DEEP HISTORY
and the AGES OF MAN

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DEEP HISTORY AND THE AGES OF MAN

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Inside the Temple of Khnum, Esna, Egypt
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Dedication

I dedicate this book to Captain Robert Scott, his four companions, Ernest Shackleton, Alfred Wegener, Roald Amundsen, Baron von Toll, his companions, and the many other brave souls who gave their lives testing the wild frontiers of our planet. They knew the risks but were undeterred.

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Acknowledgments

This book was only possible thanks to the pioneering work of Charles Hapgood, a true visionary.

I also need to thank the genius mathematicians and developers at Google who created the mapping software that, even as I write, is revolutionizing geography, archeology, paleontology, and many other fields.

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Introduction:
Hidden in Plain Sight

The impulse for this book grew out of the disquieting sense that our human past, what we call history, is woefully incomplete. I felt there had to be more. Intuition served as my guide.

Strange as it may seem, I first learned about Charles Hapgood's theory of crustal displacement many years ago, while listening to late-night talk radio. During a 1:00 a.m. interview about ancient civilizations, a guest on Art Bell's Coast to Coast live radio program began talking about Hapgood's work and I was hooked. I acquired one of Hapgood's books and began checking out sources. By 2004, I had assembled a library of related materials and was 39,000 words into a manuscript of my own. I enjoy writing about issues that interest me. My intention is always the same: to dig down to the root.

But research seldom occurs in a straight line. The process of writing has a natural ebb and flow. Each project has its own critical path. And there are times when a manuscript needs to gestate in the unconscious, even for years. In 2005, some changes in my life situation compelled me to put the research on hold. I remember being acutely disappointed.

However, it's apparent with hindsight that the delay was beneficial. At the time, the mapping software I needed to pursue my investigation was not yet readily available. In 2018, when I returned to the project, things came together quickly.

Charles Hapgood was a remarkable individual. During World War II, he served in the Office of Strategic Services (OSS), the forerunner of the CIA. After the war, he taught history and anthropology for many years at Springfield College in Massachusetts, which is a part of the University of New Hampshire.

In 1952, Hapgood approached Albert Einstein (who was then at Princeton) with an idea that "electrified" the great scientist. Einstein describes the moment in his foreword to Hapgood's 1958 book *Earth's Shifting Crust*:

> "The very first communication....I received from Mr. Hapgood electrified me. His idea is original, of great simplicity, and—if it continues to prove itself—of great importance to everything that is related to the history of the earth's surface....The author has....also set forth, cautiously and comprehensively, the extraordinarily rich material that supports his displacement theory. I think that this....astonishing....idea deserves the serious attention of anyone who concerns himself with the theory of the earth's development."[1]

It was the start of a three-year correspondence that continued until Einstein's death in 1955. During this period, the two men exchanged letters and materials, and met to discuss Hapgood's hypothesis on at least one occasion. Einstein made suggestions and encouraged Hapgood to consult with an astrophysicist, Dr. M. Schwarzschild, who was then at the Princeton University Observatory.

In a 1953 return letter to Hapgood, Einstein wrote:

> "I find your arguments very impressive and have the impression that your hypothesis is correct. One can hardly doubt that significant shifts of the crust of the earth have taken

> place repeatedly and within a short time. The empirical material you have compiled would hardly permit another interpretation."[2]

Hapgood also consulted other experts, including Reginald Aldworth Daly, an Ice Age scholar who informed him that no one to his knowledge had so far investigated the possibility that the crust of the earth could move. George Sarton, a historian of science, told Hapgood the same thing. In a 1955 letter to Hapgood, Sarton wrote: "the combination of ideas is so new that the history of science has nothing to contribute."[3]

When Hapgood delved deeper, however, he learned that some 19th century scientists, including Lord Kelvin and Giovanni Schiaparelli,[4] had proposed ideas similar to his own. But they were persuaded to drop their inquiries due to strenuous objections raised by Clerk Maxwell and George Darwin (Charles Darwin's son), among others. Maxwell and Darwin believed that the crust of the earth was immovable due to the stabilizing effect of the earth's equatorial bulge. The spinning earth behaves like a gyroscope and owes its stability to the bulge around the equator, which is caused by centrifugal force. Darwin and Maxwell were unable to conceive of a force great enough to overcome the bulge, and they concluded that crustal displacement was not worth investigating.

By the start of the 20th century, however, compelling new evidence from various fields called for a fresh look at the problem. Geologists were shocked to find irrefutable evidence that ice sheets had once existed in South Africa and tropical India. Did the locations of entire continents change over time? How else to explain this and other evidence, for example, the discovery of extensive coal deposits in the far north which date to the Carboniferous? Admiral Byrd likewise found coal in Antarctica during an expedition after World War II.

A number of scientists observed that the east coast of South America matches the west coast of Africa. The two coastlines seem to fit together almost like a hand in a glove. Both continents also feature identical geological formations and share a number of species in common. Some concluded on this basis that South America and Africa were once connected, part of a larger super continent.[5]

In 1912, a Cambridge paleobotanist shocked the world with the announcement that *Glossopteris* forests had once flourished near the South Pole. Members of the British Antarctic expedition led by Captain Robert Scott gathered the fossils near the Beardmore Glacier (82° S) in February 1912 on their return from the South Pole. Tragically, however, several days later the entire party perished from exposure. The fossils were recovered along with the men's gear and their remains.[6] It was the first hard evidence that forests formerly existed in a polar region.

Many other discoveries of ancient forests have since been made in Antarctica and in the far north, from different geological periods. Temperate, sub-tropical and even tropical forest species have been identified, most recently, in northern Norway.[7]

In 1915, a German geophysicist, Alfred Wegener, proposed that the equatorial bulge was not an insuperable problem. Why not? Because the earth is not entirely rigid but has "a finite degree of fluidity…[and therefore] the equatorial bulge must also be able to reorient itself."[8]

Wegener believed that the land masses of North America, Greenland, and Europe were once connected, but had drifted apart. According to Wegener, this explained the weird oblong shape of the glaciated northern region and why it is presently displaced so far from the pole. Wegener thought Greenland might be drifting at a rate of twenty meters per year.[9] In the 1920s and 30s, geologists hotly debated his ideas, but ultimately rejected them.

While searching for evidence in the 1950s, Hapgood learned about a Chinese oceanographer, Ting Ying H. Ma, based at the University of Fukien.[10] Ma was a leading authority on coral reefs that, as we know, grow only in subtropical and tropical seas. Yet, fossilized coral is common at higher latitudes, even north of the Arctic Circle. How did the coral come to be there? Over many years, Ma studied the annual growth rates of different kinds of coral and was able to correlate growth with latitude. After examining hundreds of samples from various geological periods, Ma concluded that the earth's equatorial zones (tropical *and* subtropical) were remarkably constant over long spans of geologic time. His research is important because it refutes the idea of "hothouse" (and "icehouse") Earth, the belief that the entire planet was warmer (or cooler) during a particular age. In short, professor Ma's research strongly supported Hapgood.

In the 1960s, Wegener's ideas enjoyed a revival, because investigations of the deep oceans revealed that the sea floor in the middle of the Atlantic is spreading apart.

Scientists found that magma from deep in the earth rises along the mid-oceanic ridge as the plates move apart. These discoveries led to the present geological model that attempts to merge continental drift and plate tectonics. One of the model's flaws, however, is that it can only account for a few centimeters of lateral movement per year, not nearly enough to explain the evidence I will present in this book. Nor can the side-by-side jostling of plates begin to explain it.

II.

At great intervals of time, our planet has hosted disturbance events on a cataclysmic scale, events that greatly influenced all living things, including our species. Recorded history makes almost no mention of these events, and few of them are known to science. Why? Quite simply because the 500-year era of science and the several thousand years of recorded history are much too short of a time frame to serve as a reliable yardstick for what is possible. The past did not always resemble the present. Nature is full of surprises.

I hate to disillusion my reader (especially at the start), but the reality is that most of what we know about our human past, or think we know, is wrong or at best a partial truth. And if recent events have taught us anything, they have demonstrated just how dangerous partial truths can be. "History," as James Joyce wrote, "is a nightmare from which I am trying to awaken." Recorded history is a litany of victims, long periods of darkness, and social upheaval. Nor is survival a guarantee of progress. Too often, recorded history has been the lie generally agreed upon. As a sage once famously wrote: "History is written by the victors, never by the vanquished."

But the history of Earth is unlike recorded history. Nature's laws are impartial. They apply to all the same. The natural world plays no favorites. Gaia, our Earth Mother, views all living things as her children, and treats each species with the same caring indifference. In an ever-changing cosmos, the only constant is change itself. In Gaia's natural order, things come into being, develop, flourish for a time, then pass away or metamorphose into something else. A corollary is that human civilizations tend to have a brief shelf life. Shockingly brief.

This is why the study of deep history can be shattering. I speak from experience. The research for this book involved a relentless process of shedding false beliefs and unexamined assumptions. Not always pleasant work, but vital if one is to pursue questions all the way down to the root.

Still, nothing prepared me for what I found.

I have always felt that human origins is both the most exciting and the most important issue. Even so, at the outset I had no idea of the scope of what I was undertaking. Only by degrees did I begin to realize that the deep history of our species and the untold story of our planet are inextricably joined, like two interwoven threads. Both spiral backward in time together.

At some point, I was also stunned to discover that I was engaged in the biggest science revolution since the time of Isaac Newton. This is not hyperbole. I never exaggerate as a writer, because in my experience reality is stranger (and more interesting) than fiction. I would argue that crustal displacement is the single most overlooked *and* under-reported phenomenon in the world of science today. And in my opinion, this speaks to just how powerfully our assumptions about reality shape our world view. Limiting beliefs constrain not only our thinking but our greatest resource: our imagination.

The truth is that we are older as a species than we know, much older than we have been led to believe.

As I write, the horizon for human civilization is roughly 120,000 years BP. And I fully expect, within a few years, this date will be pushed further back. However, as of now, this is as far as the best available data allows us to "see." In the following pages, I will present multiple lines of evidence that the earth's crust has moved at least four times during this period. The evidence for these events is overwhelming. Until now, however, only pieces of this amazing story have been told.

The good news is that the evidence supporting Hapgood's theory is all around us. We need only train ourselves to recognize it.

Ecology has been called "the subversive science," and I find that an apt description. In 1969, two ecologists, Paul Shepard and Daniel McKinley, actually co-authored a book with this very title. I remember it from my college days. The book left a lasting impression. But the book you are now holding takes ecology to another level. For this reason I expect that *Deep History & the Ages of Man* will be controversial. Not that I have a problem with controversy. I do not. That is how we progress. If I am an optimist, it is because I am confident truth will eventually prevail.

Let us pray it prevails soon. As I write in 2020, the human experiment hangs by a thread.

III

In the course of my research I came across evidence of advanced civilizations in our remote past, what Plato referred to as Atlantis. I also found, quite unexpectedly, evidence of a possible extraterrestrial presence on our planet. I will present this powerful evidence with no spin and a minimum of interpretive analysis. I leave the reader to make up his or her own mind.

Because my first discovery occurred while reviewing the exploits of Charles Darwin in South America during his epic voyage of the Beagle, I will start there.

The oldest anomaly in science holds a profound secret about our planet that was hidden in plain sight for nearly two centuries…

Geologic Time Scale

Eon	Era	Period	Epoch / Date
PHANEROZOIC EON	Cenozoic Era	Quaternary Period	Holocene Epoch ~11,500 yrs. ago
			Pleistocene Epoch ~1.8 mya ago
		Tertiary Period	Pliocene Epoch ~5.3
			Miocene Epoch ~23
			Oligocene Epoch ~34
			Eocene Epoch ~56
			Paleocene Epoch ~65
	Mesozoic Era	Cretaceous Period	~65 million years ago ~146
		Jurassic Period	~200
		Triassic Period	~251 million years ago
	Paleozoic Era	Permian Period	~300
		Pennsylvanian Period	~318
		Mississippian Period	~360
		Devonian Period	~416
		Silurian Period	~444
		Ordovician Period	~488
		Cambrian Period	~542 million years ago

The Cryptozoic Eon also known as the Pre-Cambrian, was approximately 542 million to 4.5 billion years ago. Dates are approximate and based on the United States Geological Survey's (USGS) Fact Sheet 2007-3015 of 2007. Notes: "~" indicates approximate. "mya" means millions of years ago.

Chapter One
How Darwin Almost Explained Evolution

Charles Darwin is acclaimed as the man who made "evolution" a household word, and by evolution we generally mean a long gradual process of incremental change. There is broad agreement that the seed for Darwin's theory began to gestate during his five-year voyage of discovery aboard HMS Beagle, 1831–1836. This is the standard view and while not wrong, it is misleading because that is not the full story. Readers may be surprised to learn that Darwin actually encountered abundant evidence of past Earth cataclysms, especially during the South American portion of his trip.

The quarters aboard the Beagle were tight, the ship was only 90-feet long, and at each port-of-call the young naturalist was eager to abandon ship and explore the country. Darwin describes many of these side excursions in his memoirs, indeed, in minute detail, including one such experience while in Patagonia. Captain FitzRoy had anchored the Beagle at the mouth of the Santa Cruz River, about sixty miles south of Port St. Julian, whereupon Darwin and a group of sailors from the ship set out in small boats to explore upstream. The going was difficult due to the swift current, and to make headway the men had to manually pull the boats with ropes as they moved along the shore.

After two weeks of hard work thus engaged, the party had penetrated many miles into the interior. At this point, Darwin set out on his own and after a steep climb reached a broad plain high above the river. At an estimated altitude of several thousand feet above sea level, and within sight of the Andes, about sixty miles distant, Darwin discovered a field of enormous angular-shaped boulders far removed from any parent rock. They were of a kind known as erratics, and Darwin concluded they must have been transported by sea ice; in other words, they were moved by large icebergs during some great flood which had transgressed all of Patagonia.[11]

Nearly every place Darwin visited on the east coast of South America, and later up and down the coast of Chile, he found terracing, which he interpreted as the former coastline or continental shelf that had risen high above sea level. In Patagonia the broad terraces occurred in stair-step fashion, one plain above the other, mostly composed of deep deposits (as much as fifty feet deep) of small rounded pebbles. The deposits were extensive and stretched for hundreds of miles along the coast.

