

mix of climate types is explained by floods transporting high altitude trees down into low altitude swamps. This explanation is doubtful, since the floras are found within flat interbeds between layers of the Columbia River Basalt.

This mix of tropical and cool-climate paleofloras during the early Tertiary is seen at other locations of western North America Brown, 1962; MacGinitie, 1974; Wolfe, 1977). In the Ruby River area of southwestern Montana, swamp cypress and a tropical vine are found with pine, spruce, and fir (Becker, 1961). At Republic, Washington, a mild temperate paleoflora was found (Wolfe and Wehr, 1987). These cool-climate trees and plants are assumed to be from an "upland" area, similar to the explanation given for cool-climate trees at Vantage. However, of the estimated 450 species in the paleofloras found at Republic and nearby Princeton. British Columbia, some are from tropical climates (Wehr and Hopkins, 1994).

Other Mid and High Latitude Paleofloras

So far, I have briefly discussed warm-climate paleofloras from the mid latitudes of western North America. The pattern is typical for other areas of the Northern Hemisphere. During the early Tertiary, a wide tropical belt supposedly extended to 50° paleolatitude with warm-climate to tropical paleofloras found from 50° almost to the poles (Frakes, Francis, and Syktus, 1992). For instance, palms and mangroves are among the tropical fossils found in southern England (Collinson and Hooker, 1987). Palms and swamp cypress are found in the early Tertiary of Spitsbergen (Schweitzer, 1980). *Metasequoia* and swamp cypress have been discovered in the Queen Elizabeth Islands of northeast Canada (Christie and McMillan, 1991a). A number of petrified palm fruits have been unearthed in northwestern Greenland (Koch, 1963).

Fossil floras indicating a warm climate have recently been discovered in Antarctica. Jefferson (1980) found a paleoflora on Adelaide Island of the Antarctic Peninsula that indicated a temperate Cretaceous climate. Closer to the South Pole on Alexander Island, at 70°S latitude, a fossil "forest" was discovered (Jefferson, 1982). Several other localities on the Antarctic Peninsula have yielded fossil trees, including cycads that currently grow in a subtropical to tropical climate (Francis, 1986, p. 668). Pollen and sports from a variety of tropical plants and trees are abundant on the Antarctic Peninsula (Dettmann, 1989). In spite of the tropical to subtropical vegetation and pollen, the climate is said to be only temperate, although equable and wet (Jefferson, 1980, 1982; Dettmann, 1989)

The Cretaceous trees from Antarctica show wide growth rings that are often uniform. The ring widths from the wood on Alexander Island average about 2 to 3 mm. The largest width is about 10 mm. These are comparable to ring widths of living trees from the warm- to cool-temperate forests of Australasia (Francis, 1986, p. 678). Semitropical Queensland, Australia, where trees have an average ring width of 2.5 mm, is a suggested analog. The precipitation in that region averages 1.7 to 2.7 meters / year with a dry season that causes the rings.

Just as surprising is the recent discovery of a fossil "forest" in the Transantarctic Mountains at 84°S latitude (Taylor, Taylor, and Cúneo, 1992). These upright tree stumps were fossil dated as Permian. They are likely *Glossopteris* trees because the shale below the "forest" contains leaf impressions from this tree. The rings of the tree stumps averaged 4.5 mm and were as large as 11.38 mm! There is a large amount of early wood, little late wood, and no frost rings. The climate was deduced to be warm and equable.

Normally, *Glossopteris* is assumed to be a cool climate plant only because it is closely associated with ancient ice age "tillites" from the Southern Hemisphere. However, recent information suggests that the *Glossopteris* paleoflora is a warm, possibly tropical, paleoflora (Banerjee, 1990). If *Glossopteris* was a tropical or even a warm-temperate plant, the late Paleozoic "tillites," intimately associated with the *Glossopteris* paleoflora, likely are not hardened ice age tills, but large submarine mass flows (Molén, 1990; Oard, 1994).

In discussing fossil paleofloras, I have assumed the current latitude. If the assumed paleolatitude is considered, the Antarctic Peninsula is shifted to a lower latitude, but much of Australia and New Zealand would be included within the Antarctic polar circle. A large variety of Cretaceous fauna and flora, including abundant dinosaurs, have been found in southeast Victoria, Australia (Oard, 1995). The paleolatitude is assumed to be 70 to 85°S (Douglas and Williams, 1982). A mixture of climatic types is found, including the subtropical cycad tree. The conifers indicate no marked period of dormancy. Although Douglas and Williams interpret this data as supporting a warm temperate climate, much of the fauna and flora indicate at least a subtropical climate with rare freezing temperatures.

The abundant evidence for warmth at mid and high latitudes is extremely perplexing to uniformitarian scientists. Because of this conundrum, some uniformitarian scientists have tried to downplay the tropical aspect of the paleoflora (MacGinitie, 1974, p. 40; Axelrod, 1984; Horrell, 1991). Creber and Chaloner (1985, p. 38) state the implication of this warm mid and high latitude vegetation:

> Together with the broadening of the low-latitude belt there is a corresponding extension of fossil wood occurrences into very high northern and

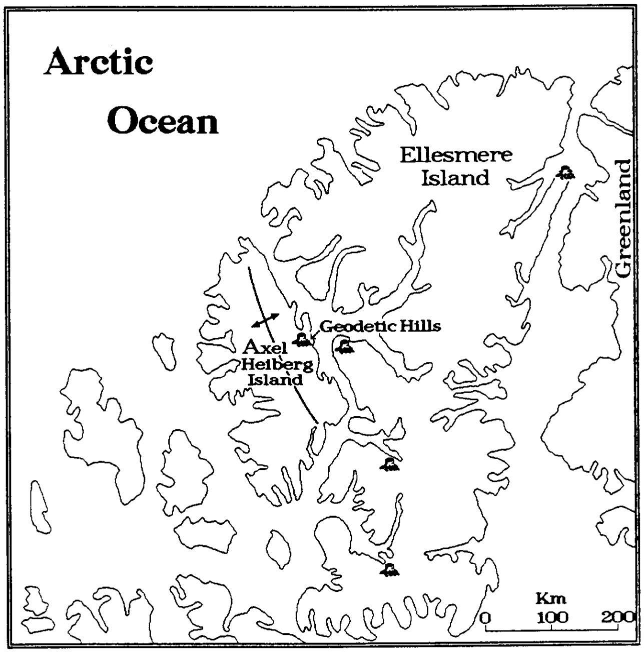

Figure 2. Map of Axel Heiberg and Ellesmere Islands showing locations of the Geodetic Hills stacked mummified "forests" and other "forests" found on Ellesmere Island. Sediments at the Geodetic Hills likely derived when anticline in central Axel Heiberg Island rose (Drawn by David Oard).

