The extinction of the woolly mammoth—it *was* a quick freeze!

Malcolm Bowden

In the *TJ* **14**(3), Michael Oard claimed that the woolly mammoths were not quickly frozen but were suffocated in a dust storm that buried them and they were then frozen.[1] Having examined his article carefully, I have concluded that his proposals are contradicted both by evidence within the article itself and with that found at the wide range of sites where many of these animals have been discovered.

A point of agreement.

Oard notes that some creationists suggest that the mammoths were frozen at the time of the Flood. He rightly points out that this could not be so because they are always found on top of great depths of fossil-bearing strata that would have been laid down in the Flood period. In addition, they are depicted in cave art and have spear points embedded in some carcasses—all post Flood indicators.

In this, I would agree with him. The mammoths lived for some time after the Flood in a warm climate with lush vegetation.

Oard's proposal

Oard rejects the proposition that they were rapidly frozen at an early stage of their death. I summarise his proposals in the following stages.

1. All the animals (mammoths, rhinos, etc.) lived in a warm climate with lush vegetation. The conditions in winter would not have been hard, with light snowfall only.
2. A huge dust storm raged, which suffocated the animals and buried them.
3. The level of permafrost then rose from below and froze the mammoths.
4. The existence of vegetation in the stomach does not necessarily require rapid freezing as a cylindrical mass of vegetation has been found inside the skeleton of a mastodon.
5. Local sliding and shearing of the frozen ground broke some of the bones of the mammoths.

There are a number of errors in this model, but I will only examine some of the larger of them.

Major errors in dust storm model.

(1) The climatic conditions

Oard is an experienced meteorologist, but there seems to be something wrong in the sequence of events he proposes.

(a) The conditions before the catastrophe

He notes the weather is warm, vegetation is lush, and, most importantly—'The post-Flood rapid ice age would have had milder winters and cooler summers *with little if any permafrost'*, and the land 'would have been a favorable environment for many mammals'.

If the winters were as mild as he depicts, surely there would be no permafrost. This can take many years to build up if the surface is kept well below freezing for most of the year—as it is today in Siberia and Alaska.

(b) The conditions after the catastrophe

The mammoths were rapidly buried in the dust storm, which choked them to death. He then says:

> 'The permafrost would then move *upward* (emphasis his) after the loess was deposited and rapidly freeze the remains, thus accounting for the rapid burial, which seems impossible any other way.'

Having said the permafrost was probably *not* present, he then has to call upon this non-existent permafrost to rise rapidly to freeze the mammoth quickly!

I would also question just how rapidly it could rise to freeze a huge mammoth so quickly that the whole of the meat of this huge animal was preserved for over 3,000 years. It was so well preserved that it could be fed to the sledge dogs of the excavators. Long before the top of the animal (say 2–3 metres above the (non-existent) permafrost level) could have been frozen, it would have decayed badly.

Present conditions in Siberia and Alaska are exceptionally cold, with the permafrost only melting about 60 cm in depth and freezing again in winter. This indicates that the level of permafrost moves very slowly—60 cm in say 4–5 months of warmer weather! At this rate it would take possibly 20 months to rise sufficiently to freeze the carcass of a mammoth—by which time it would have rotted badly.

The evidence clearly indicates that the *whole* of the animal was frozen very quickly.

(2) The surrounding material

Oard claims the mammoths were asphyxiated during a dust storm of loess. However, the Beresovka mammoth, and many other animals, were not found in loess but in 'muck'. This is described as a chaotic mixture of sand, gravels and clay. Now there are fine clay (loess) and sand storms even today, but it is unlikely that gravel would be picked up also. Winds that could do that would have knocked over even mammoths and battered their ribs and skins badly with the flying gravel. There is no evidence of this, and therefore Oard has no explanation of the situation of the Beresovka mammoth and the vast majority of the other animals buried in similar 'muck'.

(3) The vegetation in the Beresovka mammoth

(a) The stomach contents

Vegetation was found in the stomach. Oard says that this does not require a rapid freeze as stomach contents have been found inside a skeleton of a mastodon, and that digestion takes place mainly *after* the stomach. However, he notes:

> '… the stomach had a very acidic pH of about 2. This high acidity is expected to partially degrade the stomach vegetation. It is clear, therefore, that *the stomach is mainly a storage area before digestion* [emphasis in the original].'

He does not list the stomach contents but there were 11 kilograms of undigested food consisting of many delicate plants that were still recognizable. Thus, even with a very acidic stomach, the contents had not had time to be badly degraded. This would not have taken place if they had been engulfed in a dust storm and then waited for the permafrost to reach the stomach level.