In Chile, Darwin found beds of perfectly preserved seashells on old beaches that had been uplifted 1,000 feet or more above the present-day coast. He personally experienced several powerful earthquakes, found abundant evidence of others, and concluded that repeated quake activity caused by unknown forces within the earth had gradually uplifted the cordillera of the Andes by at least 8,000 feet.[12]

On numerous occasions while exploring the Argentine Pampas, Darwin was shown the fossil remains of giant quadrupeds, including the mastodon, mylodon, toxodon, and many other extinct megafauna. Several times, Darwin himself unearthed teeth and bones of these creatures.[13] In his other book, *Geological Observations on South America,* Darwin took pains to itemize the sites of these discoveries.[14] There were so many, he concluded that "the whole area of the Pampas is one wide sepulcher of these extinct gigantic quadrupeds."[15]

Darwin added, "It is impossible to reflect on the changed state of the American continent without the deepest astonishment. Formerly, it must have swarmed with great monsters; now we find mere pigmies compared with the antecedent races."[16]

Darwin ruled out the possibility that the fossil remains had been transported by river action, glaciers, or by some other means. No, the big creatures had died where they lived, precisely where their remains were being unearthed, a sensible opinion I will revisit in a later discussion about Siberia. Nor in Darwin's view did hunting by humans play a significant role in the extinctions, because, as he rightly notes, the extinct species included rodents, birds, and many other small animals not likely to have been a human food source.[17] For this reason hunting seemed an improbable factor. I should add that despite Darwin's sound judgment on the matter, a small academic group of die-hard adherents of the hunting hypothesis, today known as "Pleistocene overkill," remain vocal on the issue.

As to what caused the disappearance of the South American megafauna, Darwin wrote, "Since they lived, no very great change in the form of the land can have taken place. What then has exterminated so many species and whole genera? The mind at first is irresistibly hurried into the belief of some great catastrophe; but thus to destroy animals, both large and small, in southern Patagonia, in Brazil, on the Cordillera of Peru, in North America up to Bering's Straits, we must shake the entire framework of the globe."[18]

In short, the evidence for past upheavals was everywhere at hand. And its sheer abundance compelled Darwin to consider, however briefly, the possible role of past cataclysms. The idea was far from taboo in the first half of the 19th century.

During the 1820s, debates about the Biblical Flood were commonplace at the London Geological Society. It is a fact of history that the majority of Darwin's contemporaries in the fields of geology and paleontology were catastrophists. These included George Cuvier, whose research proved that the mammoth was an extinct relative of the elephant. Another, William Buckland, who had a substantial following, wrote the first account of a fossil dinosaur.

Another well-known catastrophist, Cambridge fellow Adam Sedgwick, worked out the stratigraphy for the Cambrian epoch and along with Roderick Murchison named the Devonian. At a meeting of the Geological Society in 1930, Sedgwick proposed that deformed mountain strata and erratic boulders were solid evidence for episodes of Earth's "feverish spasmodic energy."[19]

Nonetheless, as we know, Darwin broke decisively from catastrophism, concluding that the great landscapes of South America had been formed by incrementally slow change over long expanses of time. Certainly, there was no shortage of evidence for gradual change. It was apparent, for example, that the perfectly flat valleys of the Chilean Andes had been shaped not by rivers and streams but by strong tides and sea currents. This dated to a period before the land emerged from the sea. In valley after Andean valley, Darwin observed the same level terracing and deep beds of rounded pebbles that he had first seen in Patagonia. It was obvious to him that these pebble beds had been formed by the rolling action of swift currents and powerful tides, processes that were still conspicuously underway in the steeply submerged valleys of Tierra del Fuego.[20]

In the 1859 book that made his name a household word, *The Origin of Species*, Darwin paid lip service to the evidence for past Earth cataclysms: "The extinction of species has been involved in the most gratuitous mystery….No one can have marveled more than I have done at the extinction of species."[21] Lip service indeed, because Darwin concluded his history-making book with these words:

> "As all the living forms of life are the lineal descendants of those which lived long before the Cambrian epoch, we may feel certain that the ordinary succession by generation has never once been broken, and that no cataclysm has desolated the whole world. Hence, we may look forward with some confidence to a secure future of great length."[22]

How to account for Darwin's pronounced bias against catastrophism, a bias that was to prove decisive in shaping the views of generations of scientists who came after him?

For the answer we need look no further than Darwin's close friendship with the influential geologist Charles Lyell. When HMS Beagle departed England in December 1831, Darwin had in his baggage a copy of Lyell's *Principles of Geology*, the first volume of which had just been published. Volume two reached Darwin many months later at Monte Video, Uruguay, one of the Beagle's ports-of-call. Lyell's book served as young Darwin's bible during the long voyage that became the seed bed for his later thinking. Certainly it is no understatement to describe the five-year expedition as the crucible in which Darwin conceived the theory of evolution.

"The great merit of the *Principles*," Darwin wrote, is "that it altered the whole tone of one's mind, and therefore that, when seeing a thing never seen by Lyell, one yet saw it partially through his eyes."[23]

So impressed was Darwin that he modeled his own work after Lyell's book. Darwin wrote in his autobiography:

> "After my return to England it appeared to me that by following the example of Lyell in geology, and by collecting all facts which bore in any way on the variation of animals and plants under domestication and nature, some light might perhaps be thrown on the whole subject."[24]

Geology was a young field at the time. The Geological Society of London was only founded in 1807, and geology courses were still extracurricular at Oxford when Lyell matriculated. There, Lyell attended lectures by the flamboyant Oxford professor William Buckland, one of the catastrophists I have already mentioned. After graduating from Oxford in 1821, Lyell moved to London to prepare to become a barrister, but he soon changed his mind and decided instead to pursue a career as a professional geologist. This was a bold decision in the 1820s because in those days the field of geology was the province of armchair speculators and amateur enthusiasts.

The Principles was Lyell's attempt to change this and establish geology as a rigorous science. Many felt he achieved his goal. The book's enduring success (it went through eleven editions in Lyell's lifetime) was due to his brilliant writing, especially in the fine art of persuasion. *The Principles* was one long argument for an empirical geology based on fieldwork. Lyell's objective, fully expressed in his subtitle, was "to explain the former changes of the earth's surface by causes now in operation." The author took it for granted that the basic laws of Nature (such as gravity) had not changed over time. The present was the key to the past. All past events on Earth were therefore explainable in terms of causes currently in force.

Another key assumption was that the rate or intensity of these causes also remained constant over time. Although Lyell did not give his strict methodology a name, a reviewer, William Whewell, provided one in 1832 when he coined the term "uniformitarianism." The word was a gag in the mouth, but it stuck nonetheless.

Lyell strove to teach by showing. His unabridged *The Principles* ran to 1400 pages of detailed exposition richly documenting hundreds of cases. His many sources included cutting-edge research by prominent French, German, and Italian scientists. And his more than able writing was grounded in his own extensive travels in the United Kingdom and on the continent, a fact which must have impressed Darwin, who was similarly engaged in South America.

The Principles served up robust analogies and vivid metaphors. Lyell skillfully cited literature; he was well read in the classics. He portrayed his own methodology of uniformity as the light of reason, which, he argued, would ultimately prevail with its logic and wealth of documentation, over the forces of superstition and darkness. By this, of course, Lyell meant outdated religious doctrines and "invented theories" that the past was somehow different from the present. He took a dim view of what in his opinion were mere conjectures. "Never was there a dogma," Lyell writes, "more calculated to foster indolence, and to blunt the keen edge of curiosity, than this assumption of the discordance between the former and existing causes of change."[25]

In his view such speculations ran counter to rational science because they required an appeal to faith. Apparently it never occurred to Lyell (nor to Darwin) that rational men might view the universality of the Deluge idea in every world religion and in every indigenous mythology as evidence the earth had really and truly suffered one or more cataclysmic events in the past.

Today, we know that Lyell erred in his assumption about the uniformity of process, by which he took it for granted that natural causes in the past unfolded at the same rate as they do today. His conclusion was founded on quicksand because the 500-year span of modern science is much too short a time frame on which to reliably assume the regularity of natural causes.

In the mid-1980s, a team of scientists discovered that the level of cosmic radiation that reaches the earth is not uniform. The team analyzed ice samples from a deep core drilled at Camp Vostok in East Antarctica, and found that high levels of Beryllium-10 had been deposited during the last ice age.[26] Beryllium-10 is a rare isotope of the light element Beryllium, produced in the upper reaches of the atmosphere by cosmic radiation. Elevated levels of the isotope (which has a half-life of 1.5 million years) in ancient Antarctic ice, points to a much higher level of cosmic radiation when the ice was formed than now. And these radiation peaks also correlate with abrupt climate changes on Earth.

But it was not only radiation that varied. When an independent researcher named Paul LaViolette analyzed Greenland ice core samples in 1980-1981, he found they contained much higher concentrations of cosmic dust than present-day snow and ice. The samples were from deep ice cores drilled in the 1960s at Camp Century, Greenland.[27]

Scientists had already checked and found no change in the rate of deposition over the last 700 years. But until LaViolette posed the question, no one had thought to look more deeply into the past and examine ancient samples. Scientists had merely assumed (after Lyell) that the rate of dust deposition was constant over time. LaViolette's study showed this was not the case.

It turned out that the rate of deposition between 40,000–78,000 years BP was hundreds of times higher than the current rate. Quantitative analysis of the dust found high levels of nickel and iridium, indicating the dust was not of Earth origin, but had come from outer space. In a more recent 2015 paper, LaViolette also reported anomalous levels of tin isotopes and lead in ice from the same period, also indicating an extraterrestrial origin.[28] A separate study of the deep ice core drilled at Dome C in Antarctica also reported much higher levels of dust deposition during the last global maximum, at 20,000 years BP.[29] The agreement of data from Arctic and Antarctic cores is compelling, but what does it mean?

LaViolette concluded that a colossal explosion at the center of our Milky Way galaxy many thousands of years ago had produced a series of galactic bursts or super waves of cosmic radiation and high energy particles which seriously affected Earth as they passed through our portion of the galaxy.[30] The super waves were responsible for the Beryllium-10 spikes, and had also pushed large amounts of interstellar dust into the solar system, triggering abrupt climate changes that may correlate with the megafaunal extinctions at ~41,000 years BP in Australia and of the mammoth at the end of the last ice age. A more recent 2006 analysis by professor Mensur Omerbashich at the University of Sarajevo drew the same conclusion.[31]

In his autobiography Darwin spares no praise for Lyell. He writes that he was "proud to remember" the very first time he practiced geology, in the Cape Verde islands, which convinced him "of the infinite superiority of Lyell's views over those advocated in any other work."

The passage and others like it are telling because they show that even in his later years Darwin never questioned Lyell's principle of uniformity. Darwin apparently never guessed that the assumption about uniformity that limited Lyell's contribution to science also limited his own. Many years before, John Stevens Henslow, one of Darwin's best friends, had cautioned him about Lyell's *The Principles.*

Darwin notes that "when I was starting on the voyage… the sagacious Henslow [who had been instrumental in arranging his passage aboard the Beagle] who like all other geologists believed at that time in successive cataclysms, advised me to get and study the first volume of *The Principles* which had then just been published, *but on no account to accept the views therein advocated.*" [my emphasis][32] It was wise counsel that Darwin unfortunately did not heed. Clearly, the alliance with Lyell foreshadowed Darwin's own rejection of catastrophism, and had the unfortunate effect of undermining his own budding theory of evolution, as I will now explain.

In *The Origin of Species,* Darwin proposes that small changes over time bring about the emergence of new species through the mechanism of natural selection. It is ironic that Lyell, who in his later years grudgingly recanted his former strong opposition to evolution, nonetheless astutely pinpointed the inadequacy of Darwin's mechanism of natural selection, much to his friend's disappointment.[33]

Entries in Lyell's journal show he correctly understood that although natural selection can explain how species become better adapted to already existing habitat niches, the mechanism cannot account for the emergence of entirely new forms. As we know, during his lifetime Darwin was unable to document the emergence of a single new species. Nor did the subsequent grafting of Mendelian genetics onto Darwinism (i.e., neo-Darwinism) rescue his theory. There remained the insuperable problem of large population size, an Everest-like obstacle to speciation.

A 19th century naturalist named Moritz Wagner seems to have intuited the problem, for he proposed that migration and isolation were necessary for the formation of a new species. Darwin dismissed Wagner's insight, however, possibly because his own theory of natural selection held that reproductive success was critical in the competitive struggle for existence.[34] Large populations therefore were more likely to evolve into new varieties and new species. In this Darwin erred.

Later, scientists discovered that genetic mutations, even when positive, tend to be washed out in large gene pools. By degrees it became clear that small population size is one of the prerequisites for new species to emerge. To appreciate the serious implications this held for incremental Darwinism, one need only ask: How does one arrive at a small population? The inescapable conclusion follows that cataclysmic change, by reducing large populations, is and has doubtless always been one of the principal engines driving evolution.

Here, the lesson of the missing strata is relevant. Although Lyell defined the epochs of the Tertiary, he never explained the mysterious gap between the Tertiary and the Cretaceous periods, the so-called K-T boundary. Lyell offered various hypotheses to account for the conspicuous discordance of fossils above the gap as compared with below, but none of these turned out to be correct.[35] Nor were the missing strata ever found because the catastrophists were right, all along! The K-T gap was a red flag pointing to an extinction level event, which terminated the reign of the dinosaurs and announced the onset of the Tertiary: the age of mammals. Today, many scientists attribute this to a cataclysmic impact of a large asteroid near Yucatan.[36] I hasten to add, however, the matter has by no means been settled and remains hotly contested.

And there is another reason why cataclysmic earth changes push evolution in new directions. In the process of reworking and drastically altering Earth's landscapes, cataclysms create a multiplicity of new environments, thereby confronting the survivors with fresh challenges. And well, what is a challenge but another name for an opportunity? In this way cataclysms, probably in association with spikes of mutagenic radiation, create the conditions for rapid speciation. Sharply increased mutation is critical to the process because this offsets genetic drift which tends to reduce genetic diversity. And a reduction in genetic diversity can doom a small population to a downward spiral of inbreeding and probable extinction. I will discuss an important example in chapter fourteen.