> southern palaeolatitudes where tree growth is not possible today in the climate that obtains in such high latitudes. Not only do the occurrences of fossil wood indicate the existence of very high latitude forests but the wide ring widths show that wood productivity was of a high order. . . . The ring widths of the modern plants are minute compared with those in the later Mesozoic and Early Tertiary at comparable latitudes. It is very evident that the climate of the latter geological periods must have been of a totally different character to have promoted such productivity demonstrated by the fossil woods.

Mummified "Forests" on Axel Heiberg Island

Perhaps the most perplexing fossil flora site for uniformitarian scientists is the mummified "forests" and leaf litters found on Axel Heiberg Island at 80°N latitude in the Queen Elizabeth Islands of Canada (Figure 2). The flora is exceptionally well preserved and well studied (Christie and McMillan, 1991a). The wood is not petrified and can be cut with an axe and burned. The upright trees are up to one meter high, waterlogged, and often hollow.

The largest trunk diameter is one meter, and the root mass flares to as much as several meters in diameter. There are also horizontal logs associated with the upright stumps. One horizontal log is 11.5 meters (m) long with little taper, indicating the tree was once much longer (Francis, 1991b, p. 34). Mummified fossil forests are also found on Ellesmere, Ellef Ringnes, and Amund Ringnes Islands (Francis, 1988, 1990, 1991a; Taylor, 1990; Felix, 1993). Not all of the wood in the Queen Elizabeth Islands is mummified; much of it is petrified (Riediger and Bustin, 1987; Francis, 1988).

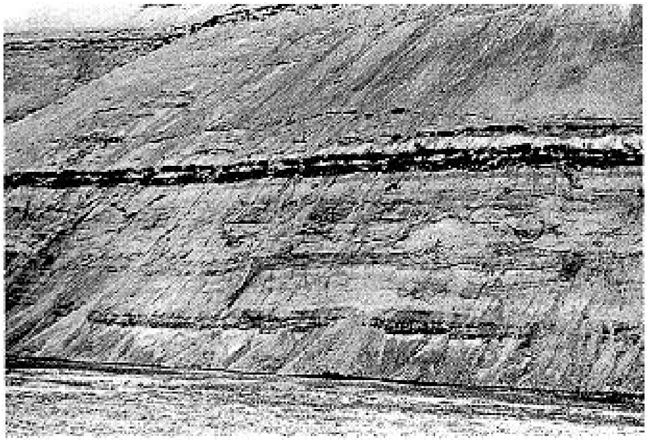

Figure 3. Fining-upward sandstone-coal (lignite) units in the upper coal members of the Eureka Sound Formation at the Geodetic Hills, eastern Axel Heiberg Island (photo by B. D. Ricketts, courtesy of the Geological Survey of Canada - GSC 1994-3301).

The "forests" in the Geodetic Hills of eastern Axel Heiberg Island are located in the upper portion of the Eureka Sound Formation. This formation is a 3,300 meter thick unit that changes facies from conglomerate in central Axel Heiberg Island to interbedded mudstone, siltstone, sandstone, and "coal" in the east (Miall, 1986; Riediger and Bustin, 1987; Ricketts, 1991). The conglomerate likely was eroded during the uplift of the Princess Margaret Arch, shown as a generally north-south anticline on Figure 2 in the central part of the island. Paleocurrent directions are toward the east and southeast in eastern Axel Heiberg Island (Ricketts, 1991, p. 15). The eastern facies are generally unconsolidated and really should be called sand, silt, and clay (Tarnocai and Smith, 1991, p. 175).

In the Geodetic Hills, there are 50 "coal" beds in a 120 meter vertical section (Ricketts, 1991). However, some investigators recognize only about 20 to 30 "coal" beds. Figure 3 shows about six of these "coal" seams separated by sandstone and finer-grained layers. You can see that a case can be made for more than six, depending on whether one counts the beds that split into two or more beds due to mudstone interbeds.

The "coal" beds, also called lignite (a weakly developed coal), are actually compressed peat (Tarnocai and Smith, 1991, p. 175). The peat beds vary from a few centimeters to 1.5 m thick and can be traced up to 5 km with little change in thickness (Ricketts, 1991). On neighboring Ellesmere Island, 26 "coal" seams, one as much as 45 m thick. occur in a 434 m section (Miall, 1986, p. 249).

The hundreds of mummified upright tree stumps are found in only a few of the upper peat beds on Axel Heiberg Island. These vertically stacked "forests" bring to mind the multiple fossil "forests" in Yellowstone National Park (Coffin, 1983). Bustin (1982, p. 146) thought most of the peat was allochthonous (transported), but the upright tree stumps persuaded investigators that the peat beds were autochthonous (grew in place). See a creationist discussion of allochthonous vs autochthonous deposition of fossil wood in Williams, 1993, pp. 110-111.

The Eureka Sound Formation is dated as late Cretaceous and early Tertiary. However because of a diag-

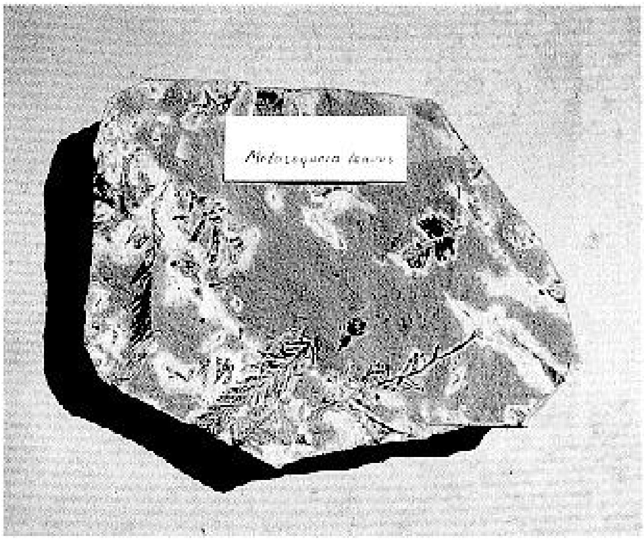

Figure 4. Fossil needles of *Metasequoia* from Ginkgo Petrified Forest State Park, Vantage, Washington Ed Nafziger's fossil collection).

nostic spruce cone, the upper part of the formation, near where the fossil forests are found. was once considered Miocene and early Pliocene. Bustin (1982, p. 140) states:

> The occurrence of abundant cones of *Picea banksii,* together with the microflora in these deposits, however, clearly indicates they are correlative with the upper member of the Beaufort Formation on northern Banks Island and on Meighen Island and are of Miocene (?)early Pliocene age . . . [emphasis mine].