(b) The mouth contents

Oard makes no mention of this. Unchewed bean pods were found in the mouth, showing that they died so suddenly that they did not even have time to swallow their last mouthful.

Had they been caught in a dust storm, it could not possibly have started so suddenly that they did not have time to swallow a few beans in their mouth. This is yet further evidence of their very sudden death.

(4) The broken bones

The Beresovka mammoth had a broken pelvis, ribs and right foreleg. Oard has a very strange passage dealing with this problem, which I give in full.

> 'The broken bones of the Beresovka mammoth could easily be explained by the shifting of ground ice and frozen sediment—in other words a diagenetic, post-mortem effect of shifting permafrost.[138,139] Although some researchers lean toward such a diagenetic explanation, there was considerable blood near the wound of the foreleg of the Beresovka mammoth. Bleeding had occurred between the muscles and the fatty and connective tissues.'

Let us first deal with the evidence. How does permafrost 'shift'? Likely options are either by expansion of the frozen material, or of trapped water, or by slumping of the ground where the gradient is very steep.

I would suggest that none of these were operative in the 'muck'. The first two would have splintered more than a few particular bones some distance apart on the body and none others. Oard explanation for this is as follows:

> 'Some of the loess, especially in Alaska, has been reworked by downslope mass flow. Redeposition of the loess has broken and twisted the vegetation and disarticulated mammal bones and this has inspired Velikovsky and others to suggest exotic catastrophes.'

Firstly, note that this is mainly in Alaska. Secondly, there is a great deal of difference between separating whole bones from each other and actually breaking a few huge bones of a mammoth. Thirdly, the Beresovka mammoth was in 'muck' on the recently exposed bank of a river, and not in a 'downslope mass flow' of loess.

Examining the construction of this sentence, Oard first seems to fully support the idea that the broken bones 'could easily' be due to 'shifting permafrost', but then seems to move away from this in view of counter evidence—the flow of blood into the tissues. As this suggests that the bones were broken a matter of minutes or seconds before, at or after their death, this flatly contradicts his thesis of being broken in a 'downslope mass flow' that would have occurred some time later. He cannot deny the evidence, but does not point out that it badly contradicts his sequence of events; hence his strange wording.

The bones were broken at the time of death in a massive and violent catastrophe.

Conclusion

There are several other criticisms that could be made of this article, but the above are surely enough to demonstrate that Oard's explanation is a very long way from solving how these mammoths met their death when all the circumstances are considered. I know of no reasonable scenario that could explain *all* the circumstances we find, and regrettably Oard's article has only confused the situation further.

In my book—*True Science agrees with the Bible*—I have given a quite different sequence of events that solves the major problem of the animals being buried in the ground yet rapidly frozen. This could be the result of an ice meteorite at a very low temperature, breaking up before hitting the ground and churning up animals and the ground into the 'muck' we find today spread across Siberia and Alaska.

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Michael J. Oard replies:

I appreciate the feedback by Malcolm Bowden on my article on the extinction of the woolly mammoths.[1] This reply gives me the chance to clarify and amplify several concepts that were sometimes poorly stated.

I am glad that Bowden and I agree that the mammoths lived for a while after the Flood and became extinct in post-Flood time. I believe that a proper understanding of the timing is required before the cause of the extinction of the mammoths and other mammals can be appreciated. Namely, their extinction is connected with the end of the Ice Age during which the mammal population had increased greatly. I will respond to Bowden's letter in the general order of his challenges.

The climatic conditions

I must point out that the focus of my article was mainly on Siberia where the mammoth mysteries are the most pronounced. However, the fate of the mammoths can be applied elsewhere in the northern mid and high latitudes, but some differences need to be accounted for. First, the climate was not 'warm' in Siberia, as most people would understand it.

In fact, at the beginning of the Ice Age right after the Flood, the summers would have been cooler than today because increased volcanic dust and aerosols in the atmosphere would have reflected more sunlight back to space. Winters, however, would have been milder because the oceans at higher latitudes were warmer than today. This does not mean warm, like in the subtropics today, but warmer than they *currently* are in winter, and by a considerable amount. Therefore, it would still have been 'cold' as most people would conclude. I would estimate that the winter temperatures in Siberia would have been in the 0°C to -20°C range, immediately after the Flood. Such 'warm' winter temperatures in Siberia would have been attractive to mammals that can handle a moderate amount of cold.