Ultimately, the ecosystems of our planet recover from even the largest such events because living systems are incredibly resilient. If they were not, one or another of the great extinctions of the last half-billion years would have completely erased life from our planet. And today, the earth would be a desert world. To be sure, this is no reason for complacency because in Nature there are no guarantees. No outcome is foregone. The absolute worst could happen, the day after tomorrow. Nonetheless, to date the survivors of every past extinction event responded to radically new conditions by proliferating new forms and evolving. Were it not so, I would not be writing these words, nor would you be reading them. Perhaps the most important question is: Are we humans prepared for whatever the future may hold?

Charles Darwin came close to explaining evolution but drew back. By adopting Lyell's assumption about the uniformity of process, he followed Lyell's example of rejecting catastrophism in favor of gradualism. That was unfortunate for science because the reality was never a case of either/or. There was no need to choose.

Today, we know that gradualism and catastrophism are not mutually exclusive, nor do they conflict. Rather, they exist side by side. Both are complimentary.

Today, ecologists understand that disturbance events are an integral part of Nature. Disturbances range from very minute to massive. They include wildfires, floods, tsunamis, landslides, earthquakes, volcanic eruptions, hurricanes, tornadoes, and insect infestations, *but they also include* asteroid impacts, solar fares, cosmic storms, close encounters with comets, and geomagnetic phenomena. Earth cataclysms should be understood as natural disturbances at the extreme end of the spectrum. Should we dismiss them because they challenge human comprehension, or because they are unfriendly to human civilization?

The rational mind says "No! Of course not. We should consider all of the evidence." Unfortunately, we humans are seldom rational when the emotional side of our nature stands squarely in the path of reason, as it often does. Nearly all of us, including scientists, are prone to denial and narrow-minded thinking. And I believe this explains the general failure of the scientific community to attribute due justice to the creative role that cataclysms play in evolution.

Charles Darwin had many outstanding qualities. His writing shows he was inquisitive and keenly observant, always ready to launch some new expedition and see as much of South America as time allowed. His journal is filled with stories and interesting anecdotes about these side trips, down to the smallest details.

During the many months the Beagle toured the coast of Chile, both north and south, Darwin managed to escape the cramped quarters of the ship on numerous occasions, even for weeks at a time. He visited Santiago and other Chilean cities and had many interactions with the local people. Usually some prominent figure would host Darwin on these adventures, supplying him with food, guides, maps, horses and whatever else was needed. Thusly outfitted, Darwin tramped through the nearly impenetrable forests at Chiloé, discovered ancient beaches high above the present shoreline, witnessed volcanic eruptions, and explored ancient ruins in the Atacama desert.

Indeed, he puzzled over the irrefutable evidence that humans had once inhabited what is arguably the driest place on Earth. Darwin's journal also includes voluminous entries describing four separate expeditions deep into the Andes, including one trek over a high pass into Argentina. Later, the Beagle made stops along the coast of Peru, including Lima. But, notably, Darwin never visited the Altiplano, never saw the highlands of Peru and Bolivia, never gazed upon the clear cold waters of Lake Titicaca, and never walked the ancient streets of Cusco.

Chapter Two:
The South America Darwin Never Saw

Some archaeological sites are so important they must be visited firsthand to be appreciated. And I mean on foot. Written accounts and YouTube videos are useful. But not even the best of these can compare with the unforgettable experience of visiting a place like Machu Picchu. The central Andes region is absolutely unique. It is a land of mysteries so ancient they recede into the realm of imagination. The group I toured with in October 2018 visited a number of sites in Peru and Bolivia that I will discuss momentarily. But first, I need to share my initial impression because it speaks directly to the issue raised by Darwin.

Everywhere we traveled in the central Andes we saw them: the ancient system of agricultural terraces. Indeed, one cannot miss them because they are ubiquitous. The terracing along the western shore of Lake Titicaca is especially impressive and climbs up the surrounding mountains as much as 2,500 feet above the level of the lake. At an altitude of 12,507 feet, Titicaca is the highest navigable body of water in the world. It never freezes despite the elevation, because winter temperatures in the central Andes rarely dip below 10 degrees C, and also because Titicaca's water is slightly salty, another mystery. Near La Paz, Bolivia, the terraces reportedly climb even higher up, to 18,400 feet on Mt.

Illimani, which is above the line of perpetual snow.[37] Yet, despite the enormous expenditure of human labor required to construct the terracing system, farming in the area today is mainly limited to the valley floors. Introduced barley is the principal grain crop.

The terraced slopes presently stand idle because they are well above the upper limit at which corn and other crops can be grown. Nonetheless, the ambitious extent of the terrace system indicates that the region once supported a much larger population. No one seems to know when this was, though from a geologic standpoint the construction was recent. The terrace system evidently was abandoned after the entire region was uplifted by several thousand feet. Needless to say, this challenges Darwin's opinion that the Andes rose gradually over long expanses of time. Indeed, this is why I feel certain that if Darwin had visited Cusco and its environs he might have reconsidered some of his conclusions.

A prominent geologist, Norman D. Newell, spent twelve months in the mid-1940s mapping the fault lines around Titicaca, and he later observed in a memoir that "numerous investigators have considered the interesting possibility that very recent continued uplift of the Andes has been important in the cultural decline of the region."[38]

Newell trained many scientists during his career at Columbia University, including the prolific biologist Stephen J. Gould, and he agreed that the region once supported a much denser population.[39]

One of the most impressive sites we visited was the famous fortress at Ollantaytambo in the sacred valley of Peru. **(See Figure 1)** The megalithic site clings to a rock face 300 feet above the valley floor. The site is famous for its colossal walls of fine-grained rhyolite blocks, each one fitted together with absolute precision, indeed, with such precision that one cannot fit a knife blade between them. The 50-ton blocks originated from quarries near the top of a mountain across the valley. After being rough-cut, they were transported down the steep mountainside along a system of ramps and chutes, then across a wild river and up the near slope. An able archaeologist, Jean-Pierre Protzen, studied

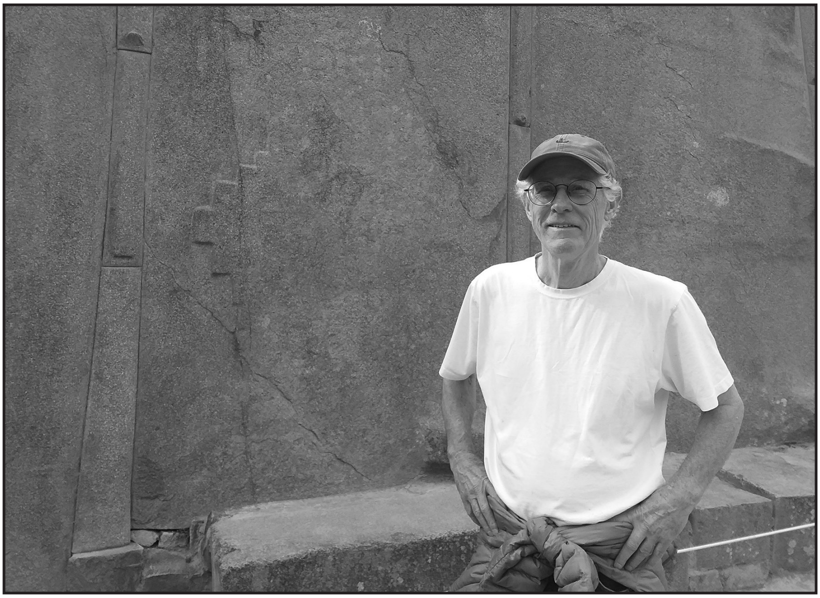


Figure 1. The author at Ollantaytambo

the site and the manner of its construction for many years and concluded that crews of men dragged the blocks using a simple rope harness. Yet, in his book, *Inca Architecture and Construction at Ollantaytambo*, Protzen admits he is at a loss to explain how the pulling crews managed to negotiate the hairpin turns on the mountain, as there is no room to accommodate a large number of men.[40]

Our guide, Brien Foerster, recounted a story that illustrates the problem. As the story goes, an Inca chief once tried to duplicate the stonework of the unknown race of men who originally constructed the site. Perhaps to show that Inca know-how was second to none, the chief ordered his top engineer to cut and transfer a similar sized block from the quarry to Ollantaytambo. One hundred fifty of the chief's best men proceeded to drag a rough-cut block from the quarry using the rope harness method. However, at some point on the steep mountain trail, perhaps at one of the hairpin turns, the crew lost control and the huge block tumbled down the mountain side, dragging the men to their deaths. Appalled, the chief canceled his order.

To this day, the stone lies where it fell, beside the

Urubamba River. No one knows whether the tale recounts actual history or legend.

Another day, we stood atop a desolate ruin, all that remains of the legendary city of Tiahuanacu, in Bolivia. Although frequented today only by ghosts and tourists, there is evidence that, in its heyday, Tiahuanacu was an important urban center and a port on Lake Titicaca, although the present shore is thirteen miles away. After 2000, archaeologists began to unearth the foundations of the famous Akapana pyramid, as well as a second unnamed structure at nearby Puma Punku. The job was challenging as crews had to remove by hand a deep deposit of red dirt, the remains of the mud flow that overwhelmed the site on the day of its destruction.

The good news is that once the overburden was removed the original foundations were found to be intact, except on one side at Puma Punku where a cataclysmic wave shattered the perimeter wall. We found tiny potsherds aplenty and bits of bone (?) in the twelve-foot-deep wall of red earth that surrounds the area.

It is ironic that the same wave of mud that wrecked Tiahuanacu thereafter saved it from pilferage, for much of the ruined city became a quarry after its destruction. Thereafter, over many centuries, the local populace carted off just about every accessible stone they could carry. Which were used to construct nearby towns and villages, including a local Spanish church. At Puma Punku, only a small number of megalithic blocks of andesite remain, including some truly enormous slabs.

We also saw evidence that someone had attempted to cut even these into more manageable blocks but had given up, frustrated by the stone's unyielding hardness. A number of deeply chiseled but unfinished cuts attest to their failed efforts. Yet, once upon a time, an unknown race had succeeded in cutting, dressing and moving the gigantic slabs from a quarry forty-seven miles away. We also found evidence among the remaining blocks of advanced technology: precision drill holes and laser-straight saw cuts, which simply are not achievable with stone hammers nor even with Bronze Age tools.

In Cusco we found similar evidence of an ancient high civilization. **(See Figure 2)** One fine afternoon, we strolled through the narrow streets of the quaint old city, past stone walls so artfully made they are nearly impervious to earthquakes. The walls of Cusco whisper of a forgotten time. No one knows who built them, or how. Orthodox archeology credits the Incas, but the fact is the Incas never took credit. It seems the megalithic stonework was already ancient when the Incas arrived.

Archeology's standard attribution is even belied by the walls themselves. For even an untrained eye can discern the difference between the consummate skill of the megalithic builders and the later Inca work. Many of the walls combine both; hodgepodge Inca repair work side-by-side the earlier fine joinery, distinguished by the many-sided polygonal blocks fitted together with astonishing skill, and without mortar. Also in evidence is the shoddy work of the Spanish conquistadors, conspicuous in the footings and walls of the cathedrals that were hastily thrown up atop the holy Inca sites to establish priority of place. One of these, the church of Santo Domingo, has repeatedly crumbled from earthquakes while the nearby megalithic curved wall of the Coricancha remains intact.[41] The incompetent Spanish walls give silent testimony to the arrogance of colonialism and a failed Christianity.

On the last day of our tour, at de Cutimbo, about fifteen miles west of Titicaca, we hiked from the parking lot along a strenuous path to the top of a nearby mountain where we inspected a 30-foot high cylindrical tower made of the same finely cut blocks; except that these blocks were pillow shaped. **(See Figure 3)** A small trap door at the base told us humans once crawled inside. For what purpose we could only guess. We found other clues at a similar half-destroyed tower at nearby Sillustani, though whether the Spaniards had damaged it or some natural cataclysm had, we could not say. Megalithic stones were piled about the base and scattered around. We were astonished to discover that the stones, like the towers, were hollow. This prompted some in my party to wonder out loud if the stone towers had

Figure 2. Polygonal wall, Cusco

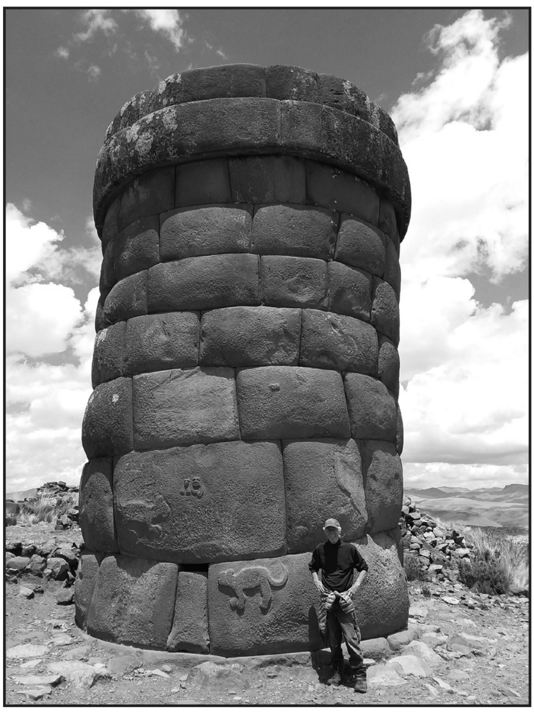


Figure 3. de Cutimbo

(and perhaps still have?) acoustic properties. Might this give some hint about their original purpose? Obviously, the sites call for continuing research.

No one, to date, has explained how the towers at de Cutimbo were built, or by whom. Not even the site of the quarry has been identified. As we stood silently marveling at the place, one of our party consulted an altimeter. It registered 13,550 feet: higher than the highest point in all but six US states. The wordless reaction of everyone around me said it all. We were stupefied. For there were neither roads nor ramps to the site, only a steep foot path. Imagine if someone plopped down a huge megalithic structure on the summit of 13,528-foot-high King's Peak, the highest point in Utah. Such an achievement—I believe it is safe to say—would immediately attract a considerable amount of attention. The national media would swarm the place. There would be headlines, in-depth news reports, interviews, special segments, and much more. Yet, before that afternoon I had never heard of de Cutimbo.

