Ancient Ice

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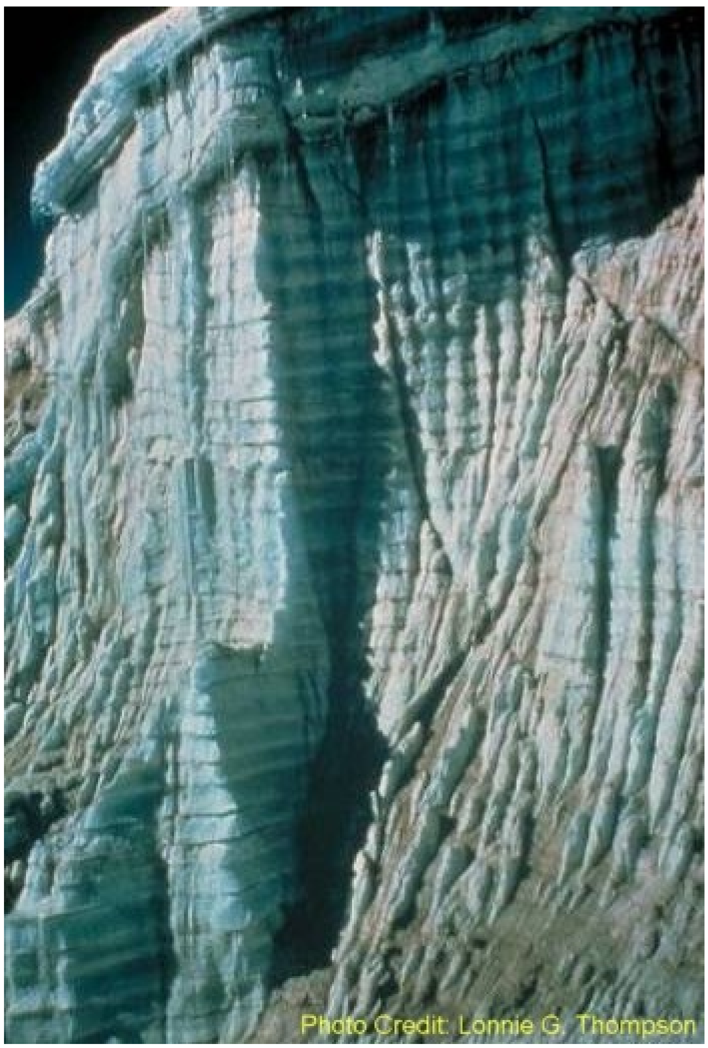

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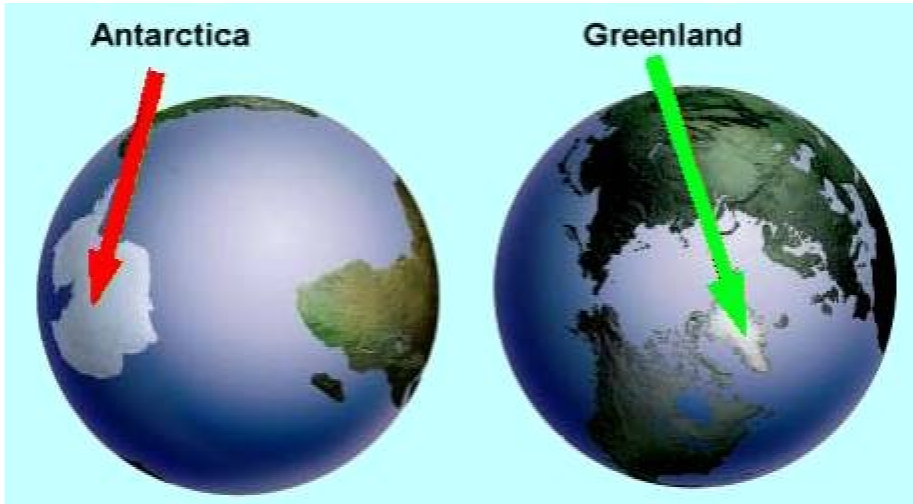
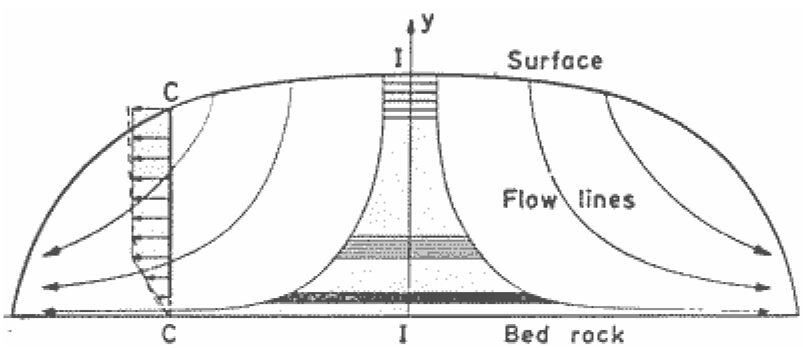
Most scientists today believe that various places on this planet, such as Greenland, the Antarctic, and many other places, have



some very old ice. The ice in these areas appears to be layered in a very distinctive



annual pattern. In fact, this pattern is both visually and chemically recognizable and extends downward some 4,000 to 5,000 meters. What happens is that as the snow from a previous year is buried under a new layer of snow, it is compacted over time with the weight of each additional layer of snow above it. This compacted snow is called the “firn” layer. After several meters this layers snowy firn turns into layers of solid ice (note that 30cm of compacted snow compresses further into about 10cm of ice). These layers are much thinner on the Antarctic ice cap as compared to the Greenland ice cap since Antarctica averages only 5cm of "water equivalent" per year while Greenland averages over 50cm of water equivalent. 1,2 since these layers get even thinner as they are buried under more and more snow and ice, due to compression and lateral flow (see diagram), the thinner layers of the Antarctic ice cap become much harder to count than those of the Greenland ice cap at an equivalent depth. So, scientists feel that most accurate historical information comes from Greenland, although much older ice comes from other drier places. Still, the ice cores drilled in the Greenland ice cap, such as the American Greenland Ice Sheet Project (GISP2) and the European Greenland Ice Core Project (GRIP), are felt to be very old indeed - upwards of 160,000 years old. (Back to Top)

The Visual Method

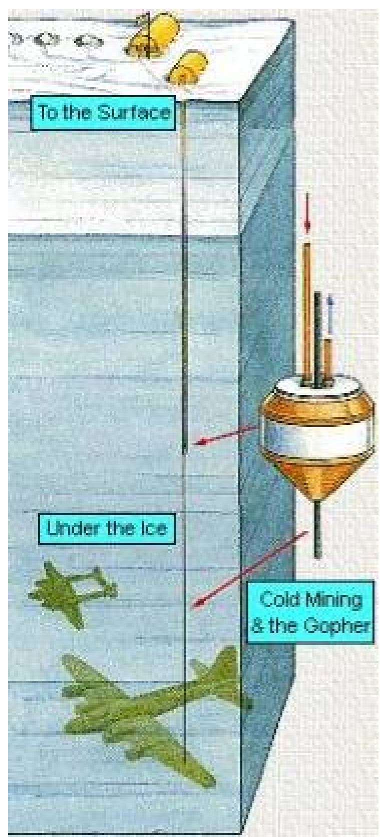
This is a 19cm section of the GISP ice core at 1,855m showing "annual" layers. This section contains 11 layers with the lighter "summer" layers sandwiched between the darker "winter" layers.

But how, exactly, are these layers counted? Obviously, at the surface the layers are easy to count visually – and in Greenland the layers are fairly easily distinguished at depths as great as 1,500 to 2,000m (see picture). Even here though, there might be a few problems. How does one distinguish between a yearly layer and a sub-yearly layer of ice? For instance, it is not only possible but also likely for various large snowstorms and/or snowdrifts to lay down multiple layers in a given year. Very short-term oscillations representing as little as a day or two do show up as variables in the layers of ice.[6] Storms can vary in their temperature patterns. They can also last a few hours to several days, weeks, or even months. Of course, these storms and other anomalous weather patterns might present a bit of a problem for the uniformitarian paradigm. Consider the following excerpt from a 1997 issue of the *Journal of Geophysical Research*:

> “Fundamentally, in counting any annual marker, we must ask whether it is absolutely unequivocal, or whether nonannual events could mimic or

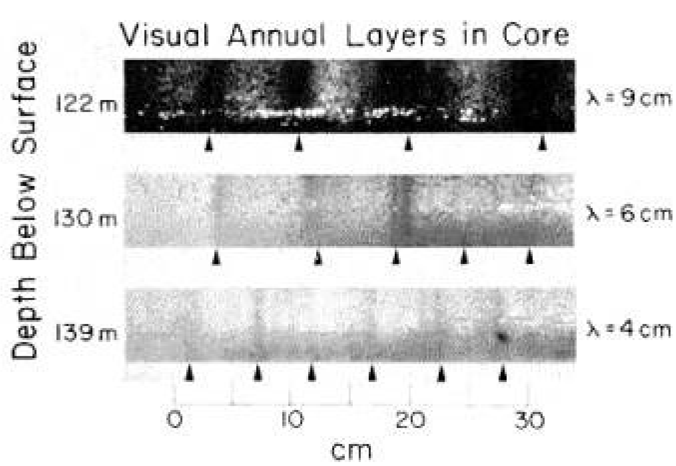
obscure a year. For the visible strata (and, we believe, for any other annual indicator at accumulation rates representative of central Greenland), it is almost certain that variability exists at the subseasonal or storm level, at the annual level, and for various longer periodicities (2-year, sunspot, etc.). We certainly must entertain the possibility of misidentifying the deposit of a large storm or a snow dune as an entire year or missing a weak indication of a summer and thus picking a 2-year interval as 1 year." [7]

Good examples of this phenomenon can be found in areas of very high precipitation, such as the more coastal regions of Greenland. It was in this area, 17 miles off the east coast of Greenland, that Bob Cardin and other members of his squadron had to ditch their six P-38's and two B-17's when they ran out of gas in 1942 - the height of WWII. Many years later, in 1981, several members of this original squad decided to see if they could recover their aircraft. They flew back to the spot in Greenland where they thought they would find their planes buried under a few feet of snow. To their surprise, there was nothing there. Not even metal detectors found anything. After many years of searching,



with better detection equipment, they finally found the airplanes in 1988 *three miles* from their original location and under approximately *260 feet* of ice! They went on to actually recovered one of them ("Glacier Girl" – a P38), which was eventually restored to her former glory.[20]

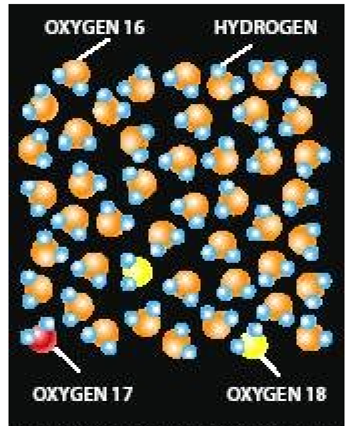
What is most interesting about this story, at least for the purposes of this discussion, is the depth at which the planes were found (as well as the speed which the glacier moved). It took only 46 years to bury the planes in over 260 feet (~80 meters) of ice and move then some 3 miles from their original location. This translates into a little over 5 ½ feet (~1.7 meters) of ice or around 17 feet (~5 meters) of compact snow per year and about 100 meters of movement per year. In a telephone interview, Bob Cardin was asked how many layers of ice were above the recovered airplane. He responded by saying, "Oh, there were many hundreds of layers of ice above the airplane." When told that each layer was supposed to represent one year of time, Bob said, "That is impossible! Each of those layers is a different warm spell – warm, cold, warm, cold, warm, cold." [21] Also, the planes did not sink in the ice over time as some have suggested. Their density was less than the ice or snow since they were not filled with the snow, but remained hollow. They were in fact buried by the annual snowfall over the course of almost 50 years.



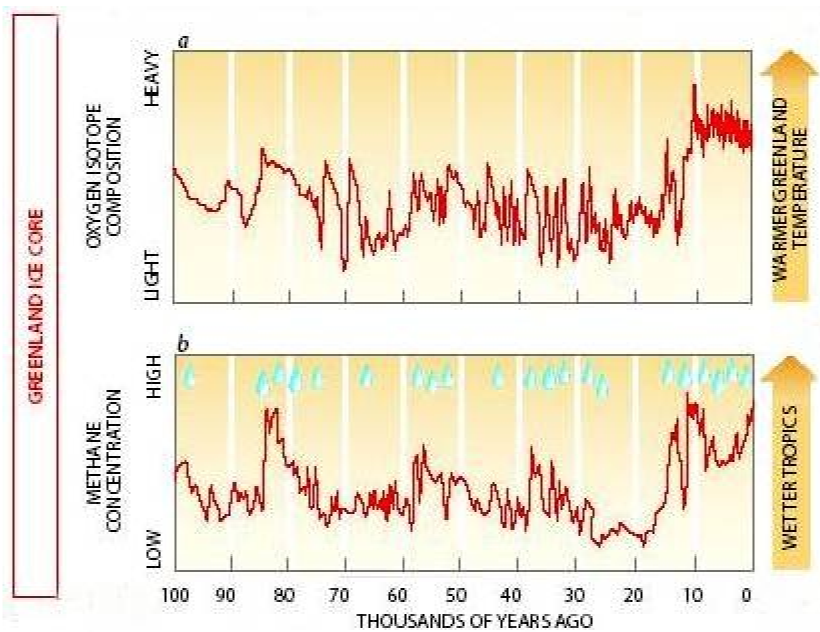
Now obviously, this example does not reflect the actual climate of central Greenland or of central Antarctica. As a coastal region, it is exposed to a great deal more storms and other sub-annual events that produce the 17 feet of annual snow per year. However, even now, large snowstorms also drift over central Greenland. And, in the fairly recent warm Hipsithermal period (~4 degrees warmer than today) the precipitation over central Greenland, and even Antarctica, was most likely much greater than it is today. So, how do scientists distinguish between annual layers and sub-annual layers? Visual methods, by themselves, seem rather limited – especially as the ice layers get thinner and thinner as one progresses down the column of ice. (Back to Top)

Oxygen and Other Isotopes

Well, there are many other methods that scientists use to help them identify annual layers. One such method is based on the oxygen isotope variation between ^{16}O and ^{18}O (and ^{17}O) as they relate to changes in temperature. For instance, water (H_2O), with the heavier ^{18}O isotope, evaporates less rapidly and condenses more readily than water molecules



OXYGEN ATOMS in the ice can vary in composition. The relative abundance of the different types reflects the temperature at the time of precipitation.