The spruce, *Picea banksii,* is considered an index fossil, dating layers as in the upper Beaufort Formation of Miocene and Pliocene age in the Canadian Arctic Islands (Hills and Ogilvie, 1970). The Beaufort Formation, found mainly in the western Queen Elizabeth Islands, contains fossil wood, seeds, and nuts of at least 95 vascular plants and trees, many of which come from modern climates much farther south (Matthews, 1987). Lithologically, the Beaufort and Eureka Sound Formations are very similar (Christie and McMillan, 1991b, p. xiv). Thus, the two formations are simply separated subjectively by index fossils (West, Dawson, Hickey, and Miall, 1981, p. 294; Hickey, West, Dawson, and Choi, 1983; Matthews, 1987, p. 83). The fossil forests of the Geodetic Hills are now considered Eocene, based on palynology, although spruce cones that look like *Picea banksii* are found in the leaf litters (Basinger, 1991, pp. 62, 63).

Because of plant fossils, the Eureka Sound Formation was long considered exclusively nonmarine in origin, until Dawson, West, Ramaekers, and Hutchison (1975) found marine fossils, including crinoids, foraminifera, and dinoflagellates. Marine fossil specimens are now relatively common (Riediger and Bustin, 1987). This indicates that a large portion of the formation is marine in origin. The marine fossils also give us a clue to the environment of formation of the fossil "forests."

An analysis of the well preserved leaves, cones, fruits, twigs, and upright stumps in the Geodetic Hills indicates the climate was much warmer and wetter than the present polar climate. The macroflora in the peat, as well as most of the upright stumps, is predominantly from the deciduous conifers *Metasequoia* and *Glyptostrobus.* The *Metasequoia* (Figure 4), like the Ginkgo tree, is a very common fossil tree found in the Cretaceous and Tertiary of the Northern Hemisphere. It was also thought extinct, but was found in a remote area of south central China, where the climate is mild with wet summers and very little winter frost (Chu and Cooper, 1950). *Glyptostrobus* is the swamp cypress and indicates a warm climate. The tree rings in the stumps are large, typically 3 mm wide with a maximum of 10 mm, and show little or no indication of stress (Francis, 1990; Greenwood and Basinger, 1993, p. 1919). An analog for the environment and climate on Axel Heiberg Island is the cypress swamps of the Alabama wetlands (Francis, 1991b, p. 34) or the Florida Everglades (Francis, 1991a, p. 60).

Analysis of macroscopic plant remains and pollen in the peat beds indicates the presence of hickory, maple, elm, ash, alder, birch, beech, oak, pine, spruce, fir, larch, cedar, hemlock, and katsura (Frances, 1990; Basinger, 1991; McIntyre, 1991). Most of these plants and trees grow in a temperate to warm temperate climate (McIntyre, 1991, p. 86). The spruce, larch, and white pine generally grow in cool to temperate climates (Obst et al., 1991, p. 141). So there is a mixture of plants and trees from different climates (Greenwood and Basinger, 1993, p. 1921). Thus, the climate deduced from the paleoflora of the Geodetic Hills fits with the early Tertiary paleoclimate from other areas of the high latitudes of the Northern Hemisphere (Basinger, 1991, p. 40).

Vertebrate fossils unearthed from the Eureka Sound Formation on west central Ellesmere Island include varanid lizards, snakes, salamanders, tortoises, alligators, birds, and several mammals, including rodents, horses, and brontothere (West, Dawson, and Hutchison, 1977; Estes and Hutchison, 1980; McKenna, 1980; Francis, 1988, p. 315). The mammals also include abundant flying lemurs, which need a year-round supply of seeds and fruits in the trees, implying above freezing conditions all through winter. The fossil fauna is further reason the "forest" beds are now placed in the Eocene upper Eureka Sound Formation and not in the Beaufort Formation (Ricketts, 1991, p. 3). The fossil vertebrates reinforce the conclusion of an equable climate, but also indicate it was more subtropical or tropical than temperate (Brattstrom, 1961; McKenna, 1980; Estes and Hutchison, 1980; Francis, 1988). Basinger succinctly sums up the climatic implication of this paleoflora and paleofauna: "There was no frost" (Pearce, 1992, p. 6).

The present mostly frozen terrain is barren with only a few dwarf willows that grow a few centimeters high in summer. The current annual average temperature for the area is estimated to be -20°C with a yearly precipitation of only 6.5 cm (Tarnocai and Smith, 1991, p. 172). The average temperature of the coldest month is -38°C (Pearce, 1992). At that average, minimum temperatures likely average around -45°C. The extreme minimum temperature, therefore, is probably around -55°C, the difference between the extreme minimum temperature represented by the Eureka Sound paleoflora and paleofauna and the present temperature is about 55°C!

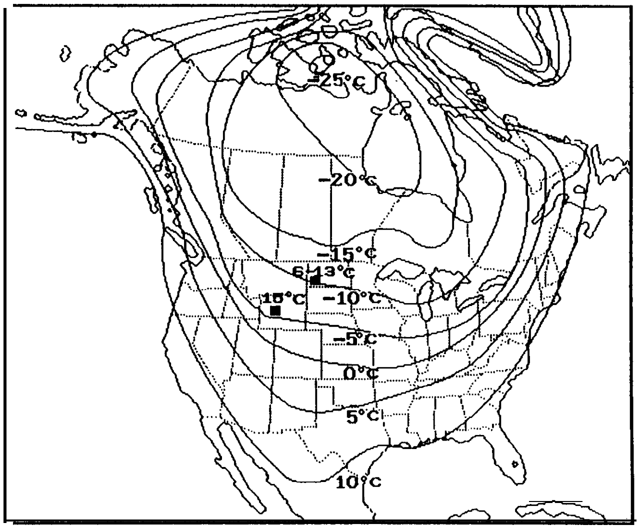

Figure 5. Simulated minimum January surface temperature for the Eocene of North America using polar sea-surface temperatures 6 to 12°C warmer than today with low topography. Minimum surface temperature from Eocene paleoflora indicated for western Wyoming and North Dakota (Redrawn from Sloan and Barron (1992) by David and Nathan Oard).

Computer Simulations Indicate Cold Winters

Uniformitarian scientists talk often about a warm Cretaceous and early Tertiary at mid and high latitudes. But is such a climate possible? To test this possibility, climatologists have tried to model the paleoclimate with presumed Cretaceous and early Tertiary geography. The GENESIS model, run by Sloan and Barron (1990, 1992), has seasonably varying solar radiation and a mixed-layer ocean submodel. So the recent climate models are much improved over the older versions.