There is nothing in Darwin's journal or autobiography to suggest he knew about it, either. Evidently, word of the megalithic sites in Peru and Bolivia never reached him. Although in the 1830s no Westerner had seen the "lost" city of Machu Picchu; even so, the Spanish conquest was three centuries old and many other equally impressive similar sites were known, though not always easily accessible. Histories had been written (though not very good ones). Personal accounts were available.

The evidence of a vanished high civilization in South America was there for anyone with an eye in his or her head to see.

Chapter Three
The Oldest Anomaly in Science

Charles Darwin never explained the mysterious 8,000-foot rise of the Andes Mountains. As already noted, the father of evolution attributed the uplift to unknown gradual processes acting deep within the earth over long spans of time. However, as I've also noted, Darwin never visited the Altiplano, hence, never encountered the extensive abandoned terracing system around Cusco and Lake Titicaca, which tells us that the uplift, or a large portion of it, was historically recent and must date to sometime *after* the establishment of the high civilization at Tiahuanacu; and this points to a geologically recent cataclysm.

What portion then, of the ~8,000-foot rise of the Andes should we attribute to this singular event? In 1883, professor P.M. Duncan provided an answer when he reported finding corals of an extant species 2500–3000 feet above the Peruvian coast, west of Titicaca.[42] Whatever had lifted up the corals flourishing along the coast was, very likely, also responsible for elevating the Altiplano, and by the same amount.

Although Darwin wrote years before Duncan's discovery and did not know about this particular species of coral, in his journal he mentions a porphyritic escarpment on the coast of northern Chile (at Iquiqui) and in southern Peru between 2,000–3,000 feet in elevation, thus anticipating Duncan's estimate.[43]

In a subsequent discussion I will return to this issue and attempt to account for the extraordinary uplift of the region. However, for the moment, it is important to understand that vertical uplift was not the only type or direction of movement.

There is compelling evidence that the entire mountain chain of the Andes—indeed, the whole continent of South America—simultaneously moved south by a distance of 1,657 miles even as it was rising! I understand this may sound incredible. But the evidence I am about to present admits of no other possible interpretation.

Indeed, it amounts to a powerful confirmation of the theory of crustal displacement articulated brilliantly by Charles Hapgood in *Earth's Shifting Crust*, published in 1958, and in a wholly reformulated second edition, *The Path of the Pole*, released in 1970.

I was stunned when I first came across this evidence while reading Charles Darwin's 1846 book about the geology of South America.[44] Evidently, the French naturalist, Alcide d'Orbigny, had shared this important evidence with Darwin. D'Orbigny, a student of George Cuvier, preceded Darwin to South America and, on his later return to France, published a detailed account of his travels that Darwin called "a most important work."[45]

It's unclear whether the two men ever met, but we know they corresponded over a period of years. Darwin cites d'Orbigny numerous times in his books, and in a footnote he writes that d'Orbigny's research placed him "on a list of American travelers second only to Humboldt."[46]

The other individual who helped gather the data was Hugh Cuming. Though almost unknown today, he was a well-known collector at the time. An Englishman, Cuming relocated to Chile to make his fortune. After succeeding in that endeavor, he acquired a boat and indulged his favorite hobby. Over a period of years, Cuming sailed up and down the coast of Chile and Peru, exploring and collecting specimens. Later, his huge shell collection ended up in the British Museum.

Darwin included the data compiled by both of these men in a table along with a detailed discussion.[47] The evidence was not limited to a few scraps or observations pertaining to mollusks, but instead amounted to an entire dataset. I was stunned when I saw this material. It was also clear at a glance that Darwin did not understand what had come into his hands. True, shellfish are not sexy like saber-toothed tigers and woolly mammoths. Nonetheless, by the 1830s, the study of mollusks was on a solid scientific footing. This may have been due, in part, to the universal popularity of beach combing and collecting among amateur enthusiasts and trained scientists alike. We humans have always been fascinated with seashells, and we love to collect them whether the specimens come from a beach or a sedimentary deposit on a mountaintop.

It is noteworthy that Darwin's associate, Charles Lyell, drew heavily upon this science in the course of identifying the different epochs of the Tertiary. Lyell applied a statistical method of his own design to distinguish the relative percentage of surviving versus extinct mollusk populations.[48] The early editions of his *Principles of Geology* (volume three) actually included a sixty-five-page appendix with tables listing innumerable mollusk species. The innovation became known as statistical paleontology, and though the approach has since gone out of fashion—modern editions of the *Principles* are heavily abridged and do not include the tables; present-day science still owes a substantial debt to the early work on mollusk taxonomy and paleontology accomplished by Lyell, d'Orbigny, and many others.[49]

My excitement mounted as I studied the table in Darwin's book and eagerly devoured his discussion. **(See Figure 1)** The facts are easy to summarize. Mollusks tend to live in communities (the standard jargon is "faunal assemblages") and occasionally fossil beds of these communities are found in a pristine state of preservation. Such finds are rare because ocean surf is a powerful destroyer of seashells. Fortunately,

Genera, with living and tertiary species on the west coast of S. America*	Latitudes, in which found fossil on the coasts of Chile and Peru.	Southernmost latitude, in which found living on the west coast of S. America.
Bulla	30° to 43° 30′	12° near Lima
Cassis	34°	1° 37′
Pyrula	34° (and 36° 30′ at Concepcion)	5° Payta
Fusus	30° to 43° 30′	23° Mexillones; reappears at the St. of Magellan
Pleurotoma	34° to 43° 30′	2° 18′ St. Elena
Terebra	34°	5° Payta
Sigaretus	34° to 44° 30′	12° Lima
Anomia	30°	7° 48′
Perna	30°	1° 23′ Xixappa
Cardium	30° to 34° (and 36° 30′ at Concepcion)	5° Payta
Artemis	30°	5° Payta
Voluta	34° to 44° 30′	Mr. Cuming does not know of any species living on the west coast, between the equator and lat. 43° south; from this latitude a species is found as far south as Tierra del Fuego.

Figure 1. Data table from Darwin's book

due to the aforementioned Andean uplift, a number of these old beds were discovered in pristine condition. On several occasions, as already noted, Darwin himself found former raised beaches as much as a thousand feet above the present-day shore.

The table summarizes the joint collaborative efforts of d'Orbigny and Cuming who gathered specimens of seventy-nine different species from the late Pleistocene from two different sites on the Chilean coast: Coquimbo (30° S) and Navidad (34° S). Navidad is located just south of Santiago, while Coquimbo is 275 miles up the coast. Although many of the specimens were of extinct species, the collection included twelve living genera which are listed in the table. The column at left lists the genera. The middle column indicates the latitude at which the fossil specimens were collected. And the right column indicates the southernmost latitude at which the extant genera may still be found.[50]

My jaw dropped as I studied the table. Notice the conspicuous disparity between the latitude at which the fossil specimens were gathered, compared with the latitude at which they are presently found. *Nearly all of the extant genera had relocated far up the coast.*

Mollusks are extremely fussy about where they live, and water temperature is the most important factor defining their habitat. Shellfish require a narrow temperature range, outside of which they are simply not found. Each species has slightly different requirements. When I crunched the numbers, based on the data compiled in the table, I calculated that the average habitat displacement was 24.4° of latitude to the north. Given 68.7 miles per degree of latitude in the equatorial zone, this means the mollusks had migrated northward at least 1,600 miles to warmer equatorial waters. Some had relocated as far north as Ecuador.

Before I proceed, I should mention that mollusks have very limited mobility. Unlike fish, they cannot swim. However, when they reproduce they pass through a larval stage, and these tiny larvae are able to hitch a ride on ocean currents over considerable distances. Evidently this is how the various species relocated far up the coast of South America, at the end of the Pleistocene.

The migration of so many genera intrigued Darwin, for he writes: "the first impression…is that the climate [where the fossils were collected] must formerly have been warmer than it now is."[51] Yet, having raised the key question, Darwin unaccountably begins to hedge, citing cases and evidence which, looking back today with the benefit of 20/20 hindsight, seem weak and unconvincing.

For example, Darwin mentions the exceptional case of Voluta at the bottom of the list, which apparently did manage to adapt to the same altered, i.e., cooler water temperatures that drove the other warm water loving species north toward the equator.

At present, Voluta is only found south of 43° S, which is approximately the latitude of the town of Chonchi on the island of Chiloé, one of the large islands in the archipelago of southern Chile. In his account Darwin shows great reluctance to formulate an opinion about what it all could mean. In a rambling discussion on the next page, he defers to his colleague, Mr. Lyell, who invariably counseled caution in the face of anomalous data. Most often, Lyell resorted to local factors. We will encounter the same tendency again, very shortly.

How then do we account for the fact that warm water loving mollusks were formerly found at southern latitudes of the Pacific coast, a region that today is significantly cooler? Did the temperature of the nearby Humboldt current change at the end of the Pleistocene? Insofar as I have been able to determine, there is no evidence for this. The ability of the exceptional genera Voluta to adapt to cooler temperatures only clarifies the rule. Indeed, as we look back, the 1,600+ mile northward migration of eleven mollusk genera stands in silent witness to an extraordinary event. And this should also have been obvious in the 1840s. A paradigm-busting data set had fallen into Darwin's lap, pointing toward a mind-boggling conclusion: The crust of the earth had shifted, at the close of the Pleistocene, by approximately the same distance the mollusks had migrated.

But Darwin was unable to make this leap of imagination, however logical, probably because doing so required him to think outside the box. The great man who very nearly explained evolution could not shake himself free from the scientific model that held him fast. Darwin remained a prisoner of his own beliefs and, as we are about to learn, in this he was far from alone.

The "extralimital anomaly"

On a hunch, I did a Google search and within minutes was staring at several scientific studies of mollusk assemblages on the west coast of North America. As I began to read I was blown away. The first paper I examined, published in 1966 by W.O. Addicott, a scientist working for the US Geological Survey, describes a heretofore unrecognized late Pleistocene molluscan province characterized by northern mollusks and foraminifers (i.e., linear and spiral shelled mollusks) that are no longer living off the central California coast."[52]

The paper goes on to describe virtually the same phenomenon reported by Darwin in 1846, except that in this case the northward migration of mollusks was from warm water to cold (instead of from cold water to warm) and had occurred not in South America but on the west coast of the United States. By this point, as you might well imagine, I was completely engrossed.

Undisturbed fossil beds at several sites in central California, one at Santa Cruz and two others at Point Año Nuevo a few miles up the coast, documented the southernmost outpost of a faunal community of at least eighty species of late Pleistocene mollusks, many of them still living, that are no longer found in the area but presently inhabit the cooler waters of Puget Sound and the coast of British Columbia north to Alaska.[53] The data presented by Addicott indicates that the surviving late Pleistocene mollusks had migrated from the vicinity of Santa Cruz northward by a minimum of 11° of latitude, a distance of 755 miles.[54]

Today, water temperatures in Puget Sound are four degrees Centigrade cooler than the coastal waters at the latitude of Santa Cruz. Evidently the cool water loving mollusks had moved north in search of their preferred habitat, after the coastal waters of central California warmed up. *The question that Addicott failed to answer is: What caused this warming? Surely the correct answer is: It was the same event that caused the cooling of the coastal waters of Chile.*

Writing in 1966, Addicott had no knowledge, evidently, of the South American case reported by Darwin in 1846, because he credits discovery of the so-called "extralimital anomaly" to a US-based scientist, Ralph Arnold, who described it in 1908.[55] Nor have things changed in this respect.

A 2014 monograph on the issue published by three scientists, Daniel R. Muhs, Lindsey T. Groves and R. Randall Schumann, makes no mention of Darwin.[56] Nor do the three scientists display any awareness that the phenomenon under discussion is not exclusive to North America.

In their paper, the scientists thoroughly review various local and regional factors proposed by different experts to explain why sea water temperatures along the central California coast warmed up since the late Pleistocene. The possible factors for this they cite include the upwelling of deep water, effects of winds and currents, changes in the geography of the coast over time, as well as the reworking (i.e., alteration) of fossil beds.

To their credit, the authors reject all of these, concluding that "although many mechanisms have been proposed…no single explanation seems to be applicable to all localities where thermally anomalous faunas have been observed."[57]

Muhs, Groves, and Schumann were correct in 2014 to dismiss all of the proposed local or regional explanations. Because surely a temperature-based anomaly that affects two continents and stretches across two hemispheres of the earth cannot properly be described as local or regional, no, not in any meaningful sense of the word. The same event that cooled the coastal waters of Chile probably also caused the warming of the coastal waters of central California. Both cases appear to be linked. When faced with a global mystery, does a local or regional solution suffice? Probably not. No, one should match the search and the solution to the scale of the phenomenon. In this case, the data indicates the need to think globally.

The extralimital anomaly, therefore, does not date to fieldwork by American scientists in the early years of the 20th century, but to 1846, the year Darwin published his book on the geology of South America. Notice, this would make it a whopping 170 years old. But even this is probably a conservative estimate. More likely, South American collectors knew about the mysterious northward migration of mollusks in the 1830s and possibly as early as the late 1820s. We know d'Orbigny arrived in South America in 1826. Notice, this would make the anomaly at least 190 years old; how many other fields of science can lay claim to such an extended legacy of failure? Probably few to none.

Perhaps the deeper issue is how and why trained experts can have misfired so badly. The extralimital anomaly not only has eluded scientific explanation up to the present day, but somehow in the course of doing so it has also managed to remain off the radar screen. At present, insofar as I can tell, outside the tiny field of malacology (the study of mollusks) the anomaly remains virtually unknown, a regrettable fact that I attribute to over-specialization.

The unfortunate modern-day reality is that our universities train science students to think more and more about less and less. As a result, students by and large never gain the invaluable experience of thinking outside the box. And very few of them go on to develop a holistic approach or an interdisciplinary career. Yet, if there was ever a problem that called for an interdisciplinary approach, it is this one. Sadly, when I contacted the three authors of the 2014 paper to alert them about the larger ramifications, not even one of them extended me the simple courtesy of a brief acknowledgment. Did they dismiss me as a crank or a conspiracy nut?

I would only be guessing about their motives and their state of mind if I commented further, so I will refrain. Nonetheless, it does appear that the leading authorities in the field remain prisoners of their scientific training and beliefs. And in this, things have not changed since the time of Darwin. The present generation of experts who write papers about the extralimital anomaly are unaware of its actual history and its true scope. As I write in 2020, the matter remains as anomalous as ever, from the standpoint of mainstream science.