Bowden apparently does not seem to understand that the climate would have changed from the time immediately after the Flood to the end of the ice age. It was a dynamic climate, not steady-state. He states: 'Having said the permafrost was probably *not* present, he [Oard] then has to call upon this non-existent permafrost to rise rapidly to freeze the mammoths quickly!' The favorable environment at the beginning of the ice age immediately after the Flood with little or no permafrost would attract all the many types of mammals to Siberia where their populations would increase into the millions. However, as time went on, the winters would become colder due mainly to the cooling of the oceans. Such cooling would cause increasing permafrost and a gradual drying of the climate. It does not take long for permafrost, especially in the top 20 m or so, to form if the average annual temperatures are at least several degrees below freezing. The permafrost develops from the surface downward.

Photo courtesy of NASA

View from the Space Shuttle Atlantis of a large dust storm in the upper Amu Darya Valley, Afghanistan. The strong winds along the northern border of Afghanistan loft thick, light brown dust into the air (top half of the view). Dust storms have been known to bury farm equipment, buildings, and even barbed-wire fences.

By the end of the ice age, all these large mammal populations would have been stressed by cold winters, drought, dust storms, and probably other factors. (I might add that the climate likely would have been too wet at the beginning of the ice age for many mammals, but certainly by the middle of the ice age, a drying climate would be favorable for a grassland steppe environment.) As time went on the grassland would tend to be replaced by bog vegetation, due to increasing permafrost. However, the dust from windy storms would retard the growth of bog vegetation by continuing to provide rich loess for grass above developing permafrost.

Animal death

Bowden seems to have picked up from my article that the mammoths died in one huge dust storm, since the majority of mammals are found within loess. Besides the other minor burials in river sediments, bogs, etc., the mammoths did not die in one dust storm, but must have been entombed by many dust storms over a period of a few hundred years: 'Dust storms of variable intensity likely blew from time to time for a few hundred years near the end of the ice age.'[2]

There is strong evidence for a great amount of loess deposition. For instance, the thickness of loess is about 10 to 35 m in north central Siberia but around 50 m thick near the Lena and Aldan Rivers of central Siberia.[3,4] The loess is thickest near the rivers and thins in the uplands, typical of loess deposits elsewhere.

I did not mean to indicate that most of the mammals died in the dust storms themselves. I meant to say that at least *some* mammoths and other mammals were killed by the dust storms, but the vast majority could have been simply buried and preserved by the accumulating dust. Therefore, most of the animals probably died from other causes and their flesh rotted while being buried in dust. The point is that bones and tusks still have to be buried and interred into the permafrost within say 30 years, or else these would decay. Since many bones and tusks are well preserved, especially in more northerly areas, this means that they were covered by small to moderate dust storms. This is the general case.

As I stated in the article, very few mammoths or other mammals have any flesh on them—the number is less than one hundred. It is the rare carcasses, some of which show evidence of suffocation and some that are found in a general standing position, that are the most difficult to explain. They also need to be interred into permafrost, and an explanation for the broken bones is needed. I focused on these rare, difficult situations in the article. I believe the data can be explained by the strongest dust storms. The animals can be totally covered up, suffocated, and end up in a general standing position. Compare the giant dust storms in the southern plains of the USA during the dust bowl era of the 1930s that covered up fences, tractors, and sometimes most of a house.

Development of permafrost

Bowden questions how quickly the permafrost would rise to preserve the mammoths. That is a good question. It is probably variable, depending upon a number of climatic and environmental conditions. Bowden calculated the freezing of silt at about 60 cm/4–5 months. However, he used in his estimation the melting of the frozen ground in the very short Siberian summer, usually about 2–3 months. This cannot be used to estimate the rate of freezing of silt because of other factors involved.

For a rough estimate of the freezing time of the silt, assume that in an existing area of permafrost, during winter, a woolly mammoth was suddenly covered by a storm produced silt dune 3 m high (Peter Klevberg, personal communication). Assuming the silt started above freezing and the temperature of the ground and air after the dust storm was -15°C, the time to freeze the dune to the same temperature would depend upon the water content. If the dune became wet, the freezing time of the dune would be in the neighborhood of 21 days. For the completely dry condition, the porosity of the silt dune causes the top and sides of the dune to freeze rapidly due to convective heat loss. Then the problem boils down to heat conduction from above, the sides, and from the frozen ground. This would take about 44 hours to cool the silt down to –15°C. Taking the heat of the carcass into account would not significantly alter this estimate.