that incorporate the lighter ^{16}O isotope. Since the ^{18}O requires more energy (warmer weather) to be evaporated and transported in the atmosphere, more ^{18}O is deposited in the ice sheets in the summer than in the winter. Obviously then, the changing ratios of these oxygen isotopes would clearly distinguish the annual cycles of summer and winter as well as longer periods of warm and cold (such as the ice age) – right? Not quite. One major drawback with this method is that these oxygen isotopes do not stay put. They diffuse over time. This is especially true in the “firn layer” of compacted snow before it turns into ice. So, from the earliest formation of these ice layers, the ratios of oxygen isotopes as well as other isotopes are altered by gravitational diffusion and so cannot be used as reliable markers of annual layers as one moves down the ice core column. One of the evidences given for the reality of this phenomenon is the significant oxygen isotope enrichment (verses present day atmospheric oxygen ratios) found in 2,000 year-old-ice from Camp Century, Greenland.[3] Interestingly enough, this property of isotope diffusion has long been recognized as a problem. Consider the following comment made by Fred Hall back in 1989:

> "The accumulating firn [ice-snow granules] acts like a giant columnar sieve through which the gravitational enrichment can be maintained by molecular diffusion. At a given borehole, the time between the fresh fall of new snow and its conversion to nascent ice is roughly the height of the firn layers in [meters] divided by the annual accumulation of new ice in meters per year. This results in conversion times of centuries for firn layers just inside the Arctic and Antarctic circles, and millennia for those well inside [the] same. Which is to say--during these long spans of time, a continuing gas-filtering process is going on, eliminating any possibility of using the presence of such gases to count annual layers over thousands of years." [4]

Lorius *et al*., in a 1985 *Nature* article, agreed commenting that, "Further detailed isotope studies showed that seasonal delta ^{18}O variations are rapidly smoothed by diffusion indicating that reliable dating cannot be obtained from isotope stratigraphy".[29]

Jaworowski (work discussed further below in "Biased Data" section) also notes the following:

The short-term peaks of δ^{81}Ο ωονσ φο γνιρεψαλ ρετνιω/ρεμμυσ λαυννα οτ δεβιρχσα νεεβ εϖαη στεεησ εχι εητ νι .σερυταρεπμετ ρια ρεωολ δνα ρεηγιη τα δεμροφ ροφ δεσυ νεεβ εϖαη σκαεπ εσεηΤ σεροχ εχι φο στνεμερχνι ελπμασ εητ ταητ γνιμυσσα ,εχι ρειχαλγ εητ γνιταδ εητ ταητ δνα ,νοιτατιπιχερπ φο νοιτισοπμοχ χιποτοσι ναεμ λανιγιρο εητ τνεσερπερ .μετσψσ δεσολχ ετατσ−ψδαετσ α νι ερα στνεμερχνι

,διλαϖ τον σι νοιτπμυσσα σιητ ταητ στσεγγυσ ,ρεϖεωοη ,εχνεδιϖε λατνεμιρεπξΕ τλυσερ α σα στεεησ εχι εητ νι εχι δνα ωονσ φο σισοηπρομανατεμ χιταμαρδ φο εσυαχεβ .ερυσσερπ δνα ερυταρεπμετ γνιγναηχ φο εητ ,σετισ χιτχρατνΑ δλοχ ψρεϖ τΑ εχαφρυσβυσ φο εσυαχεβ ,μ/Χ°005 ηχαερ οτ δνυοφ ερεω στνειδαργ ερυταρεπμετ νι νομμοχ σι γνιτλεμ εχαφρυσβυσ λανοιταιδαΡ .νοιταιδαρ νυΣ φο νοιτπροσβα οτ γνιδαελ ,Χ°02− ωολεβ σερυταρεπμετ ρεμμυσ ητιω σνοιταχολ τα αχιτχρατνΑ .εχαφρυσ εητ ωολεβ μ 1 τυοβα φο ητπεδ α τα ,ρεταω διυθιλ φο σδνοπ φο νοιταμροφ εητ νι πεεδ ρεταω διυθιλ φο εχνετσιξε εητ ροφ ελβισνοπσερ ερα σμσιναηχεμ ρεητΟ φο σεκαλ τεεησ−βυσ τσαϖ φο εχνεσερπ εητ οτ σδαελ ηχιηω ,εχι χιτχρατνΑ δλοχ δναλνι νι σρετεμολικ εραυθσ 000,8 τυοβα φο αερα να γνιρεϖοχ ,ρεταω διυθιλ οτ 4− φο σερυταρεπμετ λασαβ ραεν τα ,νοιτατΣ κοτσος ραεν δνα αχιτχρατνΑ νρετσαε διυθιλ φο νοιταμροφ δνα ,νοιταμιλβυσ ,νοιταζιλλατσψρχερ εχαφρυσ−βυσ εηΤ .Χ°2.62− . .εχι δνα ωονσ φο νοιτισοπμοχ χιποτοσι λανιγιρο εητ βρυτσιδ ροπαϖ δνα ρεταω .

ψλλαιτραπ(νριφ νι ψλλατνεμιρεπξε δνυοφ ερεω σεγναηχ χιποτοσι τνατροπμΙ σεμιτ 01 νεϖε οτ δεσοπξε)εχαφρυσ ρειχαλγ εητ σμροφ ταητ ωονσ ραλυναργ δετχαπμοχ .στνειδαργ λαμρεητ ρεωολ ,ραεψ α σεμιτ λαρεϖεσ ρυχχο ψαμ ηχιηω ,σεγναηχ ηχυΣ .εχι φο σεταμιτσε εγα εσλαφ οτ δαελ δλυοω ,σδοιρεπ τσαχρεϖο δνα ψννυσ γνιτχελφερ νρεητυοΣ δνα νρεητροΝ εητ νι στνεϖε εητ εζινορηχνψσ οτ ελβισσοπ τον σι τΙ ΟΧ ,ελπμαξε ροφ ,σα ηχυσ ,σερεηπσιμεΗ$_2$ χιτχρατνΑ νι σνοιταρτνεχνοχ ελβατσ μρετ– τροησ γνιβιρχσα φο τλυσερ εητ τραπ νι ,σι σιηΤ .εχι δναλνεερΓ δνα .εχι φο γνιρεψαλ ρετνιω/ρεμμυσ λαυννα οτ νεγψξο δνα νεγορδψη φο σκαεπ εποτοσι . . .γνιταδ ροφ μεητ γνισυ δνα

τσαπ εητ γνιρυδ δετισοπεδ ,δναλνεερΓ ,τιμμυΣ τα εχι δνα νριφ μορφ ρια εητ νΙ ΟΧ εητ ,σραεψ 002~$_2$ 4.146 οτ ϖμππ 3.342 μορφ δεγναρ νοιταρτνεχνοχ λαρυταν ρο γνιλπμασ ψβ δεσυαχ στχαφιτρα στχελφερ εγναρ εδιω α ηχυΣ .ϖμππ ΟΧ φο σνοιταιραϖ εητ ναητ ρεηταρ ,τεεησ εχι εητ νι σεσσεχορπ$_2$ ρετο νι δεϖρεσβο σαω εγναρ ρεταεργ ρο ραλιμιΣ .ερεηπσομτα εητ νι νοιταρτνεχνοχ .εχι ραλοπ νι σεσαγ εσυοηνεεργ φο σειδυτσ[05]

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Contaminated and Biased Data

According to Prof. Zbigniew Jaworowski, Chairman of the Scientific Council of the Central Laboratory for Radiological Protection in Warsaw, Poland, the ice core data is not only contaminated by procedural problems, it is also manipulated in order to fit popular theories of the day.

CRACKING IN ICE CORE SAMPLES AS A RESULT OF DRILLING AND TRANSPORTATION UPWARDS

A photograph in transmitted light of the inner part of an ice core from the Mizuho Plateau (East Antarctica), at a depth of 356 m. Note a dense structure of "healed" macro-cracks, which do not disturb the mechanical integrity of the core. Before "healing," the cracks were open to migration of gases and pollutants, which affect the measurements of greenhouse gases.

Jaworowski first argues that ice cores do not fulfill the essential criteria of a closed system. For example, there is liquid water in ice, which can dramatically change the chemical composition of the air bubbles trapped between ice crystals. "Even the coldest Antarctic ice (down to -73°C) contains liquid water. More than 20 physicochemical processes, mostly related to the presence of liquid water, contribute to the alteration of the original chemical composition of the air inclusions in polar ice. . . Even the composition of air from near-surface snow in Antarctica is different from that of the atmosphere; the surface snow air was found to be depleted in CO_2 by 20 to 50 percent . . ."[50]

Beyond this, there is the problem of fractionation of gases as the "result of various solubilities in water (CH_4 is 2.8 times more soluble than N_2 in water at O°C; N_2O, 55 times; and CO_2, 73 times), starts from the formation of snowflakes, which are covered with a film of supercooled liquid."[50]

"[Another] one of these processes is formation of gas hydrates or clathrates. In the highly compressed deep ice all air bubbles disappear, as under the influence of pressure the gases change into the solid clathrates, which are tiny crystals formed by interaction of gas with water molecules. Drilling decompresses cores excavated from deep ice, and contaminates them with the drilling fluid filling the borehole. Decompression leads to dense horizontal cracking of cores [see illustration], by a well known sheeting process. After decompression of the ice cores, the solid clathrates decompose into a gas form, exploding in the process as if they were microscopic grenades. In the bubble-free ice the explosions form a new gas cavities and new cracks. Through these cracks, and cracks formed by sheeting, a part of gas escapes first into the drilling liquid which fills the borehole, and then at the surface to the atmospheric air. Particular gases, CO2, O2 and N2 trapped in the deep cold ice start to form clathrates, and leave the air bubbles, at different pressures and depth. At the ice temperature of –15°C dissociation pressure for N_2 is about 100 bars, for O_2 75 bars, and for CO_2 5 bars. Formation of CO_2 clathrates starts in the ice sheets at about 200 meter depth, and that of O_2 and N_2 at 600 to 1000 meters. This leads to depletion of CO_2 in the gas trapped in the ice sheets. This is why the records of CO_2 concentration in the gas inclusions from deep polar ice show the values lower than in the contemporary atmosphere, even for the epochs when the global surface temperature was higher than now."[50]

No study has yet demonstrated that the content of greenhouse trace gases in old ice, or even in the interstitial air from recent snow, represents the atmospheric composition.

The ice core data from various polar sites are not consistent with each other, and there is a discrepancy between these data and geological climatic evidence. One such example is the discrepancy between the classic Antarctic Byrd and the Vostok ice cores, where an important decrease in the CO_2 content in the air bubbles occurred at the same depth of about 500 meters, but at which the ice age difference by about 16,000 years. In approximately 14,000-year-old part of the Byrd core, a drop in the CO_2 concentration of 50 ppmv was observed, but in similarly old ice from the Vostok core, an increase of 60 ppmv was found. In about 6,000-year-old ice from Camp Century, Greenland, the CO_2 concentration in air bubbles was 420 ppmv, but was 270 ppmv in similarly old ice from Byrd Antarctica . . .

One can also note that the CO_2 concentration in the air bubbles decreases with the depth of the ice for the entire period between the years 1891 and 1661, not because of any changes in the atmosphere, but along the increasing pressure gradient, which is probably the result of clathrate formation, and the fact that the solubility of CO_2 increases with depth.

If this isn't already bad enough, Jaworowski proceeds to argue that the data, as contaminated as it is, has been manipulated to fit popular theories of the day.

Until 1985, the published CO_2 readings from the air bubbles in the pre-industrial ice ranged from 160 to about 700 ppmv, and occasionally even up to 2,450 ppmv. After 1985, high readings disappeared from the publications![50]

Another problem is the notion that lead levels in ice cores correlate with the increased use of lead by various more and more modern civilizations such as the Greeks and Romans and then during European and American industrialization. A potential problem with this notion is Jaworowski's claim to have "demonstrated that in pre-industrial period the total flux of lead into the global atmosphere was higher than in the 20th century, that the atmospheric content of lead is dominated by natural sources, and that the lead level in humans in Medieval Ages was 10 to 100 times higher than in the 20th century."[50] Beyond this potential problem, there is also the problem of heavy metal contamination of the ice cores during the drilling process.

Numerous studies on radial distribution of metals in the cores reveal an excessive contamination of their internal parts by metals present in the drilling fluid. In these parts of cores from the deep Antarctic, ice concentrations of zinc and lead were higher by a factor of tens or hundreds of thousands, than in the contemporary snow at the surface of the ice sheet. This demonstrates that the ice cores are not a closed system; the heavy metals from the drilling fluid penetrate into the cores via micro- and macro-cracks during the drilling and the transportation of the cores to the surface.[50]

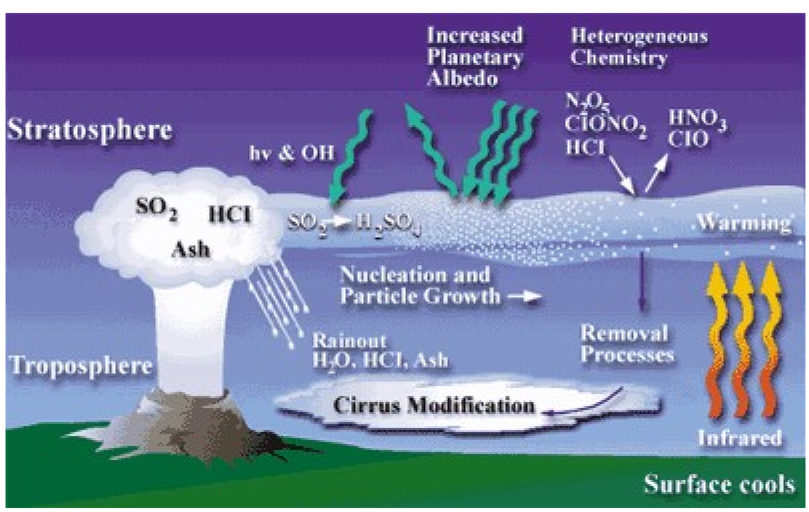
Professor Jaworowski summarizes with a most interesting statement:

It is astonishing how credulously the scientific community and the public have accepted the clearly flawed interpretations of glacier studies as evidence of anthropogenic increase of greenhouse gases in the atmosphere. Further historians can use this case as a warning about how politics can negatively influence science.[50]

While this statement is most certainly a scathing rebuke of the scientific community as it stands, I would argue that Jaworowski doesn't go far enough. He doesn't consider that the problems he so carefully points as the basis for his own doubts concerning the basis of global warming may also pose significant problems for the validity of using ice cores for reliably assuming the passage of vast spans of time, supposedly recording in the layers of large ice sheets. (Back to Top)

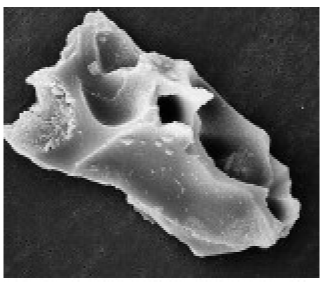
Volcanic Signatures

So, it seems as though isotope ratios are severely limited if not entirely worthless as yearly markers for ice core dating beyond a



very short period of time. However, there are several other dating methods, such as the correlation of impurities in the layers of ice to known historical events – such as known volcanic eruptions.