But please, do not suppose that our story has ended or that we are done. On the contrary, I am only getting started.

This brings us to one of Charles Hapgood's most important contributions, what he called the "meridian of maximum displacement." Hapgood theorized that slippage of the earth's crust, when it occurs, follows a line of maximum force or movement comprising a longitudinal great circle defined by four points: the present pole positions (both north and south) and the two former pole positions. In order to identify this meridian or great circle, however, it is first necessary to locate one of the former pole positions. No small task, but a challenge I will take up in the next discussion with some help from archeology.

Chapter Four:
Ancient Sites Point the Way

The orientation of ancient sites in Mexico and Central America is one of archeology's strangest enigmas. Probably the best known case is the avenue at Teotihuacan, Mexico, located about twenty miles northeast of Mexico City. Called the Way of the Dead, the broad straight avenue starts at the foot of the huge Pyramid of the Moon and extends for about two miles. En route, it passes by the even more imposing Pyramid of the Sun. I vividly recall how intrigued I was when I learned that the avenue and these two great pyramids are not aligned to true north like the pyramids at Giza, Egypt, but oddly point 15.47° (15° 28′) east of north.

Archaeologists have never explained this puzzling fact which, in my opinion, renders dubious their many attempts to identify and impute meaning to equinox and solstice points on the horizon.

Nor is Teotihuacan a lone case. Most other pyramids and temples in Central America are also aligned east of north. During the early 1970s, the archaeoastronomer Anthony Aveni surveyed the region and identified fifty such sites. He grouped them into three distinct clusters: a small minority aligned to true north, a larger group aligned to 7° east of north, and an even larger third group that ranged between

15° and 20°east of north. Aveni referred to this last group as "the 17° family."[58] He later published an exhaustive catalog of such alignments in an important book, *Skywatchers of Ancient Mexico*.[59]

But Aveni never found an explanation. He concluded that members of the 17° family were "nonfunctional imitations" of the oldest site in the region: Teotihuacan. It is curious that nearly all of the sites in this group are also located within sixty miles of Teotihuacan. Aveni suggested that whatever the original purpose of the east of north orientation had been, it was eventually forgotten and lost to history.[60]

He also reported what I regard as the most telling detail of all. An aerial survey of the Central Mexican highlands conducted in 1974 showed that the strange east of north alignment was not limited to religious and ceremonial sites. Most villages, towns, and even agricultural fields across the region were generally aligned in the same fashion: east of north.[61] *Evidently the entire grid of human society across Central Mexico was affected.*

The key question, of course, is why? Were sites in the region originally aligned to true north *before* some great Earth cataclysm in the remote past shifted the continent? This would imply that Teotihuacan is older, perhaps *much older*, than we have been led to believe. An event of this scale must have occurred in remote antiquity, because ocean bottom cores indicate that the crust of the earth has been stable for the last 10,000 years.[62]

As for the similar east-of-north orientation of Mayan sites in Yucatan and Guatemala, Aveni wrote that "the plans of Maya ceremonial centers seem to exhibit more disarray than those of Central Mexico."[63] Aveni attributed the east-of-north alignment of these sites not to the Mayans themselves but to the Toltecs who, he felt, introduced it when they conquered the region. It's a plausible explanation. But there is also another possibility. As I studied the region's geography, I began to suspect that the hypothetical event which shifted the continent might also have caused local dislocations, particularly in southern Mexico and Central

America. I am no geologist and could be wrong about this. But look at the map. The narrow isthmus of Central America does look twisted. I believe we are safe to assume, as a general rule, that the larger the land mass the more stable.

I gained additional insights from the Austrian geologist Eduard Suess whose landmark four-volume work, *The Face of the Earth*, published between 1904-1909, attempted the nearly impossible task of summarizing everything that was known at that time about our planet. More than a century later, Suess's opus is still a valuable resource. His book drew my attention to the string of young and very active volcanoes on the west coast of Guatemala, and to the great complexity of the nearby Caribbean basin, including the deep trench south of Cuba and the Antilles.[64] The seafloor map features three prominent ridges radiating eastward from where Guatemala, Belize, and Honduras come together. Were the Guatemalan volcanoes born of deep stresses in the earth caused by the shifting crust?

During a recent flight on a clear day from Mexico City to San Francisco I got a good look at Central Mexico from above. The beautiful countryside is pock-marked with calderas. These old volcanoes are long dormant. But things are very different down in Guatemala. As my thinking evolved, I decided to rule out as unreliable any archaeological site south of Mexico City. Ultimately, I retained confidence in only one, Teotihuacan, which I assumed to be the oldest. As I will now show, one was sufficient.

Tiahuanacu, Bolivia

Recently, we learned that an important site in South America is also aligned east of north. Ongoing archaeological excavations since 2000 at legendary Tiahuanacu, Bolivia eventually succeeded in exposing the original foundations of the famous Akapana pyramid, and also the foundation of a second pyramidal structure at nearby Pumapunku. **(See Figure 1)**

When I visited Tiahuanacu in October 2018 I was pleasantly surprised to find that the foundations of both of these pyramids are largely intact. This is good news because

Figure 1. Akapana pyramid. Photo taken in October, 2018 at Tiahuanacu, Bolivia showing exposed intact foundation.

a deep overburden of red mud had long stymied efforts to investigate this key site. An early investigator, Arthur Posnansky, called Tiahuanacu the cradle of South American civilization and dated it to 15,000 BP. Today, of course, a near consensus of archaeologists reject his early date. Most think Tiahuanacu is much younger, dating only to the first millennium BP.

Yet the foundations of these two pyramids are now exposed, and their alignments raise new questions. Their east-of-north orientation is hard to explain, assuming that the axis of the present world map has been constant in perpetuity. The Akapana is aligned 0.2° east of north, and the nearby pyramid at Pumapunku is a full 2° east of north.[65] Neither azimuth makes sense from the standpoint of archeology. One may ask: Were these east-of-north alignments caused by the same earth-changing event that affected Teotihuacan, Mexico?

There is no doubt about the alignments at Tiahuanacu. I was able to confirm them myself using Google Earth Pro, a user-friendly mapping software that I'm also happy to report, is now a free download. The program is based on satellite imagery and has rendered theodolites largely obsolete. Most of the surface features of our planet have now been surveyed from space and are accessible via the Internet. The good news is that it is no longer necessary to go to the trouble and expense of traveling to an archaeological site simply to obtain an alignment.

We can now visit sites in cyberspace. Google Earth Pro allows us to zoom in and out with ease. The program is also promising for another reason. Although it displays the earth in virtual space as a perfect sphere, the software takes into account the equatorial bulge and the flattening at the poles when doing calculations.

Moreover, Google Earth Pro automatically plots the shortest distance between two points on the earth's surface. These are big advances over the frustratingly inaccurate method of attempting manually to plot azimuths on a physical globe with a piece of string, or by some other means. Armed with this relatively new earth mapping tool, any computer literate person can accurately plot arcs and great circles at home. So, let's get to it!

I should mention, right off, that I could make nothing of the 2° east-of-north alignment of the Pumapunku pyramid. That remains a mystery.

Even so, my excitement grew as I plotted the alignments of the Akapana and the pyramids at Teotihuacan. (**See Figure 2**) Is it mere coincidence that the two arcs cross over Baffin Island, Canada, at a point very near to the probable center of the Laurentide ice sheet during the last glacial maximum? In my opinion, no, because I suspect both of these pyramids were originally aligned to true north. If this is correct, it means they still point like an arrow to the former North Pole.

A Third Leg

Although I felt confident about these two alignments, it was obvious that a third match would strengthen my case. So began the hunt for another matching site. My search led me quite naturally to Egypt, which I judge to be ideal because of its great antiquity, and also because of its geological stability, due to Egypt's location at the geographical center of the continental land mass of the planet.

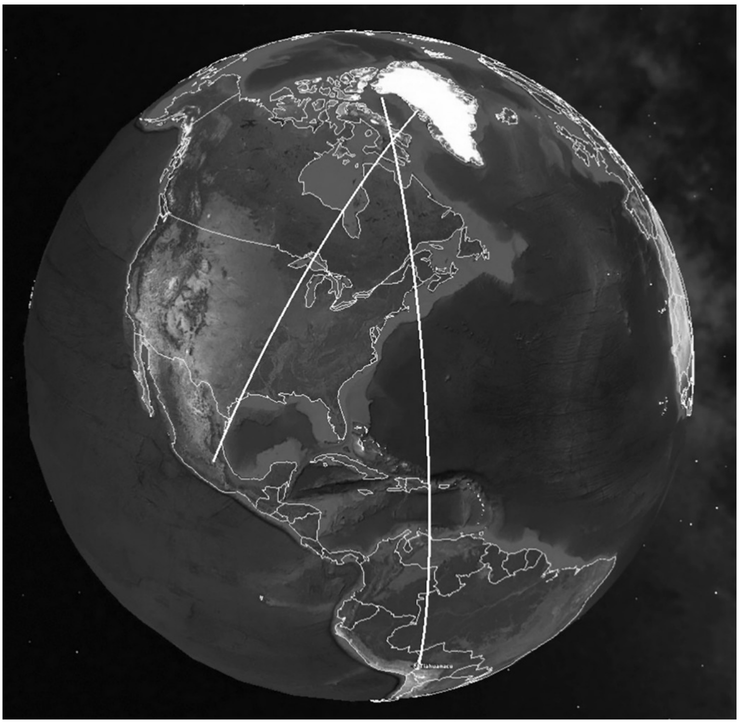


Figure 2. Plot of pyramid alignments: Teotihuacan, Mexico (at left) and Tiahuanacu, Bolivia (at right)

(Google Earth Data SI0, NOAA U.S. Nave, NGA, GEBCO,US Dept of State Geographer; ©2020 Google, Image Landsat/Copemicus. View from Space (Altitude: 7371 mi))

By the time I arrived in Cairo in April 2019 for a two-week tour of ancient sites, I had already done enough homework that I knew what I was looking for: a pyramid or temple aligned *not* to the present axis of true north/south, but rather, to a grid oriented west-of-north. I was even half-convinced I had already narrowed the search to one particular site.

In 2005, two archaeoastronomers, Mosalam Shaltout and Juan Antonio Belmonte, published a list of the orientations of 115 ancient Egyptian temples in southern Egypt. Their paper was a compilation of fieldwork completed in 2004, and their list was exhaustive. It included every ancient site from Abydos south to Abu Simbel.[66] So, I was greatly encouraged when I discovered that one site on their list, the temple of Nekhbet at Elkab (on the Nile), was apparently aligned to 25° west-of-north (155° southeast-of-north), the magic angle at that latitude/longitude which matches the pyramids of Mexico and Bolivia. Nekhbet was the vulture goddess of southern Egypt, and during my tour I observed her winged image on the walls and ceilings of numerous temples.

However, I was not able to confirm the professors' data. Unfortunately, after checking the temple with Google Earth Pro, I reluctantly concluded that Shaltout and Belmonte had erred. There are actually two temples of Nekhbet at Elkab, and both of them are aligned 140° southeast-of-north. There was no match. I was back to square one.

Notwithstanding the setback, the Egypt tour was an amazing experience. My group was international, made up of individuals from more than a dozen countries, and nearly all of us were megalithomaniacs. Each day, we visited incredible places and saw mind-boggling sights. Our tour guides were exceptionally competent. Almost everywhere we went, we saw evidence of advanced technology. No question about it, the ancients had used power equipment, including saws and drills capable of cutting, dressing, and polishing multi-ton blocks of granite, which is six or seven on the Mohs scale of hardness (diamond being ten and marble three). Somehow, the ancients also knew how to move gigantic stone blocks with apparent ease.

Although a full account is beyond the scope of this discussion, I will mention one site in northern Egypt because of its relevance to this discussion, namely, the pyramid complex at Abusir. The place is about seven miles southeast of the Giza Plateau, and is a part of the greater Memphite necropolis, which the scholar Eve A.E. Reymond called "the sacred homeland of the Egyptian temple," based on her detailed study of the building texts at Edfu.[67] Today, Abusir is a near-total ruin. Some great cataclysm evidently engulfed the place in the remote past, shattering its megalithic walls and granite columns and tossing blocks of stone about as if they were toys. At one temple, we observed that the tops of large limestone columns were missing entirely. Why? Apparently because they had been exposed to extreme heat. But what could vaporize limestone?

Back home after the tour, my search continued online. As I checked alignments using Google Earth Pro, I was able to confirm that most of the Egyptian pyramids from Abu Ruwash south to Meidum are on the same grid as the Great Pyramid, which is aligned to true north. This supports the standard view that all of these pyramids date to the same general period. Nonetheless, I found some exceptions, including the Userkaf Sun temple, which is usually considered a part of the Abusir complex. It was allegedly constructed by Userkaf, the first pharaoh of the fifth dynasty. Yet, as I zoomed in, it was obvious and, to my mind, telling that the standard descriptions of the place by Egyptologists are at odds with the facts on the ground.

The site is distinctive because it includes a small pyramidal structure, which is aligned to a different grid. Viewed from above, the disparity is quite conspicuous. (**See Figure 3**) Notice that the compound and rectangular enclosing wall are aligned to true north, while the associated pyramid at the left is oriented west of north. Unfortunately, drifting sand has obscured its base so it was not possible to obtain an alignment. Although this discovery was inconclusive, it inspired me to continue searching in the vicinity.