Sloan and Barron are sympathetic to the concerns of the paleobotanists. Thus, they have tried to simulate the presumed early Eocene January climate using favorable sea-surface temperatures and low continental altitudes. Figure 5 shows the simulated average January minimum temperatures over North America for the Eocene with low continental altitude and with polar ocean temperatures 6 to 12°C warmer than at present. This compares with the computer simulation with current polar ocean temperatures in Figure 6. As can be seen, warmer polar oceans significantly warmed northern Canada. However, January temperatures over large areas of interior Canada were colder than -15°C. The model is known to be 7°C too cool in some areas within the continental interior (Sloan and Barron, 1992, p. 485). However, they do not believe this model bias for local areas is significant for their conclusions.

Figures 5 and 6 both show quite cold January temperatures in the northern United States. January minimum temperatures generated by the GENESIS model compare to the calculated minimum temperatures from the fossils of 6 to 13°C for western North Dakota and 15°C for western Wyoming. The fossil temperatures were based on both the paleoflora and paleofauna (MacGinitie, 1974; Hickey, 1977; Wing and Greenwood, 1993; Wing, 1994). For instance, there are Eocene crocodiles, large tortoise that cannot hibernate, tree ferns, and palm fossils in Wyoming and Montana (Brattstrom, 1961; Kerr, 1993; Wing and Greenwood, 1993). A new analysis of fossil crocodiles in the United States and southern Canada shows crocodiles are found as far north as extreme southern Alberta or Saskatchewan in the Eocene, as well as in the Miocene (Hutchison, 1982; Markwick, 1994). The above warm-climate fossils constrain the paleoclimate of interior North America to at least a mild climate with rare frost (Wing and Greenwood, 1993, p. 245). Both Eocene climate simulations, on the other hand, simulated temperatures of -10°C for North Dakota and -6°C for Wyoming. Simulated annual precipitation for western North Dakota was about 50 cm/yr, while the paleoflora suggested 129 cm/yr (Sloan and Barron, 1992, p. 198).

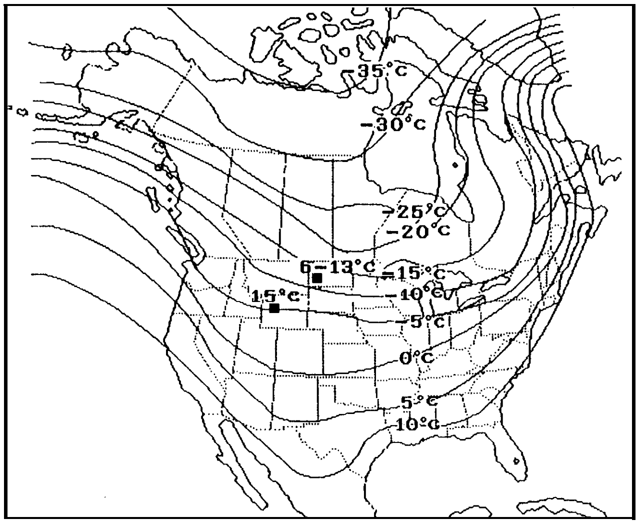

Figure 6. Same as Figure 5, except for present-day sea-surface temperatures (Redrawn from Sloan and Barron (1992) by David and Nathan Oard).

In analyzing the cold Eocene temperatures under favorable boundary conditions, Sloan and Barron (1990, 1992) conclude that January temperatures in continental interiors depend only weakly on sea-surface temperature and altitude. The cold, dry winter temperatures at high and mid latitudes within continental interiors depend primarily on the *lack of sunlight,* and there does not appear to be anything that can be done about it. Thus, Sloan and Barron (1990, p. 489) see little hope for resolving the contradiction between the paleofloras and paleoclimate:

> Eocene and Cretaceous climate-model experiments demonstrate that regardless of conditions of warm polar oceans, differences in pole-to-equator surface-temperature gradient, or topography, above freezing temperatures in winter for continental interiors at middle to high latitudes cannot be maintained.

Of course, paleobotanists cannot accept this conclusion. They believe there is something drastically wrong with the climate simulations. Paleobotanist Bruce Tiffney insists the climate models are wrong: "The models don't match the data we've got. The modellers have missed something, and its time we brought them to heel" (Pearce, 1992, p. 6). Could it be that the models are basically correct and the paleobotanists are operating with a defunct uniformitarian model?

Uniformitarian Attempts to Solve the Contradiction

Uniformitarian scientists have brought forth several proposed solutions to the contradiction. Some have suggested increasing greenhouse gases, such as CO_2, in the climate models by up to 10 times current levels. However, increased CO_2 will not help because high CO_2 concentrations are already implicit in the Sloan and Barron model by the higher polar sea-surface temperatures. Besides, increased greenhouse gases would likely cause the tropics to overheat (Barron and Washington, 1985; Wing, 1994, p. 2).

One obvious possibility is that the paleofloras could have floated to mid and high latitude. Uniformitarian scientists, therefore, would not be constrained to postulate a warm climate at polar latitude. They reject this idea because the upright fossil trees and the fresh leaves, cones, and fruits force them to believe the floras grew in place.

One possible explanation is that the flora "floated" to higher latitudes from low latitudes on crustal plates. However, plate tectonics is of little help. The paleolatitude of Antarctica supposedly has changed little since the Permian. Although the Antarctic Peninsula supposedly was at lower latitude during the Cretaceous, Australia and New Zealand were within the Antarctic circle (Douglas and Williams, 1982). More land would produce cooler polar temperatures. According to plate tectonics, Axel Heiberg and Ellesmere Islands had an Eocene paleolatitude of between 74 and 80°N, not much different from the present (Irving and Wynne, 1991). The presumed paleolatitude of Alaska during the late Mesozoic and early Tertiary presumably was 70 to 75°N, about 10° farther north (Wolfe, 1985)! The mid latitudes of North America have changed little since the Cretaceous (Wolfe, 1985).

Some have suggested that Alaska is a patchwork of "exotic" microplates or terranes, plastered there by the northward moving Pacific plate. Thus, they claim the warm climate vegetation originated at low latitude. Wolfe (1977, pp. 36, 37; 1978, p. 698) believes that this plastering of microplates occurred before the Tertiary. Wolfe (1985, p. 362) also states that the geologic and paleontologic data do not support the Yakutat microplate being at low latitude during the warm early Eocene. Besides, the warm climate vegetation is found in many other areas of the mid and high latitude of the Northern Hemisphere, most notably Axel Heiberg and Ellesmere Islands. Wing (1994, p. 1) admits that drifting continents are no help:

> In the succeeding decades, however, it has become clear that many of the occurrences of warm-adapted lineages in regions that presently have cold climates are not explained by drifting continents.