After a volcano erupts, the ash and other elements from the eruption fall out and are washed out of the atmosphere by precipitation. This fallout leaves "tephra" (microscopic shards of glass from the ash fallout – see picture), sulfuric acid, and other chemicals in the snow and subsequent ice from that year. Sometimes the tephra fallout can be specifically matched via physical and chemical analysis to a known historical



Volcanic glass particle from the GISP2 ice core

eruption. This analysis begins when electrical conductivity measurements (ECM) are made along the entire length of the ice core. Increases in electrical conductivity indicate the presence of increased acid content. When a volcano erupts, it spews out a great deal of sulfur-rich gases. These are converted in the atmosphere to sulfuric acid aerosols, which end up in the layers of ice and increase the ECM readings. The higher the acidity, the better the conduction. Sections of ice from a region with an acidic spike are then melted and filtered through a capillary-pore membrane filter. An automated scanning electron microscope (SEM), equipped for x-ray microanalysis, is used to determine the size, shape and elemental composition of hundreds of particles on the filter. Cluster analysis, using a multivariate statistical routine that measures the elemental compositions of sodium, magnesium, aluminum, silicon, potassium, calcium, titanium and iron, is done to identify the volcanic "signature" of the tephra particles in the sample. Representative tephra particles are re-located for photomicrography and more detailed chemical analysis. Then tephra is collected from near the volcanic eruption that may have produced the fallout in the core and is ground into a fine powder, dispersed in liquid, and filtered through a capillary-pore membrane. Then automated SEM and chemical analysis is used on this known tephra sample to find its chemical signature and compare it with the unknown sample found in the ice core - to see if there is a match.[22]

Tephra from several well-known historical volcanoes have been analyzed in this way. For example, Crater Lake in Oregon was once a much larger mountain (Mt. Mazama) before it blew up as a volcano. In the mid-1960s scientists dated this massive explosion, with the use of radiocarbon dating methods, at between 6,500 and 7,000 years before present (BP). Then, in 1979, *Scientific American* published an article about a pair of sagebrush bark sandals that were found just under the Mazama tephra at Fort Rock Cave. These sandals were carbon-14 dated to around 9,000 years BP. Even thought this date was several thousand years older than expected, the article went on to say that the bulk of the evidence still put the most likely eruption date of Mt. Mazama at around 7,000 years BP. [23,24] Later, a “direct count” of the layers in the ice core obtained from Camp Century Greenland put the date of the Mazama tephra at 6,400±110 years BP.[23,25] Then, at the 16th *INQUA* conference held June 2003, in Reno Nevada (attended by over 1,000 scientists studying the Quaternary period), Kevin M. Scott noted in an abstract that the Mazama Park eruptive period had been “newly dated at 5,600-5,900 14C yrs BP.” Scott went on to note that this new date “includes collapses and eruptions previously dated throughout a range of 4,300 to 6,700 14C yrs BP.” [26] At this point it should also be noted that the carbon-14 dating method is being calibrated by the Greenland ice cores, so it is circular to argue that the Greenland ice core dates have been validated by carbon-14 analysis.[26]

Another famous volcano, the Mediterranean volcano Thera, was so large that it effectively destroyed the Minoan (Santorini) civilization. This is thought to have happened in the year 1628 B.C. since tree rings from that region showed a significant disruption matching that date. Of course, such an anomaly was looked for in the ice cores. As predicted, layers in the "Dye 3" Greenland ice core showed such a major eruption in 1645, plus or minus 20 years. This match was used to confirm or calibrate the ice core data as recently as 2003.

Interestingly enough though, the scientists did not have the budget at the time to a systematic search throughout the whole ice core for such large anomalies that would also match a Thera-sized eruption. Now that such detailed searches have been done, many such sulfuric acid peaks have been found at numerous dates within the 18th, 17th, 16th, 15th, and 14th centuries B.C. [35] Beyond this, tephra analyzed from the "1620s" ice core layers did not match the volcanic material from the Thera volcano. The investigators concluded:

> "Although we cannot completely rule out the possibility that two nearly coincident eruptions, including the Santorini eruption, are responsible for the 1623 BC signal in the GISP ice core, these results very much suggest that the Santorini eruption is not responsible for this signal. We believe that another eruption led not only to the 1623 BC ice core signal

> but also, by correlation, to the tree-ring signals at 1628/1627 BC." [36]

Then, as recently as March of 2004, Pearce *et al* published a paper declaring that another volcano, the Aniakchak Volcano in Alaska, was the true source of the tephra found in the GRIP ice core at the "1645 ± 4 BC layer." These researchers went on to say that, "The age of the Minoan eruption of Santorini, however, remains unresolved." [37]

So, here we have a clearly erroneous match between a volcanic eruption and both tree rings and ice core signals. What is most curious, however, is that many scientists still declare that ice cores are solidly confirmed by such means. Beyond this, as flexible as the dating here seems to be, the Mt. Mazama and Thera eruptions are still about the oldest eruptions that can be identified in the Greenland ice cores. There are two reasons for this. One reason is that below 10,000 layers or so in the ice core the ice becomes too alkaline to reliably identify the acid spikes associated with volcanic eruptions.[5] Another reason is that the great majority of volcanic eruptions throughout history were not able to get very much tephra into the Greenland ice sheet. So, the great majority of volcanic signals are detected via their acid signal alone.

This presents a problem. A review of four eruption chronologies constructed since 1970 illustrate this problem quite nicely. In 1970, Lamb published an eruption chronology for the years 1500 to 1969. The work recorded 380 known historical eruptions. Ten years later, Hirschboek published a revised eruption chronology that recorded 4,796 eruptions for the same period – a very significant increase from Lamb's figure. One year later, in 1981, Simkin *et al.* raised the figure to 7,664 eruptions and Newhall *et al.* increased the number further a year later to 7,713. It is also interesting to note that Simkin *et al.* recorded 3,018 eruptions between 1900 and 1969, but only 11 eruptions were recorded from between 1 and 100 AD. So obviously, as one goes back through recent history, the number of known volcanic eruptions drops off dramatically, though they were most certainly still occurring – just without documentation. Based on current rates of volcanic activity, an expected eruption rate for the past several thousand years comes to around 30,000 eruptions per 1,000 years.[25]

With such a high rate of volcanic activity, to include many rather large volcanoes, how are scientists so certain that a given acid spike on ECM is so clearly representative of any particular volcano – especially when the volcanic eruption in question happened more than one or two thousand years ago? The odds that at least one volcanic signal will be found in an ice core within a very small "range of error" around any supposed historical eruption are extremely good - even for large volcanoes. Really, is this all too far from a self-fulfilling prophecy? How then can the claim be made that historical eruptions validate the dating of ice cores to any significant degree?

"The desire to link such phenomena [volcanic eruptions] and the stretching of the dating frameworks involved is an attractive but questionable practice. All such attempts to link (and hence infer associations between) historic eruptions and environmental phenomena and human "impacts", rely on the accurate and precise association in time of the two events. . . A more general investigation of eruption chronologies constructed since 1970 suggest that such associations are frequently unreliable when based on eruption data gathered earlier than the twentieth century." [25]

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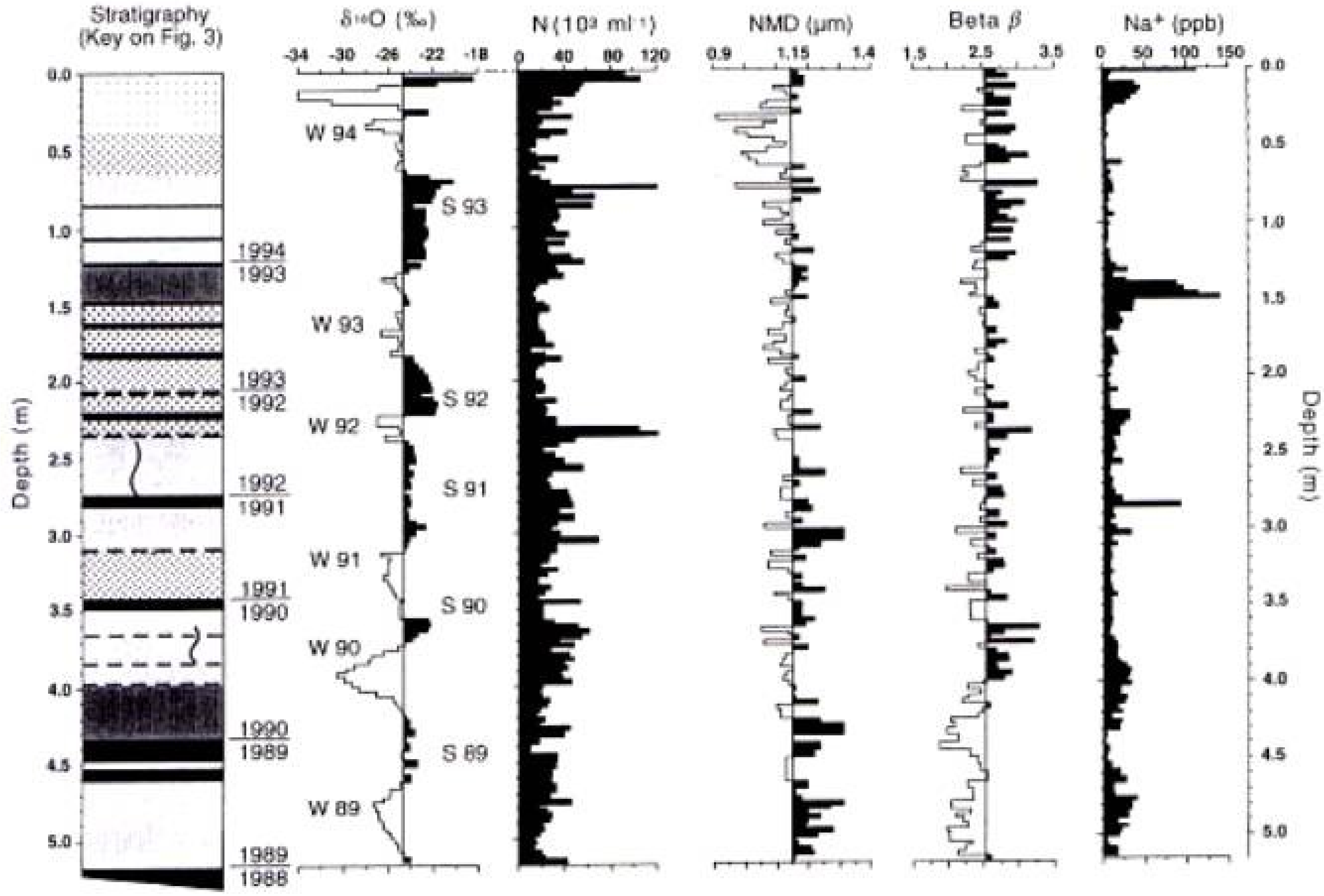
Cyclic Dust Deposits

So, if volcanic markers are generally unreliable and completely useless beyond a few thousand years, how are scientists so sure that their ice core dating methods are meaningful? Well, one of the most popular methods used to distinguish annual layers is one that measures the fluctuations in ice core dust. Dust is alkaline and shows up as a low ECM reading. During the dry northern summer, dust particles from Arctic Canada and the coastal regions of Greenland are carried by wind currents and are deposited on the Greenland ice sheet. During the winter, this area is not so dusty, so less dust is deposited during the winter as compared to the summer. This annual fluctuation of dust is thought to be the most reliable of all the methods for the marking of the annual cycle - especially as the layers start to get thinner and thinner as one moves down the column of ice.[27] And, it certainly would be one of the most reliable methods if it were not for one little problem known as "post-depositional particle migration".

Zdanowicz et al., from the University of New Hampshire, did real time studies of modern atmospheric dust deposition in the 1990's on the Penny Ice Cap, Baffin Island, Arctic Canada. Their findings are most interesting indeed:

“After the snow deposition on polar ice sheets, not all the chemical species preserve the original concentration values in the ice. In order to obtain reliable past-environmental information by firn and ice cores, it is important to understand how post-depositional effects can alter the chemical composition of the ice. These effects can happen both in the most superficial layers and in the deep ice. In the snow surface, post-depositional effects are mainly due to re-emission in the atmosphere and we show here that chloride, nitrate, methane-sulphonic acid (MSA) and H_2O_2 [hydrogen peroxide] are greatly affected by this process; moreover, we show how the mean annual snow accumulation rate influences the re-emission extent. In the deep ice, post-depositional effects are mainly due to movement of acidic species and it is interesting to note the behavior of some substances (e.g. chloride and nitrate) in acidic (high concentrations of volcanic acid gases) and alkaline (high dust content) ice layers . . . We failed to identify any consistent relationship between dust concentration or size distribution, and ionic chemistry or snowpack stratigraphy.” [28]



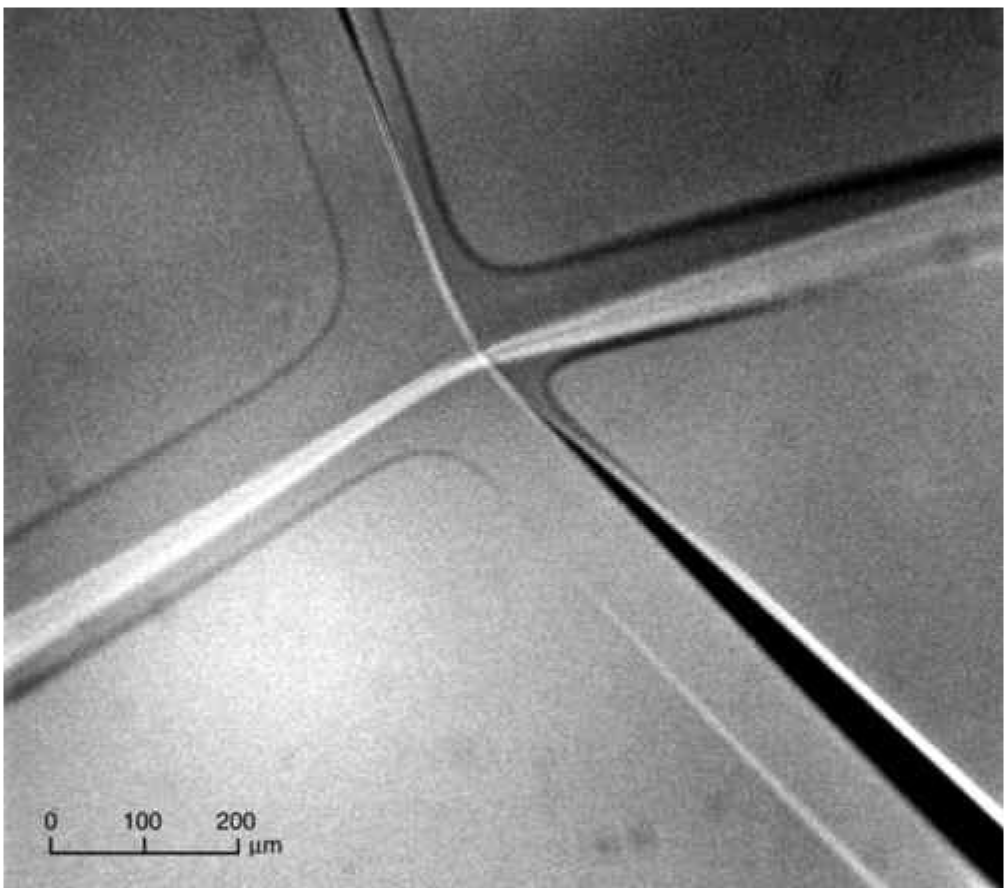
This study goes on to reveal that each yearly cycle is marked not by one distinct annual dust concentration as is normally assumed when counting ice core layers, but by two distinct dust concentration peaks – one in late winter-spring and another one in the late summer-fall. So, each year is initially marked by "two seasonal maxima of dust deposition." By itself, this finding cuts in half those ice core dates that assume that each year is marked by only one distinct deposition of dust. This would still be a salvageable problem if the dust actually stayed put once it was deposited in the snow. But, it does not stay put – it moves!