Once the silt is frozen, there is no doubt that the remains would last until this day, provided that the silt does not warm above freezing. Of course, as Bowden stated, it is true that if a mammoth is buried by a dust storm, that it may rot or partially rot during the summer as the permafrost melts in the top layer. This is another factor that would contribute to the fact that whole carcasses are exceedingly rare, and why some carcasses do show various degrees of decay.

There is a question of the degree of preservation of the meat on the carcasses since the dogs ate the meat. Researchers usually describe this meat as already partially decayed when exposed. Just because sled dogs would eat it does not mean much, since dogs eat meat in almost any state.

Furthermore, decay is generally slow in such cold environments because of the low bacteria counts in Siberia today[5] and presumably at the end of the ice age. Taber states: 'Decomposition of organic matter is brought about almost entirely by bacteria which are relatively scarce in cold climates.'[6] So, the freezing of a carcass need not be so quick that one has to postulate a quick freeze.

The surrounding material

Bowden questions the material surrounding the mammoths and states: 'However, the Beresovka mammoth, and many other animals, were not found in loess but in "muck".' The Beresovka Mammoth of Siberia slid down the riverbank,[7] so in one sense it was found in 'muck'. However, this is not the normal meaning of the word. As stated in the article,[2] 'muck' actually is loess, mostly a silt, that has been sloughed downhill in Alaska because of the higher relief than the lowlands of Siberia.[8,9] It is an organic-rich deposit named by gold miners for the material above auriferous gravels in Alaska and the Yukon. There is little gravel in 'muck'. Any gravel that is mixed into the 'muck' could easily have been picked up from pre-glacial or stream gravels. During this sliding process, animal and plant remains and other material are mixed. In the lowlands of Siberia with little relief, the material is described as loess that currently takes the geomorphological form of hills and hollows due to local melting of permafrost after the ice age. The hills are called yedomas or edomas. Two of the top Russian experts on ice age mammals in Siberia state:

> 'Of particular interest for paleozoologists is the "edoma" ... This is actually a loess layer, as a rule containing the largest amount of remains of Late Pleistocene animals.'[10]

The question of the origin of the loess in Siberia has been asked a number of times. I do not think that melting mountain glaciers of Eurasia could supply much of the great amount of loess found from France to northeastern Siberia.

I suggest two additional sources: 1) the partially exposed continental shelves around the peak of the ice age, and 2) mud left over on the surface of the earth after the Flood receded. Just like floods today, mud often remains on the surface at the end, especially in slackwater areas. Strong winds during the ice age would have reworked some of this leftover mud into loess.

I came across the idea that the source of ice age loess is from mud left over after the Flood from the Palouse 'loess' in eastern Washington, U.S.A. It is well known the this 'loess' is much too thick, up to 60 m thick, to have originated from the Columbia River flood plain that drained the southeast Cordilleran Ice Sheet. In contrast, only a thin layer of loess (1 m thick) is found on top of the Burlingame Canyon rhythmites of the Walla Walla Valley that were laid down during the Lake Missoula flood. This flood occurred at the peak of the ice age, and yet only one metre accumulated during deglaciation when the area would have been the most arid. Another piece of evidence was provided by the discovery of abundant sponge spicules in the Palouse 'loess' by Dr Harold Coffin.[11]

The lower portion of the Palouse Formation, as it should be called, is layered with several gravel lenses near the contact with the Columbia River Basalts. Therefore, the Palouse Formation is likely the last flood deposit in the area, probably laid down in slow moving water due to the uplift of the Cascade Mountains to the west. The ice age winds would have reworked the top of the mud and even buried several ice age mammals. It is interesting in this regard that sponge spicules have also been found at many locations in the Alaskan silt.[12] Similar mud layers in Eurasia likely provided a source for the abundant loess over northern Siberia.

Stomach and mouth contents

As stated in the article, the digestion of an elephant does not begin until *after* the stomach in the intestines. Therefore, it is only the acidity of the stomach that will affect the food. The acidity of the stomach likely would only partially break down the vegetation in the stomach. Thus, some vegetation remains in a reasonable state and can be identified. A quick freeze is not required.

I also presented other evidence against a quick freeze in the article. If it were a quick freeze there would be many more carcasses found in the permafrost. The partial decay of the carcasses, the discovery of fly pupae, and the signs of scavenging indicate normal post-mortem processes. A quick freeze, especially from a broken up ice meteorite well after the Flood, as Bowden postulates, would freeze everything in its tracks and mix them randomly into the sediments. (This assumes Bowden's mechanism, which likely would not work due to frictional heating of the ice meteorite, and its inability to account for some of the mammoth data, such as carcasses in a general standing position.) Based on stomach contents, the time of death seems to have occurred at various times during the year. A quick freeze would have occurred in an instant. Besides the mastodon with some preserved vegetation inside its skeleton mentioned in the article, there are other instances of partial stomach preservation outside permafrost areas. Fourteen species of plants were identified in a woolly rhinoceros corpse near Starun, West Ukraine.[13] This and other carcasses were preserved in a petrochemical seep associated with a salt deposit.