Another possibility for solving the problem of warm-climate vegetation at mid and high latitude is that the continents contained more lakes or inland seas that would moderate the climate. The Mesozoic "inland sea" should have helped warm the Cretaceous climate in the simulation. This apparently did not help. When the GENESIS model was run with presumed Cretaceous geography, it produced a mean global cooling of about 0.2 C below today's average (Walker, 1993)!

The "inland sea" of middle North America likely is of little help for the Eocene simulation, since it mostly was dry by that time. Sloan and Barron suggest that large lakes could explain the warm Eocene Wyoming paleoflora. Recently, Sloan (1994) has published a paleoclimate simulation with a large lake that makes up the Eocene Green River Formation in northeast Utah, northwest Colorado, and southwest Wyoming. She also included simulations with two and six times the preindustrial CO_2 level, and one and one half times the current northward oceanic heat transport. The simulation with six times the CO_2 level did confine below freezing January temperatures to Canada. However, nothing was said about overheating the tropics. The addition of the large lake with twice the CO_2 and one and one half times the current oceanic heat transport did manage to warm the January minimum temperatures above freezing around the lake and a little downwind to the east. However, the model was still 10°C too cool compared to the fossils found at those locations.

Sloan's model has too crude a grid, which is 4.5° in latitude by 7.5° in longitude, to accurately simulate lakes. The lake occupied roughly two grid points in the simulation, which is too large and about four times the size of one of today's Great Lakes (Valdes, 1994). The area of the Eocene Lake is only supposed to be 25,000 km^2, which is much smaller than the combined area of the Great Lakes, which is about an order of magnitude larger. The Great Lakes ameliorate winter climate some around the lakes, but temperatures are still quite cold and snowfall high in winter. I would expect the net effect of the lakes represented by the Green River Formation to be small and only near the lake. Besides, there are warm-climate Eocene paleoflora and paleofauna that are quite far from the Green River Formation, for instance in western North Dakota, southern Alberta, and southern Saskatchewan. They all could not be adjacent to large lakes. There is also the uniformitarian problem of no Arctic Ocean during the Eocene that would have modified the mid and high latitude climate (Wolfe, 1985, p. 363).

Some have suggested a reduced tilt of the earth's axis as a solution to the problem (Wolfe, 1978, 1980; Douglas and Williams, 1982). Barron (1984) has shown from climate simulations that a low axial tilt causes a cooler climate at high latitudes, not a warmer climate. This is because total annual solar radiation would be reduced. It is the 23.5° tilt of the earth's axis that causes a warmer polar climate.

Scott Wing (1994) dismisses other possibilities for explaining a much warmer climate. For instance, evolving climatic tolerances of plants and animals does not work: "It appears that evolving climatic preferences do not explain 'misplaced' tropical plants and animals" (Wing, 1994, p. 1). More efficient poleward heat transport by the oceans and atmosphere, reduced polar elevation, no polar ice, and higher sea levels are not strong enough to overcome strong cooling during winter darkness (Wing, 1994, p. 2). He concludes: "The problem of equable climates at high latitudes has become a central paradox in paleoclimatology." (1994, p. 12)

Uniformitarian Explanation for the Axel Heiberg "Forests"

Investigators, tied to uniformitarian explanations, postulate the trees on Axel Heiberg Island grew in anaerobic swamps on a meander flood plain. They also claim a paleosol below the leaf litter as evidence the trees grew in situ, even though the stumps rarely penetrate this "paleosol." The trees first died and then the part above water rotted away. Then, periodically a large flood would come along and rapidly bury the forests and their leaf litter with sand and mud (Ricketts, 1991, p. 21; Basinger, 1991, p. 46). Basinger (1986, p. 35) writes:

> Far rarer, though, were catastrophic events that could preserve an entire forest. Such events could only have been floods of immense proportions. carrying huge quantities of sediment into river systems and spilling out over the flood plain, rapidly burying the lowland swamp forests beneath a suffocating blanket of silt.

There are many serious problems with this hypothesis. One problem is that a giant flood would also have buried trees taller than one m that had not yet died. A second problem is that there are many horizontal logs up to 10 m long that had not yet rotted. A third problem is the paleoflora of the leaf litter indicates many other types of trees that do not normally grow well in swamps. A fourth reason contrary to the uniformitarian scenario is that the leaf litter was not eroded, since the thickness of each layer is generally uniform. The postulated floods would indeed be gigantic because they start out depositing thick three-dimensional conglomerate in the west that fines eastward. The thickness of the flood sediments over the peat layers varies, but is up to about 10 m thick. A flood that deposits this much sediment would be so substantial that it should bury trees taller than one m. Why are all the tree stumps a meter or less in height?

It is also doubtful the layers underlying the peat layers are really paleosols. "Paleosols" are commonly claimed in the geological literature (Wright, 1986). It seems to me these claims are specious and are based on uniformitarian assumptions (Oard, 1990, p. 149-159). In other words, since plants obviously grow in soils, buried soils are *automatically* assumed whenever plant remains are found.

In the Geodetic Hills the peat layers are assumed to be the A layer of a soil profile. So the layer below each leaf litter is automatically a B horizon. This "paleosol" was analyzed by Tarnocai and Smith (1991). After mentioning how difficult it is to distinguish ancient pedological features from those formed by geochemical effects in a layer, they list seven criteria used to determine a buried soil. According to them, if any *one* of these features is present, the layer is defined as a paleosol! Just the fact there is a leaf layer above a fine-grained sediment qualifies the sequence as a paleosol. No wonder there are so many claimed paleosols in the geological literature!

However, one criterion especially disqualifies the Geodetic Hills sequence as a series of vertically stacked paleosols. There is no gradation in the degree of decomposition in the leaf litter with depth (Basinger, 1991, p. 43). Christie and McMillan (1991b, p. xiii) express their surprise: ". . . why did the organic matter not rot, oxidize, or petrify during the approximately 45 million years it has awaited exposure in today's Geodetic Hills [sic]?"

Summary

I have mentioned the abundant evidence of paleofloras from warm, even tropical, climates that predominates at mid and high latitudes. Special attention was given to the intriguing succession of fossil mummified "forests" and their attendant leaf litters on Axel Heiberg Island. The paleoflora, as well as the warm-climate paleofauna, speak of a climate in which wintertime minimum temperatures would have been 55°C warmer than now. Climate simulations, using assumed Eocene geography, a warm polar ocean, and low altitude indicated that warmth was not likely at high latitudes nor at mid latitudes within continental interiors. The uniformitarian mechanism for depositing the Geodetic Hills "forests" and leaf litters and other mid latitude paleofloras falls far short.