“While some dust peaks are found to be associated with ice layers or Na [sodium] enhancements, others are not. Similarly, variations of the NMD [number mean diameter – a parameter for quantifying relative changes in particle size] and beta cannot be systematically correlated to stratigraphic features of the snowpack. This lack of consistency indicates that microparticles are remobilized by meltwater in such a way that seasonal (and stratigraphic) differences are obscured.” [28]

This remobilization of the microparticles of dust in the snow was found to affect both fine and coarse particles in an uneven way. The resulting “dust profiles” displayed “considerable structure and variability with multiple well-defined peaks” for any given yearly deposit of snow. The authors hypothesized that this variability was most likely caused by a combination of factors to include “variations of snow accumulation or summer melt and numerous ice layers acting as physical obstacles against particle migration in the snow.” The authors suggest that this migration of dust and other elements limits the resolution of these methods to “multiannual to decadal averages”.[28]

Another interesting thing about the dust found in the layers of ice is that those layers representing the last “ice age” contain a whole lot of dust – up to 100 times more dust than is deposited on average today.[19] The question is, how does one explain a hundred times as much Ice Age dust in the Greenland icecap with gradualistic, wet conditions? There simply are no unique dust sources on Earth to account for 100 times more dust during the 100,000 years of the Ice Age, particularly when this Ice Age was thought to be associated with a large amount of precipitation/rain – which would only cleanse the atmosphere more effectively. How can high levels of precipitation be associated with an extremely dusty atmosphere for such a long period of time? Isn't this a contradiction from a uniformitarian perspective? Perhaps a more recent catastrophic model has greater explanatory value?

Other dating methods, such as ^{14}C, ^{36}Cl and other radiometric dating methods are subject to this same problem of post-depositional diffusion as well as contamination – especially when the summer melt sends water percolating through the tens and hundreds of layers found in the snowy firn before the snow turns to ice. Then, even after the snow turns to ice, diffusion is still a big problem for these molecules. They simply do not stay put.



Four microscopic liquid channels, each about 100 microns across come together at the corner where four ice grains meet. Because impurities are concentrated in the channels, they stay liquid even though the temperature is below freezing. (Photo: Heidi Mader, University of Bristol)

More recent publications by Rempel et al., in *Nature* (May, 2001),[32] also quoted by J.W. Wettlaufer (University of Washington) in a paper entitled, "Premelting and anomalous diffusion in ancient ice",[31] suggest that chemicals that have been trapped in ancient glacial or polar ice can move substantial distances within the ice (up to 50cm even in deeper ice where layers get as thin as 3 or 4 millimeters). Such mobility is felt by these scientists to be "large enough to offset the resolution at which the core was examined and alter the interpretation of the ice-core record." What happens is that, "Substances that are climate signatures - from sea salt to sulfuric acid - travel through the frozen mass along microscopic channels of liquid water between individual ice crystals, away from the ice on which they were deposited. The movement becomes more pronounced over time as the flow of ice carries the substances deeper within the ice sheet, where it is warmer and there is more liquid water between ice crystals. . . The Vostok core from Antarctica, which goes back 450,000 years, contains even greater displacement [as compared to the Greenland ice cores] because of the greater depth." That means that past analyses of historic climate changes gleaned from ice core samples might not be all that accurate. Wettlaufer specifically notes that, "The point of the paper is to suggest that the ice core community go back and redo the chemistry."[31,32] Of course these scientists do not think that such problems are significant enough to destroy the usefulness of ice cores as a fairly reliable means of determining historical climate changes. But, it does make one start to wonder how much confidence one can actually have in the popular interpretations of what ancient ice really means. (Back to Top)

The Warm Age

Fossil Forest, New Siberian Islands. Vast, floating remains of forests have washed up on the New Siberian Islands, well inside the Arctic Circle and thousands of miles from comparable forests today. This driftwood was washed ashore on Bolshoi Lyakhov Island, one of the New Siberian Islands. The wood was probably buried under the muck that covers northern Siberia. North flowing Siberian rivers, during early summer flooding, eroded the muck, releasing the buried forests. "Fossil wood," as it is called, is a main source of fuel and building material for many Siberians.

To add to the problems inherent in ice core dating is the significant amount evidence that the world was a much warmer place just a few thousand years ago. These higher temperatures of the Middle Holocene or Hypsithermal period are said to have begun about 9,000 years ago and then started to fade about 4,000 years ago.[8,53]

So, how "warm" was this warm period? Various studies suggest sustained temperatures of northerly regions, such as the Canadian Northwest Territories, of 3-4°C warmer than today. Studies on sedimentary cores carried out in the North Atlantic between Hudson Strait and Cape Hatteras indicate ocean temperatures of 18°C (verses about 8°C today in this region).[54] However, not all regions experienced the same increase in temperature and the overall average global temperature is thought to have been about 2°C warmer than it is today.[55]

It also seems that in the fairly recent past the vegetation zones were much closer to the poles than they are today. The remains of some plant species can be found as far as 1,000 km farther north than they are found today. Forests once extended right up to the Barents Coast and the White Sea. The European tundra zones were non-existent. In northern Asia, peat-moss was discovered on Novaya Zemlya. And, this was no short-term aberration in the weather. This warming trend seems to have lasted for quite a while.[56] Consider also the very interesting suggestion of Prof. Borisov, a long time meteorology and climatology professor at Leningrad State University:

"During the last 18,000 years, the warming was particularly appreciable during the Middle Holocene. This covered the time period of 9,000 to 2,500 years ago and culminated about 6,000 to 4,000 years ago, i.e., when the first pyramids were already being built in Egypt . . . The most perturbing questions of the stage under consideration are: Was the Arctic Basin iceless during the culmination of the optimum?"[8]

Fossil Forest, Kolyma River. Here, driftwood is at the mouth of the Kolyma River, on the northern coast of Siberia. Today, no trees of this size grow along the Kolyma. Leaves, and even fruit (plums), have been found on such floating trees.

Professor Borisov asks a very interesting question. What would happen to the ice sheets during several thousand years of a "hypsithermal" warming if it really was some 2°C warmer than it is today? If the Arctic region around the entire globe, to include the Arctic Ocean, was ice free during just a few thousand years, even episodically during the summer months, what would have happened to the ice sheet on Greenland?

Consider what would happen if the entire Arctic Ocean went without ice during the summer months owing to a warmer and therefore longer spring, summer, and fall. Certainly there would be more snowfall, but this would not be enough to prevent the warm rainfall from removing the snow cover and the ice itself from Greenland's ice sheet. A marine climate would create a more temperate environment because water vapor over the Arctic region would act as a greenhouse gas, holding the day's heat within the atmosphere.

Borisov goes on to point out that a 1°C increase in average global temperature results in a more dramatic increase in temperature at the poles and extreme latitudes than it does at the equator and more tropical zones. For example, between the years 1890 and 1940, there was a 1°C degree increase in the average global temperature. During this same time the mean annual temperature in the Arctic basin rose 7°C. This change was reflected more in warmer winters than in warmer summers. For instance, the December temperature rose almost 17°C while the summer temperature changed hardly at all. Likewise, the average winter temperature for Spitsbergen and Greenland rose between 6 to 13°C during this time. [8] Along these same lines, an interesting article published in the journal *Nature* 30-years ago by R. L. Newson showed that, without the Arctic ice cap, the winters of the Arctic Ocean would rise 20-40ºC and 10-20ºC over northern Siberia and Alaska - all other factors being equal[11] M. Warshaw and R. Rapp published similar results in the *Journal of Applied Meteorology* - using a different circulation model.[12]

Of course, the real question here is, would a 2°C increase in average global temperature, over today's "global warming" temperatures, melt the ice sheets of Greenland or even Antarctica?

Rapid runoff from the Greenland Ice Sheet during the summer

Photo by Roger J. Braithwaite, *Science*, Vol. 297;5597, July 12, 2002

Borisov argued that this idea is not all that far-fetched. He notes that measurements carried out on Greenland's northeastern glaciers as far back as the early 1950's showed that they were loosing ice far faster than it was being formed. [8] The northeastern glaciers were in fact in "ablation" as a result of just a 1°C rise in average global temperature. What would be expected from another 2°C rise? - over the course of several thousand years?

Since that time research done by Carl Boggild of the Geological Survey of Denmark and Greenland (GEUS), involving data from a network of 10 automatic monitoring stations, showed that the large portions of the Greenland ice sheet are melting up to ***10 times*** faster that earlier research had indicated.

In 2000, research indicated that the Greenland ice was melting at a conservative estimate of just over 50 cubic kilometers of ice per year. However, studies done by a team from the University of Texas over 18 months from 2005 to 2006 with the use of gravity data collected by satellites, suggests that the "ice cap may be melting three times faster than indicated by previous measurements" from 1997 to 2003. Currently, the ice is melting at 239 cubic kilometers per year (measured from April 2002 to November 2005).[52]

Greenland covers 2,175,590 square kilometers with about 85% of that area covered by ice of about 2 km thick. That's about 4,351,180 cubic kilometers of ice. At current rates of melting, it would take about 18,000 years to melt all the ice on Greenland. Of course, 18,000 years seems well outside the range of the Hypsithermal period. However, even at current temperatures, the melt rate of the Earth's glaciers, to include those of Greenland, is accelerating dramatically - and we still have another 2°C to go. Towns in Greenland are already beginning to sink because of the melting permafrost. Even potatoes are starting to grow in Greenland. This has never happened before in the memory of those who have lived there all their lives.

In April of 2000, Lars Smedsrud and Tore Furevik wrote in an article in the Cicerone magazine, published by the Norwegian Climate Research Centre (CICERO) that , "If the melting of the ice, both in thickness and surface area, does not slow, then it is an established fact that the arctic ice will disappear during this century." This is based on the fact that the Arctic ice has thinned by some 40% between the years 1980 and

2000. This past summer, December 2006, explorers Lonnie Dupre and Eric Larsen made a very dangerous and most interesting trek to the North Pole. As they approached the Pole they found open water, a lot of icy slush, and ice so thin it wouldn't support their weight.

"We expected to see the ice get better, get flatter, as we got closer to the pole. But the ice was busted up," Dupre said. "As we got closer to the pole, we had to paddle our canoes more and more."[51]

Walt Meier, a researcher at the U.S. National Snow and Ice Data Center in Boulder, Colorado commented on these interesting findings noting that the melting of the Arctic ice cap in summer - is progressing more rapidly than satellite images alone have shown. Given resent data such as this, climate researchers at the U.S. Naval Postgraduate School in California predict the **complete absence of summer ice on the Arctic Ocean** by ***2030*** or sooner.[51] That prediction is dramatically different than what scientists were predicting just a few years ago - that the ice would still be there by the end of the century. Consider how a complete loss of Arctic ice and with an average temperature increase over the Arctic Ocean upwards of 20-40ºC would affect the temperature of surrounding regions - like Greenland. Could Greenland long retain its ice without the Arctic polar ice?

Alaska's Portage Glacier
Change between 1914 and 2004
http://www.worldviewofglobalwarming.org/pages/glaciers.html

If this is not convincing enough, consider that since the year 2000, glaciers around the world have continued melting at greater and greater rates - exponentially greater rates. Alaska's glaciers are receding at twice the rate previously thought, according to a new study published in July 19, 2002 *Science* journal. Around the globe, sea level is about 6 inches higher than it was just 100 years ago, and the rate of rise is increasing quite dramatically. Leading glaciologist, Dr. Mark Meier, remarked in February of 2002 that the accepted estimates of sea level rise were underestimated, due to the rapid retreat of mountain glaciers.[44]

The next year, at the American Association for the Advancement of Science (AAAS) meeting in San Francisco on February 25, 2001, Professor Lonnie Thompson, from Ohio State University's Department of Geological Sciences, presented a paper entitled, "Disappearing Glaciers - Evidence of a Rapidly Changing Earth." Dr. Thompson has completed 37 expeditions since 1978 to collect and study perhaps the world's largest archive of glacial ice cored from the Himalayas, Mount Kilimanjaro in Africa, the Andes in South America, the Antarctic and Greenland.