Days later, I found what I was looking for: an undisturbed ruin one mile south of Abusir that is aligned to the magic angle (~24° west-of-north) for this latitude and longitude. (**See Figures 4 and 5**)

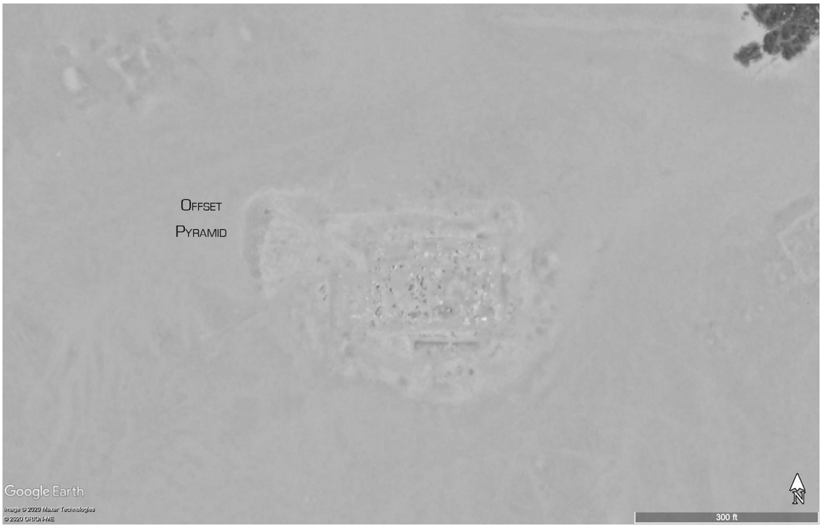


Figure 3. Userkaf Sun Temple, Abusir, Egypt. Look carefully and you will see that the pyramid at left is offset west of north. The temple compound at center is aligned north-south.

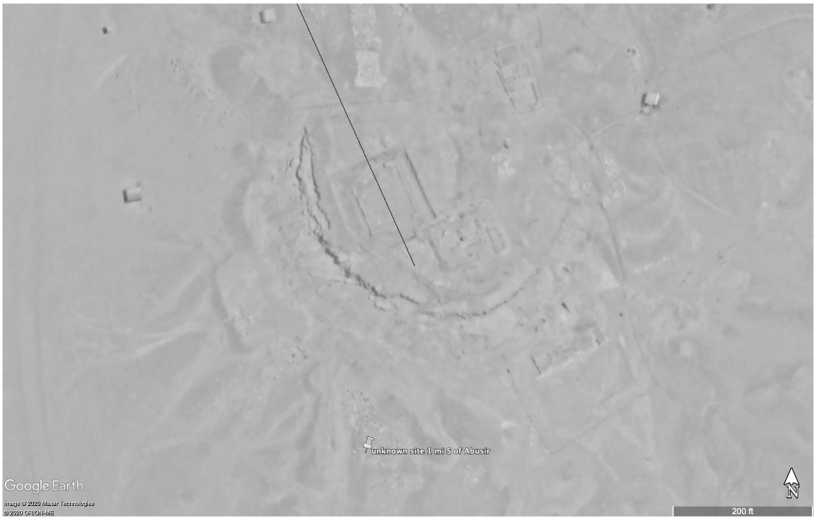


Figure 4. Unnamed foundational ruin one mile south of Abusir aligned to the former north pole position on Baffin Island.

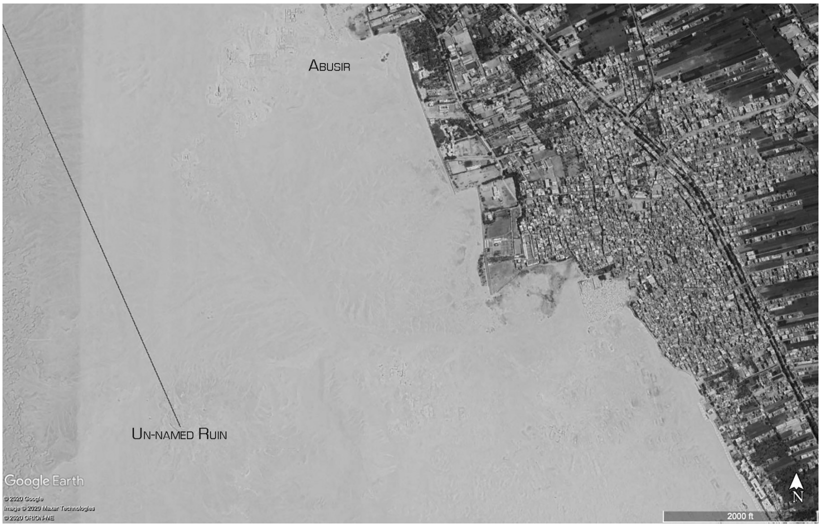


Figure 5. Showing location of the unnamed ruin (at bottom) in relation to Abusir (at top center)

The place is not on any map, nor could I find a description in the literature. Its coordinates are: 29°52' 56″ N, 31°12' 1″ E. Although apparently nameless, the site surely is known to the Egyptian authorities because someone constructed a fence around it. At least five different foundations are visible. Several are partially obscured by sand dunes but, luckily, others are exposed, and all are aligned to the same grid, ~24° west-of-north.

The site is large, more than 500 feet wide from side to side, and looks to be undisturbed. *Does it date to extreme antiquity?* The strange alignment makes this tantalizingly plausible. Of course, the site could just as easily be a former industrial center, or a military base that was later abandoned. However, if this is the case, why does its alignment match the pyramids in Bolivia and Mexico?

Although satellite imagery is a powerful tool, it is not possible to evaluate a site by means of satellite imagery alone. Ultimately, someone has to go there. One of our tour guides informed me, however, that visiting this site is impossible without authorization.[68] Even a brief walk-through is illegal without a special license.

The catch-22 is that licenses and permits are normally granted only to professional archaeological organizations, most of whose members probably regard Charles Hapgood as a crank or pseudoscientist. After centuries of neglect during which time foreigners aggressively looted Egypt's priceless antiquities, one can well understand why local authorities are reluctant to grant access. Still, only ground-truthing will answer the key question, *does this site predate the Sphinx and Great Pyramid?*

Coincidence?

I believe it is no mere coincidence that the alignment of this mysterious Egyptian site matches the pyramids of Mexico and Bolivia. (**See Figure 6**) Although the agreement is not spot on, it is too close to be a coincidence. I suspect that all three of these sites were formerly aligned to true north, *before* the crust of the planet shifted at the end of the last ice age, as Charles Hapgood proposed. This would mean that the crust of the earth shifted by more than 1,600 miles. Based on this data, I estimate the coordinates of the former North Pole at: 67° 25′ N, 67° 0.0′ W, which is about 476 miles northeast

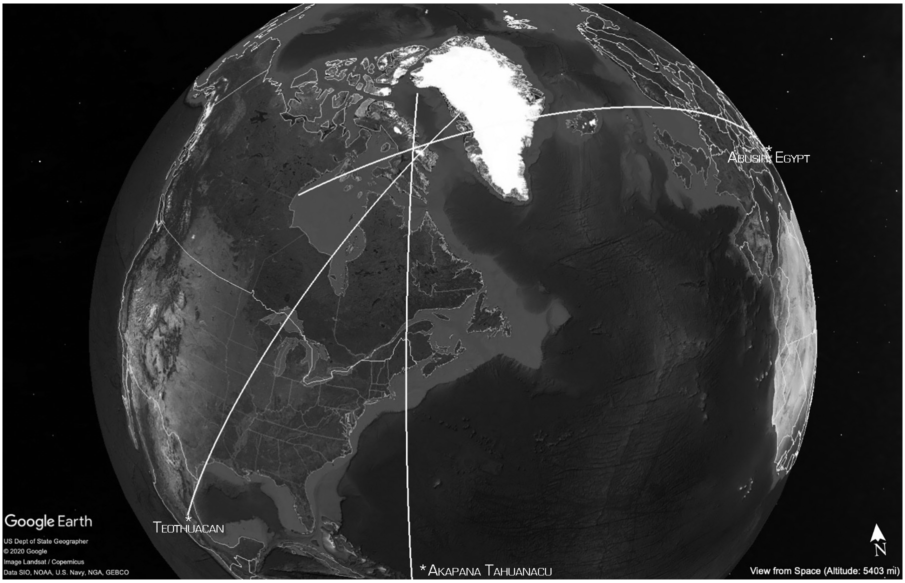


Figure 6. Plot of three alignments: Teotihuacan at left, Tiahuanacu at bottom, unnamed ruin (near Abusir) at right

of Hapgood's estimated former pole position in Hudson's Bay (65° N, 83° W).[69] Hapgood thought the crust had shifted about 2,000 miles.

I never expected such a close match. The outer crust of the earth below the continental land masses is only twenty to thirty miles thick, and beneath the oceans the crust is even thinner, only three to six miles deep. Moreover, the outermost crust is composed of interlocking tectonic plates. For these reasons, my working assumption had been that any significant movement of the crust would likely produce major fractures and/or dislocations that would severely distort any former grid on the surface. But the close agreement of Teotihuacan, Tiahuanacu, and the as yet nameless site in Egypt indicates otherwise.

Despite the susceptibility of smaller landmasses like Central America to local or regional dislocations, it appears that the earth's crust can, at times, move as a whole unit. This suggests that the slippage probably does not occur between the outer crust and the lithosphere (the layer immediately beneath it) but at a deeper level, an idea first proposed in 2000 by Rand Flem-Ath, another Hapgood aficionado.[70]

Chapter Five: The Meridian of Maximum Displacement (MoMD)

Discovery of the old North Pole on Baffin Island is important because of what this portends for our species. Humanity is the winner. Because in the process of overturning a long-established but out-of-date science model, we have collectively gained a new spatial awareness of the earth. The implications of this are indeed profound. Moreover, we have also gained a powerful means to check our work and generate proofs, as I am about to show. *Which is no less important because unless one can demonstrate the superiority of the new paradigm over the old, who will listen?* Who will be persuaded? No one.

Fortunately, Google Earth Pro software is amply suited to the task. The program enables the user to quickly and accurately measure the shortest distance between two points on the earth's surface, and to measure the size of regions and continents. It also allows one to generate virtual maps at any scale. This is important because visualizing the effects of crustal displacement is not easy. "Seeing it" may be the biggest obstacle to "getting it." A crustal displacement event rearranges the map, and this can be disorienting. Many people have a hard time relating to the altered locations of once-familiar places that now look different and seem out of place.

This is also true of climatic zones, i.e., equatorial, sub-tropical, temperate, sub-polar, and polar zones, all of which move in concert with a crustal shift. So, there is a real need to develop maps that display these changes.

For example, it is easy to show graphically that, before the last crustal displacement, the Late Pleistocene faunal community at Santa Cruz, California was at the same latitude as present-day Puget Sound. I am now going to "walk" the reader through a simple exercise to demonstrate this, using the program's ruler tool.

The first step is to measure the distance from the precisely known location of the Santa Cruz faunal bed (36° 57′ 06″ N, 122° 01′ 42″ W) to my estimated location of the former North Pole position on Baffin Island (67° 25′ 11.8″ N, 67° 0.0′8″ W). (**See Figure 1**) The distance is 2,978 miles. Recall that I already flagged the estimated pole position on Baffin Island, which I assume to be the approximate center of the triangular area bounded by the three alignments of

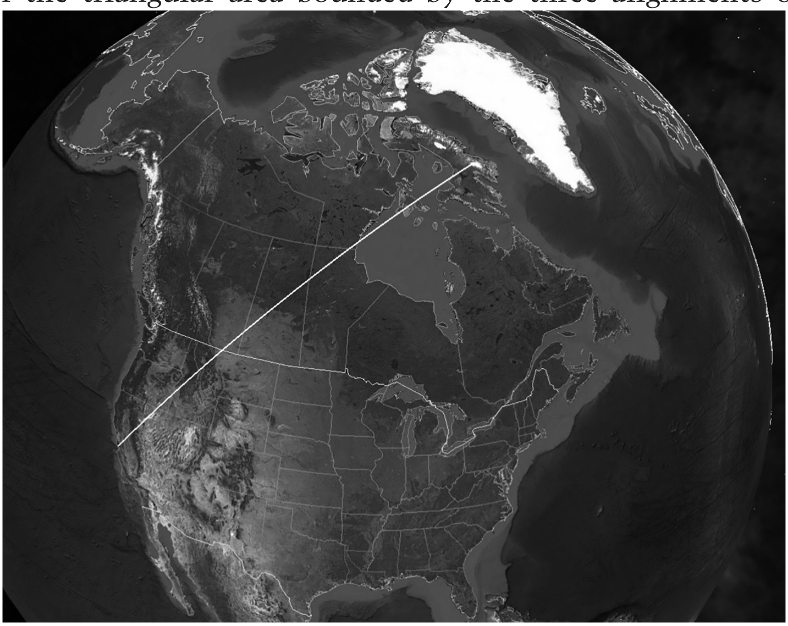


Figure 1. Plot of the distance from the Santa Cruz, California faunal bed to the estimated north pole position on Baffin Island

(Google Earth, US Dept of State Geographer, ©2020 Google, Image Landsat/Copemicus, Data S20, NOAA, U.S. Navy, NGA, GEBCO. View from Space (Altitude: 5681 mi))

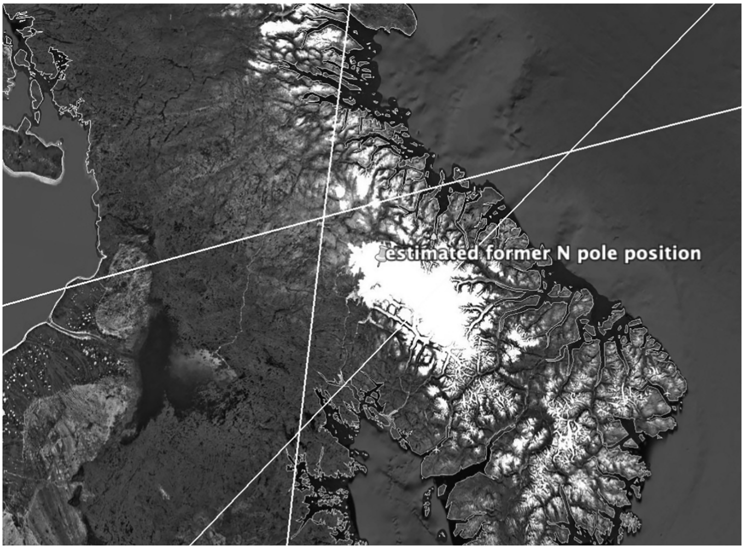


Figure 2. Close up of three alignments displayed in Figure 6, Chapter Two showing my estimated former north pole position on Baffin Island.

Teotihuacan, Tiahuanacu, and the unnamed site near Abusir. (**See Figure 2**) This assumes, of course, that the three archaeological alignments are equally accurate.