In Part II I will suggest that the warm climate paleofloras were deposited from floating plant debris during the Genesis Flood. The repeating "forests" and leaf litters on Axel Heiberg Island can also be explained by this model, which is an application of the floating log mat model developed by John Woodmorappe (1978), Harold Coffin (1983), and Steve Austin (1987).*

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References

CRSQ—Creation Research Society Quarterly.

Austin. S. A. 1987. Mount St. Helens and catastrophism. in Proceedings of the First International Conference on Creationism, Volume I. Pittsburgh. pp. 3-9.

Axelrod, D. I. 1966. Potassium-argon ages of some western Tertiary floras. *American Journal of Science* 264:497-506.

———— 1984. An interpretation of Cretaceous and Tertiary biota in polar regions. *Palaeogeography, Palaeoclimatology, Palaeoecology* 45:105-147.

Banerjee. M. 1990. Glossopterid leaves, fertile organs, their earliest occurrence, distribution in time and space and remarks on environment, in H. Ulbrich and A. C. Rocha Campos (Editors), Gondwana Seven Proceedings. Instituto de Geociencias. Universidade de Sao Paulo. Sao Paulo, Brazil. pp. 483-502.

Barron, E. J. 1984. Climatic implications of the variable obliquity explanation of Cretaceous-Paleocene high-latitude floras. *Geology* 12:595-598.

———— and W. M. Washington. 1985. Warm Cretaceous climates: High atmospheric CO_2 as a plausible mechanism, in E. T. Sundquist and W. S. Broecker (Editors). The carbon cycle and atmospheric CO_2: Natural variations Archean to present. Geophysical Monograph 32. American Geophysical Union. Washington D.C. pp. 546-553.

Basinger, J. F. 1986. Our 'tropical' Arctic. *Canadian Geographic* 106:28-37.

————.1991. The fossil forests of the Buchanan Lake Formation (early Tertiary), Axel Heiberg Island, Canadian arctic archipelago: preliminary floristics and paleoclimate, in R. L. Christie

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*Editor's Note: Readers may be interested in a recent series on petrified and charcoalified wood that appeared in the Quarterly as well as the paleoenvironmental conclusions reached in this series. Williams and Howe, 1993, Part I; Williams, 1993, Part II; Williams et al., 1993, Part III; Williams et al. 1995, Part IV.

and N. J. McMillan (Editors). Tertiary fossil forests of the Geodetic Hills, Axel Heiberg Island, Arctic Archipelago. Geological Survey of Canada Bulletin 403. Ottawa. pp. 39-56.

Beck, G. F. 1945. Ancient forest trees of the sagebrush area of central Washington. *Journal of Forestry* 43:334-338.

Becker, H. F. 1961. Oligocene plants from the upper Ruby River Basin, southwestern Montana. Geological Society of America Memoir 82. Boulder, CO.

Brattstrom, B. H. 1961. Some new fossil tortoises from western North America with remarks on the zoogeography and paleoecology of tortoises. *Journal of Paleontology* 35:543-560.

Brown. R. W. 1962. Paleocene flora of the Rocky Mountains and Great Plains. U.S. Geological Survey Professional Paper 375. U.S. Government Printing Office. Washington D.C.

Bustin, R. M. 1982. Beaufort Formation, eastern Axel Heiberg Island, Canadian arctic archipelago. *Bulletin of Canadian Petroleum Geology* 30:140-149.

Chaney, R. W. 1959. Miocene floras of the Columbia Plateau: Part I. composition and interpretation. Carnegie Institution of Washington Publication 617. Washington D.C. pp. 1-134.

Christie, R. L. and N. J. McMillan (Editors). 1991a. Tertiary fossil forests of the Geodetic Hills, Axel Heiberg Island, Arctic Archipelago. Geological Survey of Canada Bulletin 403. Ottawa.

____________________ 1991b. Introduction, in R. L. Christie and N. J. McMillan (Editors), Tertiary fossil forests of the Geodetic Hills, Axel Heiberg Island, Arctic Archipelago. Geological Survey of Canada Bulletin 403. Ottawa. pp. xiii-xvi.

Chu, K-L. and W. S. Cooper. 1950. An ecological reconnaissance in the native home of *Metasequoia glyptostroboides. Ecology* 31: 260-278.

Clutter, T. 1985. The Clarkia fossil bowl. *American Forests* 91(2): 22-25.

Coffin, H. G. 1983. Origin by design. Review and Herald Publishing Association. Washington D.C.

Collinson. M. E. and J. J. Hooker. 1987. Vegetational and mammalian faunal changes in the Early Tertiary of southern England, in E. M. Friis. W. G. Chaloner. and P. R. Crane (Editors), The origins of angiosperms and their biological consequences. Cambridge University Press. Cambridge. pp. 259-303.

Creber, G. T. and W. G. Chaloner. 1984. Influence of environmental factors on the wood structure of living and fossil trees. *The Botanical Review* 50:357-448.

____________________. 1985. Tree growth in the Mesozoic and Early Tertiary and the reconstruction of palaeoclimates. *Palaeogeography, Palaeoclimatology. Palaeoecology* 52:35-60.

Cronin, T. M. and H. J. Dowsett. 1993. PRISM—warm climates of the Pliocene. *Geotimes* November: 17-19.

Dawson, M. R., R. M. West, P. Ramaekers, and J. H. Hutchison. 1975. New evidence on the palaeobiology of the Eureka Sound Formation, Arctic Canada. *Current Issues in Zoology* 28:110-116.

Dettmann, M. E. 1989. Antarctica: Cretaceous cradle of austral temperate rainforests? in J. A. Crame (Editor), Origins and evolution of the Antarctic biota. Geological Society of London Special Publication No. 47. London. pp. 89-105.

Douglas, J. G. and G. E. Williams. 1982. Southern polar forests: the early Cretaceous floras of Victoria and their palaeoclimatic significance. *Palaeogeography, Palaeoclimatology, Palaeoecology* 39:171-185.

Estes, R. and J. H. Hutchison. 1980. Eocene lower vertebrates from Ellesmere Island, Canadian Arctic Archipelago. *Palaeogeography, Palaeoclimatology, Palaeoecology* 30:225-247.

Felix, C. 1993. The mummified forests of the Canadian arctic. *CRSQ* 29:189-191.

Frakes, L. A., J. E. Francis, and J. I. Syktus. 1992. Climate modes of the Phanerozoic. Cambridge University Press. New York.

Francis, J. E. 1986. Growth rings in Cretaceous and Tertiary wood from Antarctica and their palaeoclimatic implications. *Palaeontology* 29, Part 4:665-684.

__________.1988. A 50-million-year-old fossil forest from Strathcona Fiord. Ellesmere Island. arctic Canada: evidence for a warm polar climate. *Arctic* 41:314-318.