It is true that plant residues, including beans and buttercups, were found in the mouth of the Beresovka mammoth.[14,15] These residues were described as stuck *between* the teeth by Ukraintseva,[13] although Pfizenmayer said that the food was on the molars with a smaller amount on the tongue. I have not mentioned this information before because it is difficult to know whether the plant residues were actually recently chewed or from old food stuck between the teeth. Food residues have been found in many mammoth teeth. From the evidence, I would lean toward the view that the plant residues were from recently chewed food because the same type of beans were preserved in the stomach, and the food has been described as in good condition. This certainly would be evidence of a quick death, but how quick? Dust storms can hit suddenly, as with the passage of a cold front. An animal may not pay attention or know the significance of a wall of dust approaching. The winds may be light from a different direction before the dust hits with strong winds. This is certainly the case with many dust storms in the American Midwest. If suddenly caught in zero visibility, it may stop chewing its food, close its mouth tightly, breathe in dust, and soon become asphyxiated. The food may remain in its mouth at death. There is no way to prove this, as no one has observed such a situation in an animal, as far as I know. Regardless, there is plenty of evidence against a quick freeze to suggest alternative mechanisms for the unique aspects of the carcasses.

Broken Bones

The Beresovka mammoth had a broken pelvis, ribs, and right foreleg, as stated by Bowden. Dale Guthrie includes a broken shoulder blade.[16] In my article, I failed to include the significance of considerable blood near the broken foreleg. This is indicative of a wound inflicted just before the animal died. In this response, I will add more information.

The broken bones observed in the Beresovka mammoth, as well as the Selerikan horse, could easily be due to 1) the animal trying to extricate itself from packed dust and 2) post-mortem shifting of permafrost. The first mechanism can account for the broken foreleg while the animal was living. Fifty-two mammoths have been excavated so far from a sinkhole near Hot Springs, South Dakota, and some of these animals have broken legs. Expert mammoth paleontologists, Larry Agenbroad and Jim Mead state:

> 'The spiral fractured bones from Hot Springs … are indicative of the breaking of fresh bone, or of bone broken shortly post-mortem … The most probable processes include: 1) torsional stress, as

> caused by trying to extricate a limb mired in mud, muck, quicksand—stress possibly even enhanced by an accompanying accidental fall; or 2) the possibility of trampling of recently deceased animals by newly entrapped individuals.'[17]

For the Beresovka mammoth, we can safely neglect the second possibility. However, the Beresovka mammoth could have easily broken its foreleg while trying to extricate itself from packed loess around its body.

In regard to the broken pelvis, shoulder blade, and ribs, I suggested postmortem shifting of permafrost. Whatever the mechanism of such shifting, permafrost shifting has been *observed*. Vereshchagin and Tomirdiaro state:

> 'After burial in the permafrost the organic remains could have shifted vertically within a wide range owing to their physical properties and the features of the permafrost environment ... It is now known that in frozen ground bones and pieces of wood are sometimes shifted vertically(!) by 10–15 m along the boundary of the frozen ground and ice veins.'[18]

Sher also points out that the yedoma ice complex is known to be prone to plastic deformation.[19] I suppose downslope mass flow of loess in Alaska to form 'muck' could break bones, but I never implied that this was responsible for any broken bones, especially in Siberia. The quote he provided was an explanation of the origin of the 'muck'.

Conclusion

I realize that there are a number of questions associated with the mystery of the woolly mammoths. My article was just a summary of a larger work that will be published later. My model is based mainly on the type of sediments surrounding all the mammoth bones and the small number of carcasses. This sediment is now recognized by many workers in the field as loess, mostly silt but a small percentage of clay and sand. Therefore, it makes sense that the animals were buried and preserved in silt from dust storms during the dry, windy phase at the end of the ice age. Surprisingly to me, I discovered that gigantic dust storms and permafrost shifting could explain most, if not all, of the exotic observations of the carcasses.

Acknowledgement

I thank Peter Klevberg for working with the equations of heat conduction and convection through silt soil to estimate a rough cooling time for a silt dune 3 m high.

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