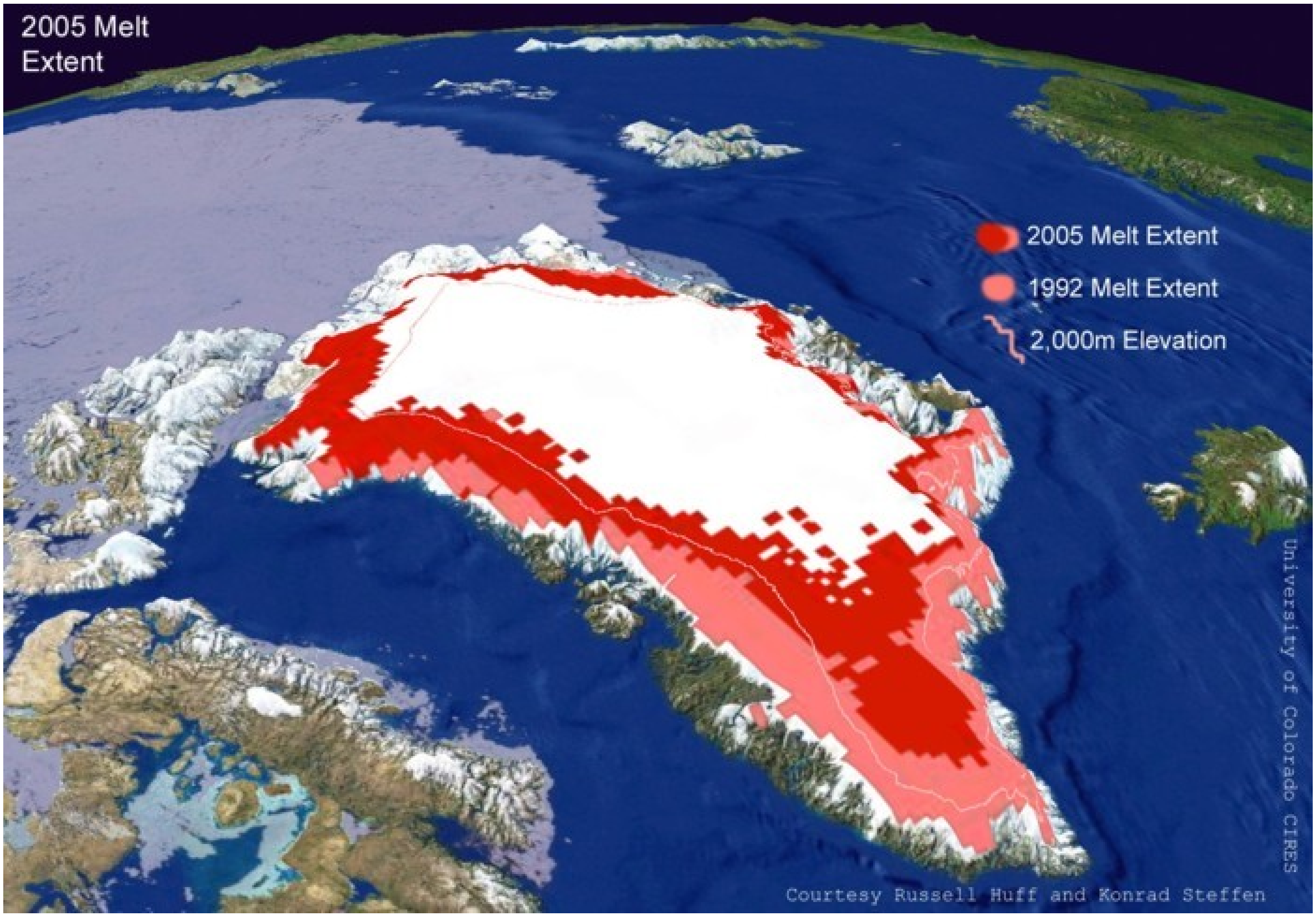
Pasterze Glacier, Austria
Change between 1875 and 2004
http://www.worldviewofglobalwarming.org/pages/glaciers.html

Prof. Thompson reported to AAAS that at least one-third of the massive ice field on top of Tanzania's Mount Kilimanjaro has melted in only the past twelve years. Further, since the first mapping of the mountain's ice in 1912, the ice field has shrunk by 82%. By 2015, there will be no more "snows of Kilimanjaro." In Peru, the Quelccaya ice cap in the Southern Andes Mountains is at least 20% smaller than it was in 1963. One of the main glaciers there, Qori Kalis, has been melting at the astonishing rate of 1.3 feet per day. Back in 1963, the glacier covered 56 square kilometers. By 2000, it was down to less than 44 square kilometers and now there is a new ten acre lake. It's melt rate has been increasing exponentially and at its current rate will be entirely gone between 2010 and 2015, the same time that Kilimanjaro dries.

The exponential nature of this worldwide melt is dramatically illustrated by aerial photographs taken of various glaciers. A series of photographs of the Qori Kalis glacier in Peru are available from 1963. Between 1963 and 1978 the rate of melt was 4.9 meters per year. Between 1978 and 1983 was 8 meters per year. This increased to 14 meters per year by 1993 and to 30 meters per year by 1995, to 49 meters per year by 1998 and to a shocking 155 meters per year by 2000. By 2001 it was up to about 200 meters per year. That's almost 2 feet per day. Dr. Thompson exclaimed, "You can literally sit there and watch it retreat."

Then, in 2001, NASA scientists published a major study, based on satellite and aircraft observations, showing that large portions of the Greenland ice sheet, especially around its margins, were thinning at a rate of roughly 1 meter per year. Other scientists, such as Carl Boggild and his team, have recorded thinning Greenland glaciers at rates as fast a 10 or even 12 meters per year. It is quite a shock to scientists to realize that the data from satellite images shows that various Greenland glaciers are thinning and retreating in an exponential manner - by an "astounding" 150 meters in thickness in just the last 15 years.[43]

In both 2002 and 2003, the Northern Hemisphere registered record low ocean ice cover. NASA's satellite data show the Arctic region warmed more during the 1990s than during the 1980s, with Arctic Sea ice now melting by up to 15 percent per decade. Satellite images show the ice cap covering the Northern pole has been shrinking by 10 percent per decade over the past 25 years.[45]



On the opposite end of the globe, sea ice floating near Antarctica has shrunk by some 20 percent since 1950. One of the world's largest icebergs, named B-15, that measured near 10,000 square kilometers (4,000 square miles) or half the size of New Jersey, calved off the Ross Ice Shelf in March 2000. The Larsen Ice Shelf has largely disintegrated within the last decade, shrinking to 40 percent of its previously stable size.[45] Then, in 2002, the Larsen B ice shelf collapsed. Almost immediately after, researchers observed that nearby glaciers started flowing a whole lot faster - up to 8 times faster! This marked increase in glacial flow also resulted in dramatic drops in glacial elevations, lowering them by as much as 38 meters (124 feet) in just 6 months.[48]

The Retreat of Greenland's Sermilik glacier

Scientists monitoring a glacier in Greenland, the Kangerdlugssuaq glacier, have found that it is moving into the sea 3 times faster than just 10 years ago. Measurements taken in 1988 and in 1996 show the glacier was moving at a rate of between 3.1 and 3.7 miles per year. The latest measurements, taken the summer of 2005, showed that it is now moving at 8.7 miles a year. Satellite measurements of the Kangerdlugssuaq glacier show that, as well as moving more rapidly, the glacier's boundary is shrinking dramatically. Kangerdlugssuaq is about 1,000 meters (3,280ft) thick, about 4.5 miles wide, extends for more than 20 miles into the ice sheet and drains about 4 per cent of the ice from the Greenland ice sheet. The realization of the rapid melting of such a massive glacier, which was fairly stable until quite recently, came as quite a shock to the scientific community. Professor Hamilton expressed this general surprise in the following comment:

"This is a dramatic discovery. There is concern that the acceleration of this and similar glaciers and the associated discharge of ice is not described in current ice-sheet models of the effects of climate change. These new results suggest the loss of ice from the Greenland ice sheet, unless balanced by an equivalent increase in snowfall, could be larger and faster than previously estimated. As the warming trend migrates north, glaciers at higher latitudes in Greenland might also respond in the same way as Kangerdlugssuaq glacier. In turn, that could have serious implications for the rate of sea-level rise."[46]

The exponential increase in glacial speed is now thought to be due to increased surface melting. The liquid water formed on the surface during summer melts collects into large lakes. The water pressure generated by these surface lakes forces water down through the icy layers all the way to the underlying bedrock. It then spreads out, lifting up the glacier off the bedrock on a lubricating film of liquid water. Obviously, with such lubrication, the glacier can then flow at a much faster rate - exponentially faster. This increase in speed also makes for a thinner glacier since the glacier becomes more stretched out.[46]

For example the giant Jakobshavn glacier - at four miles wide and 1,000 feet thick the biggest on the landmass of Greenland - is now moving towards the sea at a rate of 113 feet a year; the "normal" annual speed of a glacier is just one foot. Until now, scientists believed the ice sheet would take 1,000 years to melt entirely, but Ian Howat, who is working with Professor Tulaczyk, says the new developments could "easily" cut this time "in half". [49] Again, this is well within the range of what would have been melted during Hypsithermal warming many times over.

It seems that no one predicted this. No one thought it possible and scientists are quite shocked by these facts. The amazingly fast rate of glacial retreat simply goes against the all prevailing models of glacial development and change, change which generally involve many thousands of years. Who would have thought that such changes could happen in mere decades?

Beyond this, there are many other evidences of a much warmer climate in Greenland and the Arctic basin in the fairly recent past. For example, when Greenland's seas were 10 meters higher than they are today (during the last hipsithermal), warm water mollusks can be found that live over 500 to 750 miles farther south today. Also, the remains of land vertebrates, such as various reptiles, are found in Denmark and Scandinavia, when they live only in Mediterranean areas today.[13]

"Additional evidence is given by...peats and relics in Greenland--the northern limits may have been displaced northward through several degrees of latitude...and [by] other plants in Novaya Zemlya, and by peat and ripe fruit stones [fruit pits]...in Spitsbergen that no longer ripen in these northern lands. Various plants were more generally distributed in Ellesmere [Island and] birch grew more widely in Iceland...." [13]

The point is that these types of plants and these types of large trees should never be able to grow on islands north of the Arctic Circle. Back in 1962 Ivan T. Sanderson noted that , "Pieces of large tree trunks of the types [found] . . . do not and cannot live at those latitudes today for purely biological reasons. The same goes for huge areas of Siberia."[14] Also, as previously noted, fruit does not ripen during short autumns at these high latitudes. Therefore, the spring and summer seasons had to be much longer for any seeds from these temperate trees to germinate and grow. Likewise, the peats that have been found on Greenland require temperate, humid climates to form. Peat formation requires climates that allow for the partial decomposition of vegetable remains under conditions of deficient drainage.[13] Also, peat formations require at least 40 inches of rainfall a year and a mean temperature above 32°F. [15] In addition, there were temperate forests on the Seward Peninsula, in Alaska, and the Tuktoyaktuk Peninsula, in Canada's frigid Inuvik Region, facing the Beaufort Sea and the Arctic Ocean and at Dubawnt Lake, in Canada's frozen Keewatin Region, west of the Hudson Bay.[16] And yet, somehow, it is believed that Greenland's icecap survived several thousand years in such a recently temperate climate, but how?

What we have are temperate forests and warm waters near and within the Arctic Circle and Ocean all across the northern boundary from Siberia to Norway and from Alaska to the Hudson Bay. These temperate conditions existed for thousands of years both east and west of Greenland and at all the Greenland latitudes around the world - and these conditions had not yet ended by the time the Egyptians were building their pyramids! This, of course, would explain why mammoths and other large animals were able to live, during this period, throughout these northerly regions. (Back to Top)

Woolly Mammoths

Mammoths are especially interesting since millions of them recently lived (within the last 10-20 thousand years according to mainstream science) well within the Arctic Circle. Although popularly portrayed as living in cold barren environments and occasionally dying in local events, such as mudslides or entrapment

Berezovka Mammoth: The most famous of all mammoths is displayed in the Zoological Museum in St. Petersburg, Russia, in the struggling position in which he was found near Siberia's Berezovka River, just inside the Arctic Circle. His trunk and much of his head, reconstructed in this display, had been eaten by predators before scientists arrived in 1901. Its "mouth was filled with grass, which had been cropped, but not chewed and swallowed." The grass froze so rapidly that it still had "the imprint of the animal's molars." Twenty-four pounds of undigested vegetation were removed from the Berezovka mammoth and analyzed by Russian scientist, V. N. Sukachev. He identified more than 40 different species of plants: herbs, grasses, mosses, shrubs, and tree leaves. Below his right forefoot was "the end of a very hairy tail ... of a bovine animal, probably [a] bison." Also under the body were "the right forefoot and left hind foot of a reindeer ... The whole landslide on the Berezovka [River] was the richest imaginable storehouse of prehistoric remains." In the surrounding, loamy soil was an antelope skull, "the perfectly preserved upper skull of a prehistoric horse to which fragments of muscular fibre still adhered.

in soft riverbanks, the evidence may actually paint a very different picture if studied at from a different perspective.

The well preserved "mummified" remains of many mammoths have been found along with those of many other types of warmer weather animals such as the horse, lion, tiger, leopard, bear, antelope, camel, reindeer, giant beaver, musk sheep, musk ox, donkey, ibex, badger, fox, wolverine, voles, squirrels, bison, rabbit and lynx as well as a host of temperate plants are still being found all jumbled together within the Artic Circle - along the same latitudes as Greenland all around the globe.[39]

The problem with the popular belief that millions of mammoths lived in very northerly regions around the entire globe, with estimates of up to 5 million living along a 600 mile stretch of Siberian coastline alone,[39] is that these mammoths were still living in these regions within the past 10,000 to 20,000 years. Carbon 14 dating of Siberian mammoths has returned dates as early as 9670± 40 years before present (BP).[41] An even more recent study (1995) carried out on mammoth remains located on Wrangel Island (on the border of the East-Siberian and Chukchi Seas) showed that woolly mammoths persisted on Wrangel Island in the mid-Holocene, from 7390-3730 years ago (i.e., till about ~2,000 B.C.)[57]

So, why is this a problem?

Contrary to popular imagination, these creatures were *not* surrounded by the extremely cold, harsh environments that exist in these northerly regions today. Rather, they lived in rather lush steppe-type conditions to include evidence of large fruit bearing trees, abundant grasslands, and the very large numbers and types of grazing animals already mentioned only to be quickly and collectively annihilated over huge areas by rapid weather changes. Clearly, the present is far far different than even the relatively recent past must have been. Sound too far fetched?

Consider that the last meal of the famous Berezovka mammoth (see picture above), found north of the Artic Circle, consisted of "twenty-four pounds of undigested vegetation" [39] to include over 40 types of plants; many no longer found in such northerly regions.[43] The enormous quantities of food it takes to feed an elephant of this size (~300kg per day) is, by itself, very good evidence for a much different climate in these regions than exists today.[39] Consider the following comment by Zazula et. al. published the June 2003 issue of *Nature*:

"This vegetation [Beringia: Includes an area between Siberia and Alaska as well as the Yukon Territory of Canada] was unlike that found in modern Arctic tundra, which can sustain relatively few mammals, but was instead a productive ecosystem of dry grassland that resembled extant subarctic steppe communities . . .

Abundant sage (Artemisia frigida) leaves, flowers from Artemisia sp., and seeds of bluegrass (Poa), wild-rye grass (Elymus), sedge (Carex) and rushes (Juncus/Luzula) . . . Seeds of cinquefoil (Potentilla), goosefoot (Chenopodium), buttercup (Ranunculus), mustard (Draba), poppy (Papaver), fairy-candelabra (Androsace septentrionalis), chickweed (Cerastium) and campion (Silene) are indicative of diverse forbs growing on dry, open, disturbed ground, possibly among predominantly arid steppe vegetation. Such an assemblage has no modern analogue in Arctic tundra. Local habitat diversity is indicated by sedge and moss peat from deposits that were formed in low-lying wet areas . . .

[This region] must have been covered with vegetation even during the coldest part of the most recent ice age (some 24,000 years ago) because it supported large populations of woolly mammoth, horses, bison and other mammals during a time of extensive Northern Hemisphere glaciation." [42]

Now, does it really make sense for this region to be so warm, all year round, while the same latitudes on other parts of the globe where covered with extensive glaciers? Siberia, Alaska and Northern Europe and parts of northwestern Canada were all toasty warm while much of the remaining North American Continent and Greenland were covered with huge glaciers? Really?