__________. 1990. Polar fossil forests. *Geology Today* 6:92-95.

__________. 1991a. Arctic Eden. *Natural History* 100(1):57-64.

__________. 1991b. The dynamics of polar forests: Tertiary fossil forests of Axel Heiberg Island, Canadian arctic archipelago, in R. L. Christie and N. J. McMillan (Editors), Tertiary fossil forests of the Geodetic Hills, Axel Heiberg Island, Arctic Archipelago. Geological Survey of Canada Bulletin 403. Ottawa. pp. 29-38.

Funder, S., N. Abrahamsen, O. Bennike, and R. W. Feyling-Hanssen. 1985. Forested Arctic: evidence from North Greenland. *Geology* 13:542-546.

Greenwood D. R. and J. F. Basinger. 1993. Stratigraphy and floristics of Eocene swamp forests from Axel HeiberG Island, Canadian arctic archipelago. *Canadian Journal of Earth Sciences* 30:1914-1923.

Hickey, L. J. 1977. Stratigraphy and Paleobotany of the Golden Valley Formation (Early Tertiary) of western North Dakota. Geological Society of America Memoir 150. Boulder, CO.

Hickey, L. J., R. M. West, M. R. Dawson, and D. K. Choi. 1983. Arctic terrestrial biota: paleomagnetic evidence of age disparity with mid-northern latitudes during the Late Cretaceous and Early Tertiary. *Science* 221:1153-1156.

Hills, L. V. and R. T. Ogilvie. 1970. *Picea banksii n. sp.* Beaufort Formation (Tertiary), northwestern Banks Island, arctic Canada. *Canadian Journal of Botany* 48:457-464.

Horrell, M. A. 1991. Phytogeography and paleoclimatic interpretation of the Maestrichtian. *Palaeogeography, Palaeoclimatology, Palaeoecology* 86:87-138.

Hutchison, J. H. 1982. Turtle, crocodilian, and champosaur diversity changes in the Cenozoic of the north-central region of western United States. *Palaeogeography, Palaeoclimatology, Palaeoecology* 37:149-164.

Irving, E. and P. J. Wynne. 1991. The paleolatitude of the Eocene fossil forests of arctic Canada, in R. L. Christie and N. J. McMillan (Editors). Tertiary fossil forests of the Geodetic Hills, Axel Heiberg Island, Arctic Archipelago. Geological Survey of Canada Bulletin 403. Ottawa. pp. 209-211.

Jefferson, T. H. 1980. Angiosperm fossils in supposed Jurassic volcanogenic shales. Antarctica. *Nature* 285:157-158.

____________ 1982. Fossil forests from the Lower Cretaceous of Alexander Island, Antarctica. *Palaeontology* 24, Part 4:681-708.

Kerr, R. A. 1993. Fossils tell of mild winters in an ancient hothouse. *Science* 261:682.

Koch, B. E. 1963. Fossil plants from the lower Paleocene of the Agatdalen (Angmartussut) area, central Nugssuaq Peninsula, Northwest Greenland. *Meddelelser Om Gronland* 172(5):1-120.

MacGinitie, H. D. 1974. An early middle Eocene flora from the Yellowstone-Absaroka volcanic province, northwestern Wind River Basin, Wyoming. University of California Publications in Geological Sciences 108:1-103.

Manchester, S. R. 1981. Fossils plants of the Eocene Clarno Nut Beds. *Oregon Geology* 43(6):75-81.

_____________ 1987. Oligocene fossil plants of the John Day Formation, Fossil, Oregon. *Oregon Geology* 49(10):115-127.

Markwick, P. J. 1994. "Equability," continentality, and Tertiary "climate": The crocodilian perspective. *Geology* 22:613-616.

Matthews, Jr., J. V. 1987. Plant macrofossils from the Neogene Beaufort Formation on Banks and Meighen Islands, District of Franklin. Geological Survey of Canada Paper 87-1A. Ottawa. pp. 73-87.

McIntyre, D. J. 1991. Pollen and spore flora of an Eocene forest, eastern Axel Heiberg Island, N.W.T, R. L. Christie and N. J. McMillan (Editors). Tertiary fossil forests of the Geodetic Hills, Axel Heiberg Island, Arctic Archipelago. Geological Survey of Canada Bulletin 403. Ottawa. pp. 83-97.

McKenna, M. C. 1980. Eocene paleolatitude, climate, and mammals of Ellesmere Island. *Palaeogeography, Palaeoclimatology, Palaeoecology* 30:349-362.

Meyer, H. 1973. The Oligocene Lyons flora of northwestern Oregon. *The Ore Bin* 35(3):37-51.

Miall, A. D. 1986. The Eureka Sound Group (upper Cretaceous-Oligocene). Canadian Arctic Islands. *Bulletin of Canadian Petroleum Geology* 34:240-270.

Molen, M. 1990. Diamictites: ice-ages or gravity flows? in Proceedings of the Second International Conference on Creationism. Volume II. Pittsburgh. pp. 177-190.

Oard, M. J. 1990. An ice age caused by the Genesis Flood. Institute for Creation Research. El Cajon, CA.

________ 1994. Submarine mass flow deposition of pre-Pleistocene "ice age" deposits, in Walsh, R. E. (Editor). Proceedings of the Third International Conference on Creationism. Pittsburgh.

________. 1995. Polar dinosaurs and the Genesis Flood. *CRSQ* 32: (in press).

Obst, J. R., N. J. McMillan, R. A. Blanchette, D. J. Christensen, O. Faix. J. S. Han. T. A. Kuster. L. L. Landucci. P. J. Newman. R. C. Petterson, V. H. Schwandt, and M. F. Mesolowski. 1991. Characterization of Canadian arctic fossil woods, in R. L. Christie and N. J. McMillan (Editors). Tertiary fossil forests of the Geodetic

Hills, Axel Heiberg Island, Arctic Archipelago. Geological Survey of Canada Bulletin 403. Ottawa. pp. 123-146.

Pearce, F. 1992. Ancient forests muddy global warming models. New Scientist 140(1901):6-7.

Ricketts, B. D. 1991. Sedimentation, Eurekan tectonism and the fossil forest succession on eastern Axel Heiberg Island, Canadian Arctic Archipelago, in R. L. Christie and N. J. McMillan (Editors). Tertiary fossil forests of the Geodetic Hills, Axel Heiberg Island, Arctic Archipelago. Geological Survey of Canada Bulletin 403. Ottawa. pp. 1-27.

Riediger, C. L. and R. M. Bustin. 1987. The Eureka Sound Formation, southern Ellesmere Island. *Bulletin of Canadian Petroleum Geology* 35:123-142.