The next step is to calculate the latitude. No higher math is required. It is easy to do. One simply divides the measured distance (2,978 miles) by 69.4, which is the average number of miles per degree of latitude (when measuring from the pole). This gives 42.9°, which is the distance (in degrees of latitude) from the former North Pole position to Santa Cruz. However, because by convention we always measure latitude from the equator, it is necessary to subtract 42.9° from 90° to obtain the answer, which is 47.1°. This is the latitude of Tacoma, Washington which, notice, is within one latitudinal degree from Puget Sound (48° N).

Voila! Just like that, I have accounted for the extralimital anomaly to within one degree of latitude (about sixty-nine miles). Not bad for a first attempt. The exercise definitely put us in the ballpark.

Finally, I measured the distance from the estimated North Pole position on Baffin Island to the present North Pole: 1,566 miles. (**See Figure 3**)

Using the same method, it is possible to show that the other faunal bed at Point Año Nuevo, located about fifteen miles north of Santa Cruz, was formerly at the same latitude as the Santa Cruz bed. The case illustrates our newfound spatial awareness. Both faunal beds shared the same water temperature during the Late Pleistocene because both were at the same location with respect to the pole. Put simply: Both were at the same latitude.

The method described above is elegant in its simplicity, yet it leads to powerful conclusions. If the west coast of North America moved ~755 miles in a southerly direction during the crustal shift event, ocean temperatures along the coast would have warmed accordingly. So it is hardly surprising that present-day water temperatures at Santa Cruz and Point Año Nuevo are about four degrees warmer than they were *before* the event. Our only assumption here is that climatic zones remain constant. So, it makes perfect sense that cool water loving mollusks would relocate ~755 miles up the coast to Puget Sound. The shellfish were merely doing what all creatures do: seeking out their preferred habitat.

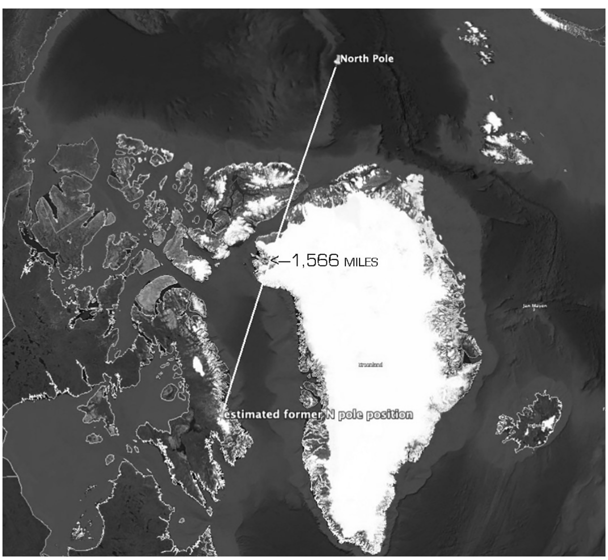


Figure 3. Plot of the distance from my estimated former north pole position on Baffin Island to the current north pole.

(Google Earth, Image IBCAO; US Dept of State Geographer; Image Landsat/Copemicus; ©2020 Google)

Next, I will examine the data from South America compiled by Darwin. Here, the method differs only slightly. Because the data is from the southern hemisphere, it is necessary to measure from the former *South* Pole, which I located when I identified the former North Pole position. The discovery of one implies the other.

In his manuscript Darwin mentions that beds of perfectly preserved faunal communities were found along the coast of Chile near Coquimbo (30° S) and at Navidad (34° S).[71] Measuring from the former south pole shows that, before the crust moved, both Coquimbo and Navidad were in the warm equatorial zone at a latitude of ~7° and ~11° respectively. Because Darwin merges the data from both faunal bed sites, I decided to calculate an average migration distance, which turns out to be 1,683 miles. But why did the South American mollusks migrate ~1,683 miles north, on average, while the North America mollusks migrated only ~755 miles? The question is instructive, because it presents an opportunity to better understand the Meridian of Maximum Displacement (henceforth, MoMD). As noted, four points define this longitudinal great circle: the present pole positions (north *and* south) and the former (north *and* south) pole positions.

A Signature Event

The great circle drawn through these four points describes both the line of maximum force, and the direction of crustal displacement. I have already introduced the primary evidence, i.e., the archaeological alignments and the extralimital migration of mollusks. No doubt, many other temperature-sensitive species also responded to the event by relocating in a similar manner. In Chapter Thirteen, I will present evidence that vegetation zones similarly responded.

Taken together, the evidence adds up to a signature that is absolutely unique, like a fingerprint. The concept of a unique signature is important because the earth's crust has doubtless moved many times during the long history of our planet. If and when other cases come to light, it will be necessary to distinguish between them. The challenge, of course, is deciphering the evidence because each time the crust moves, this tends to erase the signature of previous events. The farther one goes back in time the dimmer the record.

The maximum extent of the latest crustal event is the distance from the present North Pole to the estimated former North Pole position on Baffin Island, i.e., 1,566 miles. The MoMD includes this path of maximum movement. (**See Figure 3**)

A displacement of the earth's crust is a global event. When it happens, the entire crust of the earth moves together as a unit, and this distinguishes it from plate tectonics. As one moves away from the MoMD, at a right angle to it, the extent of displacement gradually diminishes until, at a distance of ~6,225 miles, i.e., at one quarter of the earth's circumference, the crustal shift reduces to zero. There are two such points, located on opposite sides of the planet, where the earth's crust merely pivots with no change in latitude. At the time of the last event, one of the pivot points was in northern Zaire, Africa. The other was in the Pacific, near the Line Islands.

The gradual decrease in displacement as one moves away from the MoMD explains why the faunal migration up the west coast of North America was only ~755 miles, compared to the much larger ~1,683-mile migration up the coast of South America. The North American migration was far less because the coastline of California, Oregon, and Washington was much farther away, i.e., ~2,800 miles, from the MoMD than the coast of South America. By contrast, the western coast of South America and the faunal migration were both very near to the MoMD, which followed the coastline of Chile. (**See Figure 4**)

Meet Mr. Mollusk

In August 2019, author Graham Hancock graciously posted a paper of mine, about Darwin and the extralimital anomaly, on his website. The article was basically a summary of Chapter Three. There followed a stimulating exchange of ideas with several individuals, including Mark Carlotto, an independent researcher whose work I respect and will later

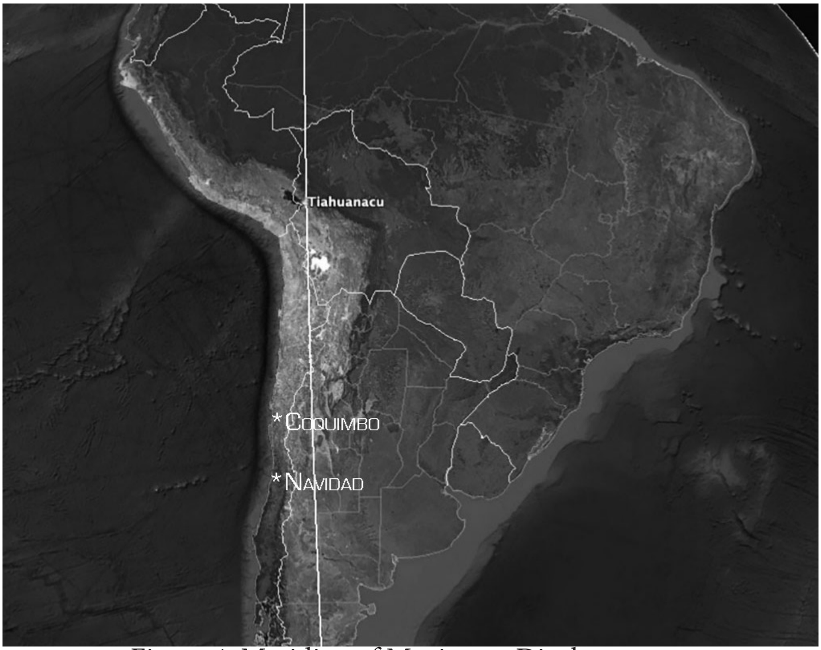


Figure 4. Meridian of Maximum Displacement
in relation to South America.
(Google Earth, Data S10, NOAA, U.S. Navy, NGA, GEBCO. US Dept of State Geographer, ©2020 Google, Image Landsat/Copemicus)

discuss in considerable detail. Carlotto raised a question that made me think, and this inspired me to review the work-up I presented above. He wrote:

> "Do you think the shift in mollusk habitats is 1:1 with the pole shift, or could there be second order effects in ocean currents resulting from a pole shift that could also influence the latitudes of the habitats?"[72]

Here, Carlotto used the more common expression "pole shift" in reference to crustal displacement, which I have sought to avoid because I believe it is ambiguous and therefore unhelpful. I mention this only for sake of clarification. Although I had already concluded that a near 1:1 correlation probably existed between the mollusk migration up the coast of South America and the extent of the crustal displacement, I had not yet shown it conclusively. This remained to be done.

I was already having doubts about the reliability of my calculated ~1,683 mile average extralimital migration in South America, because this number is greater than the measured distance from my estimated former North Pole position on Baffin Island to the present North Pole, i.e., ~1,566 miles. This seemed wrong to me. *I felt certain that whatever the extralimital migration distance might be, it would always be equal to or smaller than the maximum extent of crustal shift. It could not be a larger number!*

By this point, I also suspected that the 275-mile distance between the faunal beds of Coquimbo and Navidad might be at the root of the disparity. Recall, when I did my initial calculation, I merged all of the migration data. Had this thrown off my calculation? Perhaps. Such was my thinking.

So, I decided to re-calculate the extralimital migration distance. This time, instead of merging all of the data together I adopted a more methodical approach. I first sorted the genera into two groups, one group for each faunal bed. Because several genera were found at both beds, I included these in both groups. Then, I crunched the numbers. The average migration distance for the Coquimbo group turned out to be 22.49° of latitude = 1,545 miles. The average migration distance for the Navidad group turned out to be 25.76° of latitude = 1,769 miles. *The mean of these averages was 1,657 miles. This became my new best estimate for the average South American migration distance.*

Once again, the outcome surprised me. *Frankly, I was flummoxed because the number was still larger than my estimated 1,566-mile estimate for the amount of crustal shift.* I stewed over this for a time, pondering the possibilities. Eventually, a fresh outlook dawned on me in the form of a question: *Did I have it backward?* I went on in this way, studying the issue from all sides.

Recall, when I ran the check on the North American faunal migration, my estimated pole position on Baffin Island placed the Santa Cruz faunal bed at the latitude of Tacoma, Washington (47.1°). This was within one degree of Puget Sound (48°), where the Late Pleistocene mollusks from the Santa Cruz and Point Año Nuevo beds can still be found.

For this reason, the latitude of Puget Sound (48° N) was my Holy Grail, my bottom line. My estimated location of the former pole position on Baffin Island was definitely in the ballpark. A flurry of questions began resonating between my ears. *Could I do better than one degree?*

I was working with two different lines of evidence. Were they equally accurate? Or was one more accurate than the other? Which one? The extralimital migration data? Or the archaeological data? By this point, I was also beginning to doubt my assumption that the three archaeological alignments were equally accurate. I decided to put the matter to the test.

I designed a new exercise. I started by plotting an arc from the North Pole to the intersection point of the pyramid alignments on Baffin Island. (**See Chapter 4, Figure 2 page 52**) The result stopped me dead in my tracks. I could hardly believe my eyes. The length of the arc was exactly 1,657 miles! (**See Figure 5**)

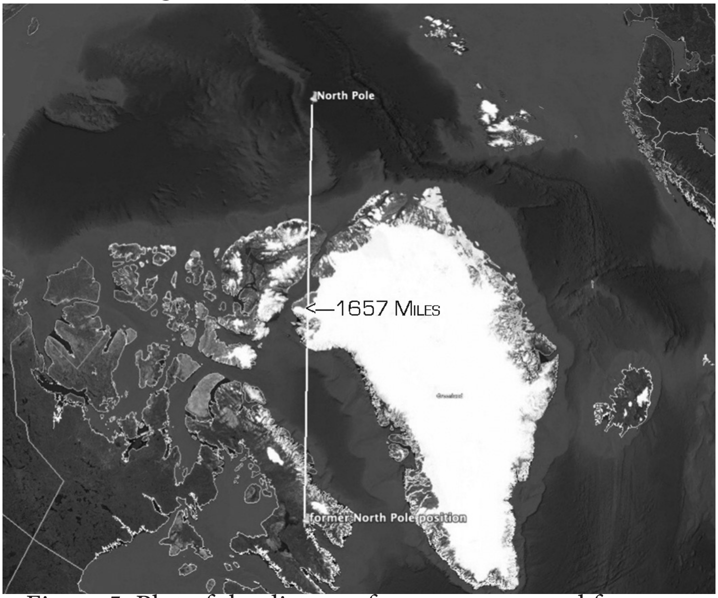


Figure 5. Plot of the distance from my corrected former north pole position on Baffin Island (as determined by the alignments of pyramids at Teotihuacan and Tiahuanacu) to the current north pole.

(Google Earth, Image IBCAO, ©2020 Google, US Dept of State Geographer; Image Landsat/Copemicus)

Eureka! There was no mistake. The Teotihuacan and Tiahuanacu alignments pointed to the former pole position! The distance from this point to the present North Pole precisely matched the average mollusk migration distance of 1,657 miles from South America. The archaeological data and the South American migration data were not only consistent, they were in perfect sync!

Now, I understood my earlier mistake. It was so obvious. At issue was my democratic assumption that the three ancient sites should be treated as equals. Not so. Obviously, the unnamed site in Egypt was much less accurately aligned than the pyramids in Mexico and Bolivia. Whoever laid out those two pyramids, so long ago, plainly knew what they were doing.

I was no less astonished by the equally accurate mollusk migration data, and I gained new respect for Alcide d'Orbigny who obviously did a first-rate job compiling the extralimital data from the faunal beds at Coquimbo and Navidad.

Before my latest exercise, I had tended to downplay the mollusk data, thinking its usefulness was solely to corroborate the archaeological alignments. Yes, it had accomplished that, and admirably. But I now understood its true value. I had in my hands an extremely accurate geolocation tool. Mr. Mollusk might not have the sex appeal of saber-toothed tigers or woolly mammoths, but he definitely had the edge in the global positioning department. Mr. Mollusk was nothing less than a geo-positioning guru! How does one define "spot on"? I was elated as I considered the implications. Indeed, my level of confidence was now in the stratosphere.