Beyond this, consider that the mammoths didn't have hair erector muscles that enable an animal's fur to be "fluffed-up", creating insulating air pockets. They also lacked oil glands to protect against wetness and increased heat loss in extremely cold and damp environments. Animals currently living in Arctic regions have both oil glands and erector muscles. Of course, the mammoth did have a certain number of cold weather adaptations compared to its living cousins, the elephants; such as smaller ears, trunk and tail, fine woolly under-fur and long outer "protective" hair, and a thick layer of insulating fat,[39] but these would by no means be enough to survive in the extremes of cold, ice and snow found in these same regions today - not to mention the lack of an adequate food supply. It seems very much as Sir Henry Howorth concluded back in the late 19th century:

"The instances of the soft parts of the great pachyderms being preserved are not mere local and sporadic ones, but they form a long chain of examples along the whole length of Siberia, from the Urals to the land of the Chukchis [the Bering Strait], so that we have to do here with a condition of things which prevails, and with meteorological conditions that extend over a continent.

When we find such a series ranging so widely preserved in the same perfect way, and all evidencing a sudden change of climate from a comparatively temperate one to one of great rigour, we cannot help concluding that they all bear witness to a common event. We cannot postulate a separate climate cataclysm for each individual case and each individual locality, but we are forced to the conclusion that the now permanently frozen zone in Asia became frozen at the same time from the same cause."[40]

Actually, northern portions of Asia, Europe, and North America contain the remains of extinct species of the elephant [mammoth] and rhinoceros, together with those of horses, oxen, deer, and other large quadrupeds.[39] Even though the evidence speaks against the "instant" catastrophic event freeze that some have suggested,[39] the weather change was still a real and relatively sudden change to a much colder and much harsher environment compared to the relatively temperate and abundant conditions that once existed in these northerly regions around much of the globe. Is it not then a least reasonable to hypothesize that Greenland also had such a temperate climate in the resent past, loosing its icecap completely and growing lush vegetation? If not, how was the Greenland ice sheet able to be so resistant to the temperate climate surrounding it on all sides for hundreds much less thousands of years? (Back to Top)

A Recently Green Greenland?

Interestingly enough, crushed plant parts have been found in the ice sheets of northeastern Greenland – from a dike ridge of a glacier. This silty plant material was said to give off a powerful odor, like that of decaying organic matter.[17] This material was examined for fossils by Esa Hyyppa of the Geological Survey of Finland, who noted the following:

“The silt examined contained two whole leaves, several leaf fragments and two fruits of Dryas octopetala; [also] a small, partly decayed leaf of a shrub species not definitely determinable . . . and an abundance of much decayed, small fragments of plant tissues, mostly leaf veins and root hairs . . . " [17]

It is most Interesting that scientists think that this plant material must have originated from some superficial deposit in a distant valley floor of Greenland and that this material was squeezed up from the base of the ice. Some scientists have even suggested that, “The modern aspect of the flora precludes a preglacial time of origin for it.” [17] Note also that the northeastern corner of Greenland is actually its coldest region. It has a “continental climate that is remote from the influence of the sea.” [18] The ocean dramatically affects climate. That is why regions like the north central portions of the United States have such long, cold winters when compared to equal latitudes along the eastern seaboard. Northeastern Greenland, therefore, would have the coldest climate of the entire island.

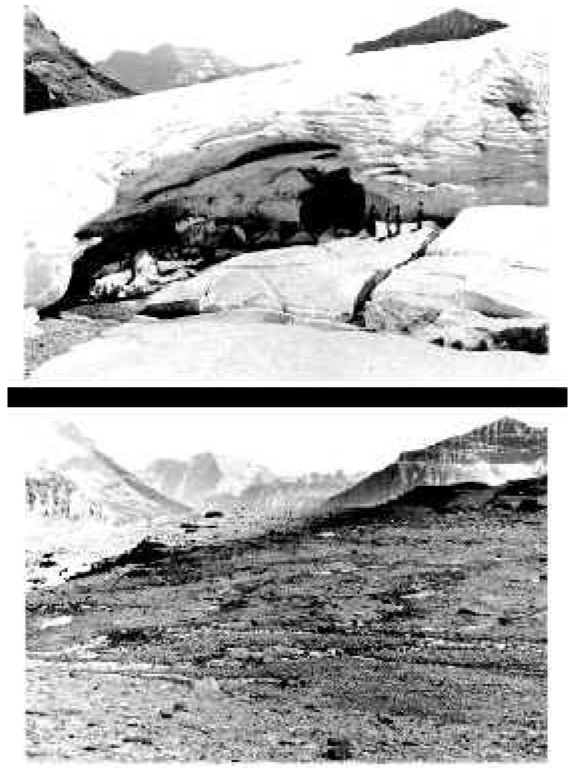
NGRIP researchers found what looked like pine needles or blades of grass and bark in mud at the bottom of the Greenland ice sheet - July, 2004

Also, consider that just this past July of 2004, plant material consisting of probable grass or pine needles and bark was discovered at the bottom of the Greenland ice sheet under about 10,400 feet of ice. Although thought to be several million years old, Dorthe Dahl-Jensen, a professor at the University of Copenhagen's Niels Bohr Institute and NGRIP project leader noted that the such plant material found under about 10,400 feet of ice indicates the Greenland Ice Sheet "formed very fast."[38]

Sub-Icecap Pine Needle Greenland

Beyond the obvious fact that such types of organic material suggest an extremely rapid climactic change and burial by ice, the question is, Why hasn't such organic material been stripped completely off Greenland by now by the flowing ice sheets? For instance, we know how fast these ice sheets move - up to 100 meters per year in central regions and up to 10 miles per year for several of Greenland's major glaciers. Given several hundred thousand to over a few million years of such scrubbing by moving ice sheets, how could significant amounts of such organic material remain on the surface of Greenland?

In just the last 100 years Glacier National Park has gone from having over 150 glaciers to just 35 today. And, those that remain have already lost over 90% of the volume that they had 100 years ago. "For instance, the Qori Kalis Glacier in Peru is shrinking at a rate of 200 meters per year, 40 times as fast as in 1978 when the rate was only 5 meters per year. And, it's just one of the hundreds of glaciers that are vanishing.



An ice cave at Glacier National Park's Boulder Glacier in early 1900s (top) vs. 1988 (bottom)

Ice is also disappearing from the Arctic Ocean and Greenland at an astounding rate that has taken scientists completely off guard. More than a hundred species of animals have been spotted moving to more northerly regions than they usually occupy. Many kinds of temperate plants are also growing much farther north and at higher elevations. Given all of these surprising rapid turn of events, even mainstream scientists are presenting some rather interesting scenarios as to what will happen to massive ice sheets like that found on Greenland in the near future. In some scenarios, the ice on Greenland eventually melts, causing sea levels to rise some 18 feet (~6 meters). Melt just the West Antarctic ice sheet as well, and sea

Above is a view of the lower 48 states of the United States if all the icecaps of the Earth were to melt. Notice that Florida is completely gone!

levels jump another 18 feet.[34] The speed of glacial demise is only recently being appreciated by scientists who are "stunned" to realize that glaciers all around the world, like those of Mt. Kilimanjaro, the Himalayas just beneath Mt. Everest, the high Andes, Swiss Alps, and even Iceland, will be completely gone within just 30 years.[33] The same thing happened to the Langjokull Ice Cap, in Iceland, during the Hypsithermal based on benthic diatom data. "Langjokull must have disappeared in the early Holocene for such a diverse, benthic dominated diatom assemblage to flourish."[58] It's about to happen again.

Of course, this begs the question as to how the ice sheets on Greenland and elsewhere, which are currently melting much faster than they are forming with just a 1°C rise in global temperature, could have survived for several thousand years during the very recent Hypsithermal period when global temperatures were another 2°C degrees warmer than today and temperatures within the Arctic Circle were between 20 and 40ºC warmer?

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Summary

First glance intuition is often very helpful in coming up with a good hypothesis to explain a given phenomenon, such as the hundreds of thousands of layers of ice found in places like Greenland and Antarctica. It seems down right intuitive that each layer found in these ice sheets should represent an annual cycle. After all, this seems to fit the uniformitarian paradigm so well. However, a closer inspection of the data seems to favor a much more recent and catastrophic model of ice sheet formation. Violent weather disturbances with large storms, a sudden cold snap, and high precipitation rates could very reasonably give rise to all the layers, dust bands, and isotope variations etc. that we find in the various ice sheets today.

So, which hypothesis carries more predictive power? Is there more evidence for a much warmer climate all around Greenland in the recent past or for the survival of the Greenland Ice sheet, without melting, for hundreds of thousands to millions of years? Both positions cannot be right. One of them has to be wrong. Can all the frozen temperate plants and animals within the Arctic Circle trump interpretation of ocean core sediments, coral dating, radiometric dating, sedimentation rate extrapolations, isotope matches between ocean and ice cores and Milankovitch cycles? Most scientists don't think so. Personally, I don't see why not? For me, the evidence of warm-weather animals and plants living all around Greenland around the entire Arctic Circle, is especially overwhelming.

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Various challenges:

The following is from an E-mail exchange with C. Leroy Ellenberger, best known as a one-time advocate, but now a prolific critic of controversial writer/catastrophist Immanuel Velikovsky. My response follows:

July 26, 2007:

Talbott STILL does not GET IT concerning the ability of the ice at high altitude at the summit of the Greenland ice cap to have survived the global warming that occurred during the Hypsithermal period. Just because it was six or so degrees warmer at sea level during that time DOES NOT AUTOMATICALLY mean that it was six degrees warmer at the high altitude at Greenland's summit, due to adiabatic cooling; or even if it were six degrees warmer at the summit does not mean that the summer temperature necessarily got above freezing. AS I said in July 1994, we can ski Hawaii and Chile even while the folks at sea level are basking almost naked in the sun. And besides, the cores contain NO INDICATION that such wholesale melting, draining away untold number of annual layers, has even happened at the summit of Greenland in the past 110,000 years. Period. As Paul Simon sez in "The Boxer": "The man hears what he wants to hear and disregards the rest." That is Dave Talbott, "clueless in the mythosphere".

I would also like to point out what Robert Grumbine told me earlier today: if, say, 10,000 annual layers were melted, as Talbott would like to believe, then it would have been impossible for Bob Bass to get the high correlation he did between the signals in ice core profiles and Milankovitch cycles.

Leroy

High altitude doesn't seem to be a helpful argument when it comes to explaining the preservation of Greenland Ice sheets during the thousands of years (6-7kyr) of Hypsithermal (Middle Holocene) warming. Why? Because what supports the high altitude of the ice in Greenland? Obviously, it is the ice itself.

I mean really, note that the *altitude* of the ice sheet in Greenland is about 2,135 meters. Now, consider that about 2,000 meters of this altitude is made up of the thickness of the ice itself. If you warm up this region so that the lower altitudes start to melt, the edges are going to start receding at a rate that is faster than the replacement of the total ice lost. In short, the total volume of the ice will decrease and the ice sheet will become thinner as it flows peripherally. This will reduce the altitude of the ice sheet and increase the total amount of surface area exposed to the warmer temperatures. This cycle will only increase over the time of increased warmness.

Consider this in the light of what is happening to the ice sheet in Greenland today with only a one degree increase in the average global temperature over the past 100 years or so. Currently, the ice is melting at 239 cubic kilometers per year (measured from April 2002 to November 2005). And, we aren't yet close to the average global warmness thought to have been sustained during the Hypsithermal (another 3 to 5 degrees warmer). If that's not a problem I don't know what is? But, as you pointed out, "A man hears what he wants to hear and disregards the rest." - but I suppose you are immune to this sort of human bias?

As far as Milankovitch Cycles and the fine degree of correlation achieved, ever hear of "tuning"? If not, perhaps it might be interesting to look into just a bit. Milankovitch cycles seem, to me at least, to have a few other rather significant problems as well.

http://www.detectingdesign.com /milankovitch.html
http://www.detectingdesign.com /ancientice.html

Sean Pitman
www.DetectingDesign.com

Leroy Responds:

Sean . . .
While your logic is unassailable, it is based on a false premise concerning how much warming occurred during the mid-Holocene Hypsithermal period. (1) Contrary to what you and Charles Ginenthal claim (coincidentally or not), there was no ca. 5 degree rise in average global temperature during the Hypsithermal, more generally known as the Atlantic period, from ca. 6000 B.C. to 3000 B.C. This 5 degrees is a figure that was derived for the rise in temperature in Europe, according to the source cited by Ginenthal. The consensus among climatologists is that the average global rise in temperature in the Hypsithermal/Atlantic period was about one degree, which we are seeing now. (2) However, regardless what the temperature rise might have been, another line of evidence contradicts your and Ginenthal's position. The hundreds of sediment cores extracted from the bottom of the Arctic Ocean indicate that during the past 70,000 years the Arctic Ocean has never been ice free and therefore never warm enough for all the melting you, Ginenthal, and Talbott claim allegedly happened. I urge you to read Mewhinney's Part 2 of "Minds in Ablation" and see if your dissertation on ancient ice does not need some revision or dismantling. It would appear that Dave Talbott's gloating in his email to this list at Thu, 26 Jul 3007 20:20:19-0400 (EDT), was not only premature, but totally unjustified.

Richard Alley [author of The Two Mile Time Machine] received my email while he was en route to Greenland, but he took the time to send the following reply, for which I am most grateful and which is above my request:

"Modelers such as P. Huybrechts have looked into this. In the models, there exist solutions in which somewhat smaller and steeper ice sheets are stable; warming causes melting back of the margins but not enough melting across the cold top of the ice sheet to generate abundant meltwater runoff. Averaged over the last few decades, iceberg calving has removed about half of the snow accumulation on Greenland, and melting the other half. Warming causing retreat would pull the ice largely or completely out of the ocean, thus reducing or eliminating the loss by calving; without losing icebergs, less snowfall is required to maintain the ice sheet, so stability is possible with more melting. Too much warming and the ice sheet no longer has a steady solution. The model results shown in our review paper are relevant." - Alley, R.B., P.U. Clark, P. Huybrechts and I. Joughin. Ice-sheet and sea-level changes. *Science* 310: 456-460 (2005).

On 7/26/07 8:17 PM, "Leroy Ellenberger"

Dear Leroy,

I appreciate your response. It seems to me though that you are now simply throwing out anything that comes to mind to see if it will fly. First you argue that the altitude of Greenland would preserve the ice sheet in a warm environment for thousands of years. But, now that you see that this argument is untenable, you have now decided that it must not have been that warm during the Hypsithermal?

I've read through Mewhinney's "Minds in Ablation" several times now in my consideration of this topic. To be frank, I don't see where Mewhinney convincingly deals with the topic of the Hypsithermal warm period. For example, you argue that there was only a significant rise in temperature (relative to today) in Europe. Beyond this, you suggest that the overall average global temperature during the Hypsithermal was about the same as the average global temperature today.

Well, it seems to me like there are at least a few potential problems here. The first problem is that even at current global temperatures, the Greenland Ice sheet is in ablation at a rate that would easily melt it well within the time frame of the Hypsithermal period - several times over. Also, the notion that only Europe experienced significantly increased temperatures doesn't seem to gel quite right with the available facts.