Schweitzer, Hans-Joachim. 1980. Environment and climate in the early Tertiary of Spitsbergen. *Palaeogeography, Palaeoclimatology, Palaeoecology* 30:297-311.

Sloan, L. C. 1994. Equable climates during the early Eocene: significance of regional paleogeography for North American climate. *Geology* 22:881-884.

——— and E. J. Barron. 1990. "Equable" climates during earth history? *Geology* 18:489-492.

——— 1992. A comparison of Eocene climate model results to quantified paleoclimatic interpretations. *Palaeogeography, Palaeoclimatology, Palaeoecology* 93:183-202.

Tarnocai, C. and C. A. S. Smith. 1991. Paleosols of the fossil forest area, Axel Heiberg Island, in R. L. Christie and N. J. McMillan (Editors). Tertiary fossil forests of the Geodetic Hills, Axel Heiberg Island. Arctic Archipelago. Geological Survey of Canada Bulletin 403. Ottawa. pp. 171-187.

Taylor, E. L., T. N. Taylor, and N. R. Cuneo. 1992. The present is not the key to the past: A polar forest from the Permian of Antarctica. *Science* 257:1675-1677.

Taylor, I. 1990. Canada's frozen forests. Creation Science Association of Ontario No. 18. pp. 14.

Valdes. P. 1994. Damping seasonal variation. *Nature* 372:221.

Walker, G. 1993. Back to the future. *Nature* 362:110.

Wehr, W. C. and D. Q. Hopkins. 1994. The Eocene orchards and gardens of Republic, Washington. *Washington Geology* 22(3): 27-34.

West, R. M., M. R. Dawson, and J. H. Hutchison. 1977. Fossils from the Paleogene Eureka Sound Formation, N.W.T. Canada: occurrence, climatic and paleogeographic implications, in R. M. West (Editor). Paleontology and Plate Tectonics. Milwaukee Public Museum Special Publications in Biology and Geology No. 2. Milwaukee. pp. 77-93.

West, R. M., M. R. Dawson, L. J. Hickey, and A. D. Miall. 1981. Upper Cretaceous and Paleogene sedimentary rocks, eastern Canadian arctic and related North Atlantic areas, in J. W. Kerr and A. J. Fergusson (Editors). Geology of the North Atlantic Borderlands. Canadian Society of Petroleum Geologists Memoir 7. Calgary. pp. 279-298.

Williams, E. L. and G. F. Howe. 1993. Fossil wood of Big Bend National Park, Brewster County, TX: Part I—Geologic setting. CRSQ 30:47-54.

Williams, E. L. 1993. Fossil wood of Big Bend National Park, Brewster County, TX: Part II—Mechanism of silicification of wood and other pertinent factors. *CRSQ* 30:106-111.

Williams, E. L., G. T. Matzko, G. F. Howe, R. R. White, and W. G. Stark. 1993. Fossil wood of Big Bend National Park, Brewster County, TX: Part III—Chemical tests performed on wood. *CRSQ* 30:169-176.

Williams, E. L., G. F. Howe, G. T. Matzko, R. R. White and W. G. Stark. 1995. Fossil wood of Big Bend National Park, Brewster County, TX: Part IV—Wood structure, nodules, paleosols, and climate. *CRSQ* 31:225-232.

Wing, S. 1994. Paleoclimate, proxies, paradoxes, and predictions. *Palaios* 9:1-3.

Wing, S. L. and D. R. Greenwood. 1993. Fossils and fossil climate: the case for equable continental interiors in the Eocene. *Philosophical Transactions of the Royal Society of London B* 341:243-252.

Wolfe, J. A. 1968. Paleogene biostratigraphy of nonmarine rocks in King County, Washington. U.S. Geological Survey Professional Paper 571. U.S. Government Printing Office. Washington D.C.

———. 1971. Tertiary climatic fluctuations and methods of analysis of Tertiary floras. *Palaeogeography, Palaeoclimatology, Palaeoecology* 9:27-57.

——— 1977. Paleogene floras from the Gulf of Alaska region. U.S. Geological Survey Professional Paper 997. U.S. Government Printing Office. Washington D.C.

——— 1978. A paleobotanical interpretation of Tertiary climates in the Northern Hemisphere. *American Scientist* 66:694-703.

——— 1980. Tertiary climates and floristic relationships at high latitudes in the Northern Hemisphere. *Palaeogeography, Palaeoclimatology, Palaeoecology* 30:313-323.

——— 1985. Distribution of major vegetational types during the Tertiary in E. T. Sundquist and W. S. Broecker (Editors). The carbon cycle and atmospheric CO$_2$: natural variations Archean to present. Geophysical Monograph 32. American Geophysical Union. Washington D.C. pp. 357-375.

——— 1993. A method of obtaining climatic parameters from leaf assemblages. U.S. Geological Survey Bulletin 2040. U.S. Government Printing Office. Washington D.C.

——— and W. Wehr. 1987. Middle Eocene dicotyledonous plants from Republic, Washington. U.S. Geological Survey Bulletin 1597. U.S. Government Printing Office. Washington D.C.

Woodmorappe, J. 1978. A diluvian interpretation of ancient cyclic sedimentation. *CRSQ* 14:189-208.

Wright, V. P. editor. 1986. Paleosols (their recognition and interpretation). Blackwell Scientific Publications. London.

BOOK REVIEWS

God's Own Scientists; Creationists in A *Secular World* by Christopher P. Toumey. 1994. Rutgers University Press. New Brunswick, NJ. 289 pages. Paper $15.00. Cloth $45.00.

Reviewed by Jerry Bergman*

This reviewer has read most of the three dozen or so books often termed anti-creationist, written to lambaste and "refute" the conclusions of those who argue in favor of a designed world view. Most are written by individuals who have a limited first-hand understanding of the intelligent design view. Many simply repeat incorrect statements until conclusions which lack foundation are accepted because they are so often repeated. Those who have completed extensive research in the creationist movement such as Numbers and Toumey have effectively refuted, or at least critiqued, some of the many false conclusions that are mainstay among evolutionary naturalists. As Toumey states, "Two of the most common and simplistic reactions to creationism, especially from its enemies, are that creationism is nothing more than a rote exercise in biblical literalism and that the source of creationism is ignorance of science" (p. 5). He adds that creationism is a "body of knowledge and belief [that] is much richer and much deeper than a narrow-minded devotion to a few dozen verses of sacred scripture" (p. 5). Toumey's account illustrates well the many orientations in creationist research, and effectively refutes the common misconception that creationists are uncritical, uninformed followers of a narrow ideology.

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*Northwest State College, Archbold, OH 43502.