Harvey Nichols, back in the late 60s, published a study of the history of the "Canadian Boreal forest-tundra ecotone". This study "suggested that the arctic tree-line had moved northwards 350 to 400 km beyond its modern position (extending soils evidence collected by Irving and Larsen, in Bryson et al. 1965, ref. 6) during the mid-Holocene warm period, the Hypsithermal. The climatic control of the modern arctic tree-line indicated that prolonged summer temperature anomalies of ~ + 3 to 4 C were necessary for this gigantic northward shift of the tree-line, thus fulfilling Budyko's temperature requirement for the melting of Arctic Ocean summer ice pack. A more extensive peat stratigraphic and palynological study (Nichols, 1975, ref. 7) confirmed and extended the study throughout much of the Canadian Northwest Territories of Keewatin and Mackenzie, with a paleo-temperature graph based on fossil pollen and peat and timber macrofossil analyses. This solidified the concept of a +3.5 to 4 degree (+/- 0.5) C summer warming, compared to modern values, for the Hypsithermal episode 3500 BP back at least to 7000 before present, again suggesting that by Budyko's (1966) calculations there should have been widespread summer loss of Arctic Ocean pack ice. By this time J.C. Ritchie and F. K. Hare (1971, ref.8) had also reported timber macrofossils from the far northwest of Canada's tundra from even earlier in the Hypsithermal."

Harvey Nichols (1967a) "The post-glacial history of vegetation and climate at Ennadai Lake, Keewatin, and Lynn Lake, Manitoba (Canada)", Eiszeitalter und Gegenwart, vol. 18, pp. 176 - 197.

H. Nichols (1967b) "Pollen diagrams from sub-arctic central Canada", Science 155, 1665 - 1668.

http://climatesci.colorado.edu /2006/07/page/2/

These "warm" features are not limited to Canada or Europe, but can be seen around the entire Arctic Circle. Large trees as well as fruit bearing trees and peat bogs, all of which have been dated as being no older than a few tens of thousands of years, are found along the northern most coasts of Russia, Canada, and Europe - often well within the boundaries of the Arctic Circle. Millions of Wholly Mammoth along with horse, lion, tiger, leopard, bear, antelope, camel, reindeer, giant beaver, musk sheep, musk ox, donkey, ibex, badger, fox, wolverine, voles, squirrels, bison, rabbit and lynx as well as a host of temperate plants are still being found all jumbled together within the Artic Circle - along the same latitudes as Greenland all around the globe. Again, the remains of many of these plants and animals date within a few tens of thousands of years ago. Yet, their presence required much warmer conditions within the Arctic Circle than exist today - as explained by Nichols above.

And, this problem isn't limited to the Hypsithermal period. Speaking of the area between Siberia and Alaska as well as the Yukon Territory of Canada Zazula et al said, "[This region] must have been covered with vegetation even during the coldest part of the most recent ice age (some 24,000 years ago) because it supported large populations of woolly mammoth, horses, bison and other mammals during a time of extensive Northern Hemisphere glaciation."

Grant D. Zazula, Duane G. Froese, Charles E. Schweger, Rolf W. Mathewes, Alwynne B. Beaudoin, Alice M. Telka, C. Richard Harington, John A Westgate, "Palaeobotany: Ice-age steppe vegetation in east Beringia", *Nature* 423, 603 (05 June 2003) (http://www.sfu.ca/~qgrc/zazula _2003b.pdf)

I don't get it? Was it much warmer than today all the way around the Arctic Circle, everywhere, and still cold in Greenland? How is such a feat achieved?

As far as your "other lines of evidence" they all seem shaky to me in comparison to the overwhelming evidence of warm-weather plants and animals living within the Arctic Circle within the last 20kyr or so.

The patterns of sedimentary cores are, by the way, subject to the very subjective process of "tuning" - as noted in my essay on Milankovitch Theory.

http://www.detectingdesign.com /milankovitch.html

Richard Alley's argument that smaller "steeper" ice sheets are more stable during warm periods doesn't make any sense to me. Ice sheets flow. They don't remain "steep" or all humped up like Half-Dome. To significantly increase the "steepness" or "slope" of the Greenland ice sheet, the overall size of the sheet would have to be reduced from over 2,000,000 square kilometers to just a few thousand to make a significant difference in the overall "steepness" of the Greenland ice sheet.

Even today the Greenland ice is melting quite rapidly across most of "the top" as well as the sides. It is also melting in such a way that the surface meltwater percolates down through the entire ice sheet to create vast lakes at the bottom - lubricating the ice sheet and making it flow even faster. Just because it doesn't reach the ocean before it melts and turns into water doesn't mean that less ice is melting than before - i.e., just because it is flowing as liquid water instead of "calving" into the ocean.

No, I'm afraid you, Mewhinney, and Alley have a long way to go to explain some of these interesting problems - at least to my own satisfaction. It seems like you all accept certain interpretations based on a limited data set while failing to seriously consider a significant amount of evidence that seems to fundamentally counter your position in a very convincing manner.

Thanks again for your thoughts. I did find them very interesting.

Sean

Next Response:

Dear Sean,
You raise a many points here in your rejoinder, some of which distort what I wrote. I have neither the resources nor the time to explore all the points you raise, if indeed they need to be explored considering Jim Oberg's remark to Warner Sizemore in a late 1978 letter about not needing to chase every hare Velikovsky set loose to know that Worlds in Collision is bogus. And for all the points you raise, many of them interesting about exotic Arctic conditions and so forth, you do not, as I see it, come to grips with the testimony from the Arctic Ocean sediment cores which indicate that body of water has never been ice free in the past 70,000 years, as would be the case if climate were as warm as you claim. This has to be a boundary condition on your speculations despite all the
botanical and faunal activity in the Arctic during that time.

Sure, the Pleistocene and early Holocene were interesting environments whose conditions we have difficulty understanding and doubly so as we project our own experiences on that extinct epoch. AS an example of a distortion of what I wrote, I did not claim Europe was the only area that warmed five degrees during the Hypsithermal, merely that it was the area mentioned in the source Ginenthal used to justify his claim of a global warming that large. As for the demise of the Pleistocene megafauna that seems to interest you so much, I can do no better that R. Dale Guthrie's Frozen Fauna of the Mammoth Steppe (U. Chi. Press, 1990) and William White's three part critique in Kronos XI: 1-3 which focusses on the extragant claims made over the years about the catastrophic demise and preservation of the frozen mammoths. White was rebutting my defense of the Sanderson-Velikovsky school of mammoth extinction earlier in Kronos. Oh yes, and do not forget William R. Farrand's 1961 classic "Frozen Mammoths and Modern Geology", SCIENCE 133, 729-35. I leave you with the closing quote of my previous email: "Mundus vult decipi ergo decipiatur".

Sincerely, C. Leroy Ellenberger

Dear Leroy,

If you aren't interested in seriously considering some of the main points I've raised, that's up to you. It is just that so far I haven't seen anyone present any significantly cogent arguments against the evidence for a very warm and iceless Arctic Circle and Ocean in the recent past.

You say I've not considered the evidence of the ocean cores, but I have considered this evidence. It is just that your interpretation of the ocean sediment cores seems to fly in the face of the overwhelming interpretation of the existence of warm-weather animal and plant life within the entire Arctic Circle in the recent past. Both interpretations simply can't be right. One has to win out over the other. It all boils down to which perspective carries with it the greatest degree of predictive power. Consider this in the light of the following interpretation of ocean cores take from the Barents Sea (i.e., part of the Arctic Ocean):

"Marine sediment cores [taken in the Barents Sea] representing the entire Holocene yielded foraminifera which showed that a temperature optimum (the early Hypsithermal) developed between 7800 and 6800 BP, registering prolonged seasonal (summer) **ice free** conditions, and progressing to 3700 BP with temperatures similar to those of today, after which a relatively abrupt cooling occurred." [emphasis mine]
J-C Duplessy, E. Ivanova, I. Murdmaa, M. Paterne, and L. Labeyrie, (2001): "Holocene paleoceanography of the northern Barents Sea and variations of the northward heat transport by the Atlantic Ocean" in "Boreas" vol. 30, # 1, pp. 2 - 16.

So, there you have it. How then can you argue that ocean core sediments conclusively support your contention that the Arctic Ocean has "never been ice free for the past 70,000 years"? Now, is that really true? - given the above reference?

Also, I don't see that it matters what killed off the mammoths for the purposes of this discussion - catastrophic or otherwise. That has nothing to do with the fact that these creatures and many others lived in lush warm environments for a long period of time above and around the significant majority of the Arctic Circle in the recent past. This is an overwhelming fact with an equally overwhelming conclusion that makes it very hard to imagine how Greenland could have remained frozen the whole time.

If you have something as far as real evidence or a reasonable explanation, I'd be quite interested. Otherwise, I'm not into a discussion that is mostly about who can list off the most pejoratives. That might be fun, but I'm really not up for that sort of thing . . .

Sean Pitman
www.DetectingDesign.com

Arguments from Robert Grumbine (Ph.D., Geophysical Sciences):

Pulling a couple of points out of Pitman's latest 2 notes.

And the ultimate argument -- it doesn't make sense to Pitman. Yet even though he quotes Alley's argument, he doesn't see the effect. Half the ice that is lost from Greenland today is lost by calving of iceberge. Icebergs aren't meltwater. Meltwater is the other half of the mass loss.

The size of the ice sheet depends on the balance between income (accumulation) and outgo (melting, iceberg calving). No iceberg calving halves the outgo, letting the income side win out until the ice sheet gets so large that it starts calving again.

Ice sheets do indeed flow. What Pitman has missed is covered well in the Paterson reference I made earlier. Namely, the flow rate depends on the temperture of the ice. Colder ice doesn't flow as fast as warm. A second feature he missed is that ice is an excellent insulater. It takes time for warmer conditions at the surface to warm the temperatures in the interior of the ice sheet. Enough time that parts of the Greenland ice sheet still 'remember' glacial maximum temperatures. Much more of the sheet would have remembered the glacial maximum conditions several kya than currently do so, and the ice would have been correspondingly stiffer, leading to more steeply-sloped sides.

All the preceding, though, is aside. The real point is that in talking about the Greenland ice sheets' melting away during the hypisthermal, Pitman is making a _prediction_, not an observation. Yet he and some others are taking his prediction as observed fact. The preceding merely sheds a little light on what quality of prediction he made.

More to the point is that if he were engaging in science, the thing he'd do following his prediction of the obliteration of the Greenland
ice sheet is look for evidence that it had actually happened. Forests and mammoths don't show obliteration of ice sheets, so all that is irrelevant except as clues to what motivated the prediction.

One good way of determining that Greenland had melted away is to find those extra 6 meters of sea level that it represents. Yet, in fact, the sea levels are higher now than any time in the last ~100 ky, including during the hypsithermal.

In the second note:

The Barents sea today is ice-free in the summer, yet there is a perennial Arctic sea ice pack. It was also ice free -- in summer -- during the 'little ice age'. The Barents sea is marginal for sea ice packs, so doesn't carry a perennial ice cover. William Chapman, at the University of Illinois, has a nice web site on sea ice conditions called 'the cryosphere today'. The National Snow and Ice Data Center carries more data, some Scandanavian records back several centuries included.

Robert Grumbine

Robert,

Thank you for your thoughts. However, they still don't seem to solve the problem - as I understand it anyway.

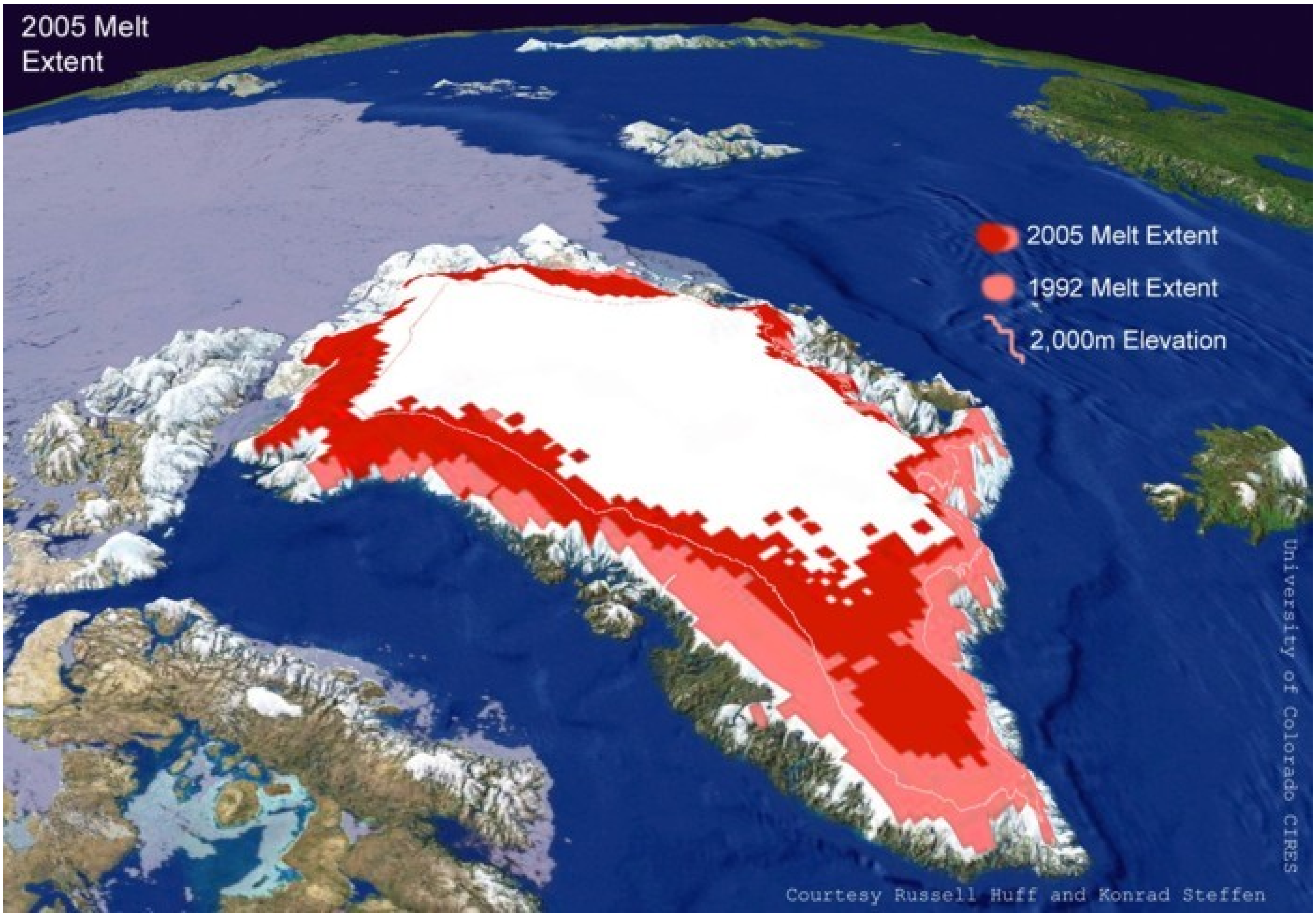
You present the seemingly obvious argument that the total ice lost from the Greenland ice sheet is the result of half melting and half calving. Obviously then, if the ice melts to a point where there is no more calving, half the loss is removed and the accumulation rate can keep up.

Superficially this seems like an obvious conclusion. The problem here is that this argument does not take into account the etiology of calving - i.e., the flow of ice all the way to the ocean. If the ice sheet melts to such an extent that it no longer reaches the ocean, the ice sheet itself would have to be quite thin. Thick ice creates a lot of pressure on itself and flows over time at a rate that is fast enough to reach the ocean before it melts. The ice isn't going to be cold enough to make it "stiff" enough so that it doesn't flow at at least its current rate of flow (contrary to your suggestion). Also, the flow rate is only going to be increased over the current rate with increased areas of surface melting. This is due to the increased lubrication of the ice sheet from the percolation of liquid water from the surface to the base of the ice sheet.

Also, the ice sheet isn't going to get much "steeper" than it already is. Why not? Because the thickness of the Greenland ice sheet is about 2 km, but around 1500 x 1500 km (2,175,590 sq km) in surface area. How does one create a relatively "steep" ice sheet unless the ice sheet one is thinking about is less than a few tens of km in maximum diameter?

In short, it seems to me that it is the flow rate that is key, not the calving rate. Ice is lost at the flow rate regardless of the calving rate. Therefore, if the melting of the ice is so great that the flow rate cannot keep up in a way that allows calving into the ocean, this does not indicate a "halving" of the rate at which ice is lost from the sheet at all. It simply indicates that the flow rate cannot keep up with the increased melt rate. At this point the ice sheet would have become so thin that a much greater surface area would be exposed to summer melt - dramatically increasing the average yearly loss of ice as well as the flow rate (due to the lubrication effect).

This sort of thing is already happening today. In the illustration below, note the significant increase in the area of summer melt in Greenland between 1992 and 2005, contributing to about 240 cubic kilometers of ice lost, per year, by 2005.



This feature will only be enhanced as the Arctic region continues to warm - still well shy of the warmth experienced in this region during the thousands of years of the Hypsithermal. Pretty soon the entire sheet will be subject to summer melting. I'm sorry, but this increased melt rate over the entire sheet isn't going to be overcome by a decline in calving rate. That just doesn't happen. There simply is no example of such a thing as far as I am aware. But, I'd be very interested in any reference of such an observation or model to the contrary.

Also, the notion that the Arctic Ocean was covered with ice during the Hypsithermal is significantly undermined by current melt rates of the Arctic Ocean ice. At current rates the ice will be pretty much gone well within 50 years (see figure below). In fact, some, like Walt Meier, a researcher at the U.S. National Snow and Ice Data Center in Boulder, Colorado, commented on these interesting findings notes that the melting of the Arctic ice cap in summer is progressing more rapidly than satellite images alone have shown. Given recent data such as this, climate researchers at the U.S. Naval Postgraduate School in California predict the complete absence of summer ice on the Arctic Ocean by ***2030*** or sooner.

Don Behm, *Into the spotlight: Leno, scientists alike want to hear explorer's findings*, Journal Sentinel, July 21, 2006 (Link)

That's only about 20 years away. And you think all the evidence that the Hypsithermal was even warmer within the entire Arctic region isn't enough to suspect that the Arctic Ocean was probably ice free then as well as it is going to be in very short order today? It stretches one's credulity to think otherwise - does it not? Yet, you argue that forests, mammoths, peat bogs, and warm-water forams are "irrelevant" to this question - even when they appear within the Arctic Circle? Really?

Thanks for your efforts though. But, I must say . . . I for one still don't "get it".

Sean Pitman

http://www.ucar.edu/news /releases/2006/arctic.shtml

Consider also that fairly recent evidence has come to light that mammoths survived on Wrangel Island (located on the border of the East-Siberian and Chukchi Seas) until 2,000 B.C. That's right. This is no joke.

http://www.radiocarbon.org /Journal/v37n1/vartanyan.html

Additional Thoughts:

Robert Grumbine presented an interesting challenge: "One good way of determining that Greenland had melted away is to find those extra 6 meters of sea level that it represents. Yet, in fact, the sea levels are higher now than any time in the last ~100 ky, including during the hypsithermal."

Well, as it turns out, this observation has been made and reported by several scientists, to include NguyÔn V¨n B¸ch, Ph¹m ViÖt Nga of the institute of Oceanography, NCNST. These authors report the following findings:

The study results of depositional environments provide with informations to reconstruct the sea-level positions in the last 6,000 years. Here, it must be admitted that in the time of 6,000 years or so before present in Trêng Sa region, the sea-level was higher than the present by 5 - 6m. That's why several coral reefs have the top surfaces of 5m in height. Nowadays, the most of scientific works touching upon Holocene sea-level changes support the conclusion that the sea-level was at +5m dated 6,000 years BP [1, 6]. Thus, in Trêng Sa Sea for the last 6,000 years BP sea-level has moved up and down 4 times (Fig.6) in a drop trend. The curve in Fig.6 is deduced from the study results of sedimentary sequence and stratigraphic, pollen-spores, chemical analysis and sedimentary basin analysis.

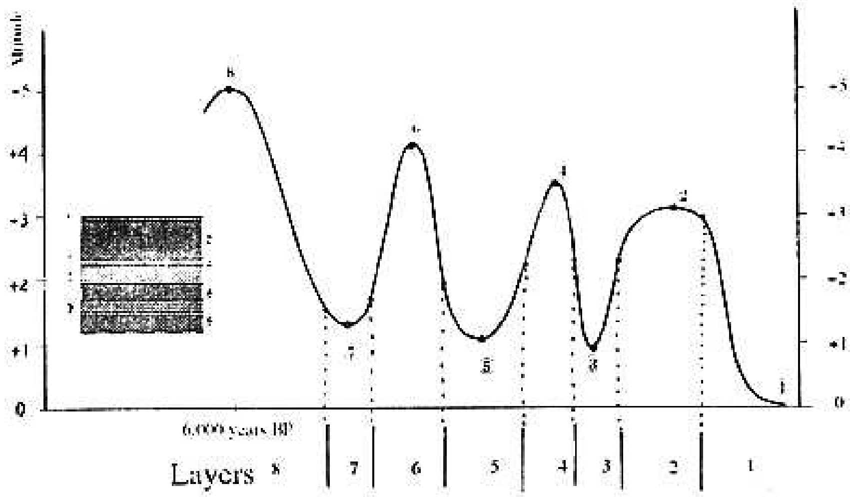


Fig. 6. *The curve showing Holocene sea-level oscillations for the last 6,000 years deduced from the study result of the origofacies of sedimentary deposits*

NguyÔn V¨n B¸ch, Ph¹m ViÖt Nga, Holocene sea-level changes in Trêng Sa archipelago area, *Institute of Oceanography, NCNST, Hoµng Quèc ViÖt, CÇu GiÊy, Hµ Néi,* July 9, 2001 (Link)

Robert Grumbine responds:

Obliterating Greenland is a matter of global sea level, not merely local, so let's see [whether] the paper is about global sea level: . . .
Worse, w.r.t. Pitman's cherry-picking, is that the same paper does include global sea level curves which do show that global sea level has not been several meters greater than present any time in the past 10ky (one stops there, the one that goes farther back shows no such higher sea level for the past 125 ky -- its limit).

Not content to cherry-pick only a single local curve, it also turns out that he cherry-picked _which_ local curve. Figure 3 shows (and labels it so) Regional Sea Level curve, one curve for 'data scattered along the Vietnamese coast', and one for the Hoang So area. The latter accord with the global curve and aren't mentioned by Pitman. Fig 4 shows a curve for the Malaysia peninsula, which shows less sea level change than the scattered Vietnamese stations (4 m peak, vs the 5-6 Pitman quotes for the Vietnamese -- someone unknowledgeable but curious about the science would wonder why there were such very large differences over such small areas 0, 4, 5 meters in three nearby areas).

The authors, even in translation, are clear about what they were doing and what they found. They found some interesting features in their local area. What they did not do, or attempt, or challenge, was to construct a global sea level curve. What's interesting, for their work, is that while global sea level was flat the last 6 ky, their area has been oscillating up and down.

Robert Grumbine

Robert,

And that's the whole point. "Global" sea level curves for the Holocene seem to be extrapolations from regional sea level curves - curves that can vary widely with all kinds of theories as to the reasons for the regional differences. Some argue that:

"The probability is strong that mid-Holocene eustatic sea level was briefly a meter or two higher than the present sea level, although separating isostatic and eustatic effects remains an impediment to conclusively demonstrating how much global ice volume was reduced. . .

In summary, when relative sea-level records are reconstructed from paleoclimatological methods, all coastlines exemplify to one degree or another the complex processes confronting inhabitants of coastlines of Scandinavia, Chesapeake Bay, and Louisiana. Multiple processes can cause observed sea-level changes along any and all coastlines and uncertainty remains when attributing cause to reconstructed sea-level trends. Only through additional relative sea-level records (including sorely needed records from the LGM and early deglaciation), better glaciological budgets, and improved geophysical and glacial models will the many factors that control sea-level change be fully decoupled."

http://www.earthscape.org/r3 /cronin/cronin08.html

Also note the Fairbridge curve with it's multiple Holocene blips several meters above today's "global" levels (Fig. 2):

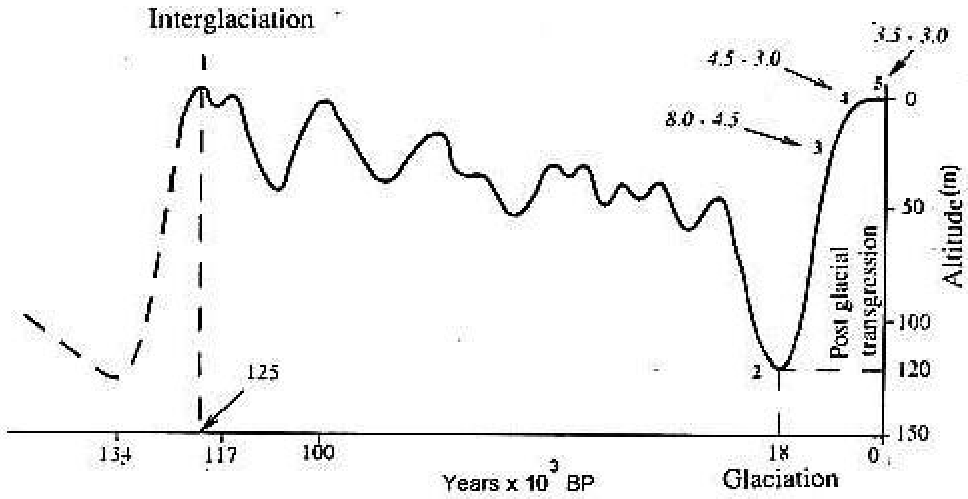


Fig1. *Sea-level curve during the period from the last interglaciation to present day (according to Chapell & Shackleton, 1986)*

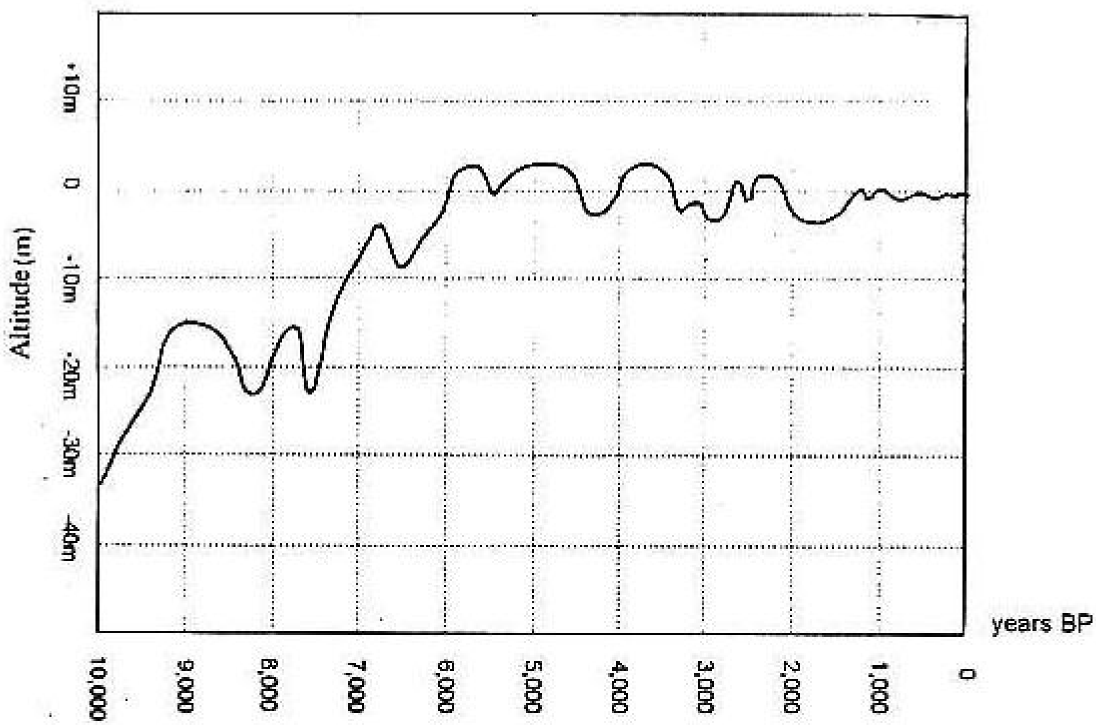


Fig 2. *Global sea-level curve showing Holocene eustatic changes in sea-level (according to Fairbridge, 1961)*

This hardly sounds to me like conclusive science - something upon which one can make very definitive negative or positive statements concerning the likely melt or non-melt of Greenland's ice. There's just not sufficient positive or negative predictive power. In short, its seems rather difficult to use such evidence, "cherry pick" if you will, and pretty much ignore the very strong evidence for a much warmer Arctic in the recent past than exists today - and the implications of this evidence for the survival of the Greenland ice sheet for thousands of years.

Sean Pitman
www.DetectingDesign.com

Additional comment:

Current concepts of late Pleistocene sea level history, generally referred to the ^{14}C time scale, differ considerably[1]. Some authors[2,3] assume that the sea level at about 30,000 BP was comparable with that of the present and others[4,5] assume a considerably lower sea level at that time. We have now obtained ^{14}C dates from *in situ* roots and peat which indicate that the sea level was lowered ***eustaticly*** to at least 40−60 m below the present level between 36,000 and 10,000 BP. The sea level rose from -13 m to about ***+5 m*** from 8,000 to 4,000 BP and then approached its present level. [emphasis added]

M. A. GEYH*, H. STREIF* & H.-R. KUDRASS, Sea-level changes during the late Pleistocene and Holocene in the Strait of Malacca, *Nature* 278, 441 - 443 (29 March 1979); doi:10.1038/278441a0 (Link)

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