There was more. In a flash I also understood that the mollusk migrations in North and South America were not only synchronized with the present and former pole positions, they were *also* synchronized with one another. Moreover, it logically followed that if other mollusk migrations occurred elsewhere on the planet in response to the same crustal event, these too were synchronized. All of them had responded to the same crustal displacement event, and so, all were synchronized together. Henceforth, my challenge would be to conduct a world-wide search for more cases. Something told me the evidence was out there, plenty of it, just waiting to be discovered.

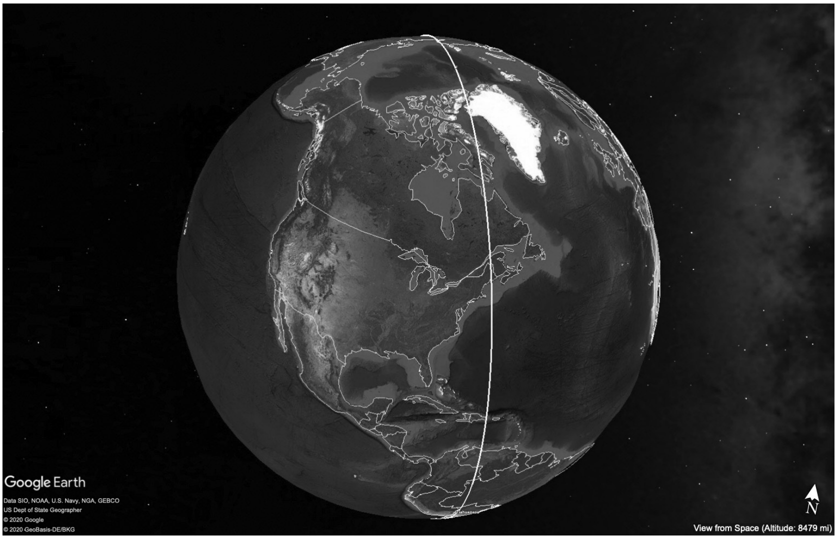
Next, I updated the MoMD based on the new corrected former pole position on Baffin Island, and made *another* startling discovery. Suddenly I understood why the South American extralimital migration distance, i.e., 1,657 miles, equaled the maximum crustal shift for the entire planet. A glance at the map told the tale. They were equal because, *purely by chance*, the path of maximum force fell very near to the coast of South America. (**See Figure 4**) The MoMD passes within 193 miles of Navidad, and within 172 miles of Coquimbo.

By a stroke of serendipitous luck, the line of force that moved the crust, coincidentally, just happened to very nearly parallel the western coast of South America and the spine of the southern Andes mountain range. But for this geographic good fortune, the last crustal displacement event might have escaped notice entirely and never come to light.

And there is more. One need only study a map to "see" that we are the beneficiaries of a gift from the gods of geography. I am referring to the western coastline of North and South America, a distance north to south, from Alaska to Tierra del Fuego, of more than 9,000 miles as the crow flies. When the crust of the earth moved at the end of the Last Glacial Maximum (LGM), doubtless many types of mollusks went extinct. Yet, the continuum of habitat and the absence of any major geographic barriers along this generally north-south coastline enabled many mollusk species to relocate along the west coast of both continents. As we will learn, the gods of geography were less kind on the other side of the planet.

By this point, it was also becoming evident that mainstream science has made a serious mistake by attempting to explain the ice ages in terms of a general planetary cooling. Notwithstanding the near consensus of scientists on the matter, it should be obvious from the above discussion that the extralimital anomaly points in a different direction. Given that the essence of the extralimital phenomenon is about relocating to preferred or favorable habitat, this surely adds up to a powerful case for the constancy of climatic zones. Mr. Mollusk is a geo-positioning expert, and his portfolio includes advanced expertise in the water temperature department. Mr. Mollusk is an ocean temperature guru without peer.

And it all started with the mollusk migration data recorded by Darwin and his associates in the 1840s, who had in their hands more than sufficient evidence to explode the current science paradigm and radically revise our understanding of the earth and its climate. Yet, they were unable to connect the dots. Why? Probably because the solution required them to momentarily set aside their beliefs, and this they were unable to do. Their reluctance to think the unthinkable prevented them from grasping the true significance of the mollusk migration data. And the same can be said of the US-based scientists who posted papers in 1908, again in 1966, and still more recently, documenting the extralimital anomaly. Although the scientific method leads in the direction of truth, the process often fails to deliver because scientists, like the rest of us, are prisoners of their training and limited beliefs. Unfortunately, limiting beliefs often stymie the imagination and hinder our capacity to think original thoughts.



Meridian of Maximum Displacement (MoMD)
in relation to North America

Chapter Six: Vindicating Darwin and d'Orbigny

Knowing the former North Pole position on Baffin Island, it is easy to determine the former latitude of any site in the northern hemisphere. I have already shown that the Santa Cruz faunal beds were formerly at the latitude of Puget Sound during the Last Glacial Maximum (LGM). A few more cases should suffice to illustrate the accuracy and power of the new mapping software.

Yosemite Valley, California (37° N) is a good example because Yosemite is a textbook case of the kind of extensive glaciation that supposedly was general during the LGM. *Except, that it is not true!* Yosemite was then actually north of Vancouver, British Columbia, at a latitude of 49° 37.8′ N. And this surely explains why the valley filled with ice. Had Yosemite been at its present latitude in central California, the famous "U" shaped valley would never have formed. Glaciation would have been confined to the highest peaks.

Monument Valley, on the Utah-Arizona border (also at 37° N), is another scenic tourist destination. Before the crust moved, however, it was located 1,080 miles to the north in what is now eastern Alberta, Canada. Its latitude was then 52° 28′ N which means it was about 100 miles north of present-day Calgary. The case illustrates the principle that as we move closer to the MoMD the extent of crustal displacement increases.

The next example shows just how improbable the standard science model is with regard to the LGM. The US Midwest cities of Indianapolis, Indiana, and Des Moines, Iowa, are both located very near to what was then the southern boundary of the Laurentide Ice Sheet. The cities are presently at ~40° N and ~41.5° N, respectively.

Des Moines is 133 miles north of Indianapolis. Yet, in relation to the former North Pole position on Baffin Island, *both* were at the same latitude of 61° N, which means they were then ~65 miles north of the latitude of Helsinki, Finland. Indeed, they were farther north than every city in Europe except Reykjavik, Iceland (~64° N).

This is exactly where we would rationally expect to find the southern margin of a polar ice cap. In other words, near the polar region, not in the temperate zone. It's also curious that both were at the same latitude. The case shows just how out of wack our present-day Earth climate model is. Postulating an ice cap in the temperate zone is the height of absurdity.

The picture becomes even more surprising as we explore the west coast of North America. Before the crust moved, Juneau, Alaska was 110 miles *north* of its present location (58° N). But Anchorage and Fairbanks (presently at 61°and 65° N, respectively) were ~350 miles *south* of their present locations. Both then enjoyed a warmer climate, compared to now. Incidentally, this also explains why the well-known conifer Douglas fir (*Pseudotsuga menziesii)* flourished on Alaska's Seward Peninsula (65° N) during the LGM, though today it grows no farther north than 55° N latitude in British Columbia.[73] Should we be surprised to learn that the latitude of the Seward peninsula was then 55° N? Today, the Seward Peninsula has few forests. Vegetation is mostly limited to low shrub and tundra plant communities. But things were very different at the end of the Pleistocene, before the crust moved.

But the real shocker is eastern Siberia. The New Siberian Islands, presently located in the Arctic Ocean 600 miles north of the Arctic Circle, were once at the balmy latitude of Berlin, Germany (52° 12′ N). And Yakutsk, presently in the frigid Siberian heartland, enjoyed a sunny Mediterranean climate at a latitude south of present-day Lisbon, Portugal (38° 24′ N). Incidentally, this also explains a persistent anomaly that many scientists go out of their way to avoid: why eastern Siberia and most of Alaska were ice-free during the last glacial maximum. The reason is simple. At the time, eastern Siberia and Alaska were located well south of the polar region. This probably also explains the presence of hunting and gathering communities in northern Siberia 40,000 years BP, as documented in a recent paper in *Nature*.[74]

Evidently, the human presence during this period also extended to Alaska and even to sites in the central Yukon surprisingly close to the Laurentide ice sheet.[75] Those human communities were actually south of the ice sheet, although from the present map one would suppose they were west of it. The case illustrates the need for a new spatial awareness that accounts for past Earth changes.

The Siberian far north is important for many reasons. I will discuss it at length in Chapters Twelve through Fourteen.

Ocean Rise Explained

Our discovery of the two former north and south pole positions resolves another unexplained mystery: why the oceans rose 350-400 feet at the end of the LGM. The textbook explanation is that sea levels rose due to abrupt global warming which melted the Laurentide ice cap.[76] *But this explains nothing. The deeper question is, "Why*? A glance at a world map provides the answer. Given that the south pole was then located along the Budd coast of Antarctica, 1,657 miles from its present position, this means the Antarctic Circle included a considerable portion of the Indian Ocean. As we know, a two-mile deep ice sheet can only develop on a continental land mass and will never form above the open sea. This suggests that the former Antarctic ice cap was as much as 50% smaller than at present. (**See Figure 1**)

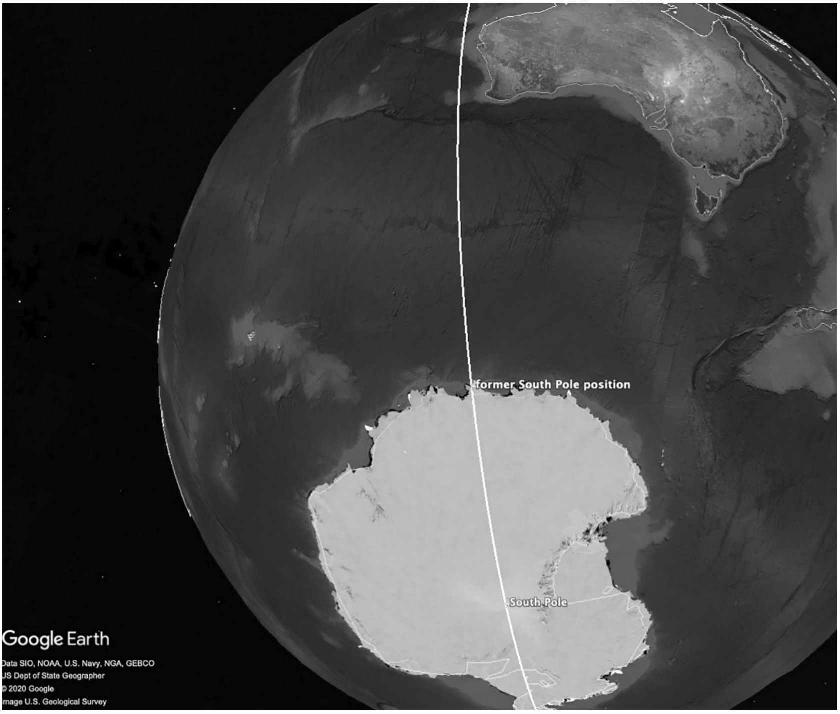


Figure 1. MoMD in relation to Antarctica and Australia, showing former south pole position on the Budd Coast.

The former south polar region still included a large portion of Antarctica. There was sufficient land base to support a substantial ice cap. If we add this smaller but substantial cap to the Laurentide ice sheet, which may have been larger than the present ice cap on Antarctica,[77] it should be apparent that the sum total of ice during the LGM was much greater than now. Why? Because *both* poles were located on continental land masses. At present, this is true only at the south pole.

The two ice caps bound up a much larger volume of water than is presently held in the current polar ice sheets. Today, experts use satellite telemetry and computers to estimate the volume of water bound up in glaciers and ice caps. Of course, not even the most advanced technology can determine the full extent and volume of ice during the LGM. But it stands to reason that the sum total of water bound as ice was much greater at that time, compared with now. In short, the ~1,657-mile crustal displacement of the crust that brought the last "ice age" to an abrupt end resulted in a net loss of polar ice and a sharp rise in sea level.

In 1971, two scientists from the University of Rhode Island reported compelling evidence that the former south pole was located on the Budd coast of Antarctica. The scientists found disconformities in the region between Australia and Antarctica based on ocean bottom cores recovered between 1967-1969.[78] The data from the sediment cores indicated that during several periods of the Pleistocene, high velocity bottom currents scoured fine sediments from the ocean floor. The scientists attributed the bottom currents to extensive sea ice during periods of glaciation and concluded that "extensive floating ice shelves developed at this time."[79]

In 1980, a different team of US scientists discovered additional evidence. They reported that *sea surface temperatures (SST) in the eastern Indian Ocean were on average 1.7 to 1.9 degrees cooler during the last glacial maximum than at present*.[80] (**See Figure 2**.) The team examined forty-two ocean cores taken from the floor of the Indian Ocean and found that plankton foraminifera were distributed very differently at that time compared to now. Plankton species are similar to mollusks in that they require a specific ocean temperature and will not inhabit water outside this narrow temperature range. The habitat requirements of the plankton found in the sediment cores are well-known. *The altered plankton distribution in the cores pointed to a lower ocean temperature in the southern seas, especially in the east Indian Ocean*.

The team concluded that during the last glacial maximum, i.e. 25,000–18,000 years BP, the "polar front" was 5° to 10° of latitude (about 700 miles) farther north than at present. Moreover, the "subtropical convergence" was also 2° to 5° of latitude (about 340 miles) farther north than at present. There was little evidence of temperature change in the tropics. Yet, the team's findings are consistent with the presence of an extensive seasonal ice pack in the southern

Indian Ocean and a former south pole position on the edge of the continent of Antarctica.

Although a greater number of core samples might have documented the full extent of crustal displacement, the study's limited number of cores succeeded nonetheless in capturing substantial evidence for a crustal displacement event at the close of the Pleistocene.

Opposite Effects on the Other Side of the Planet

Let us now follow the MoMD under the southern pole and northward into the Indian Ocean. With regard to extralimital mollusk migration, the same principles apply, the only difference being the direction of movement. In the western hemisphere, mollusks migrated northward after North and South America moved south. In the eastern hemisphere the reverse should be true. The mollusks would have migrated southward as Asia and Australia moved north.

I searched the scientific literature in vain for evidence of an extralimital mollusk migration along the west coast of

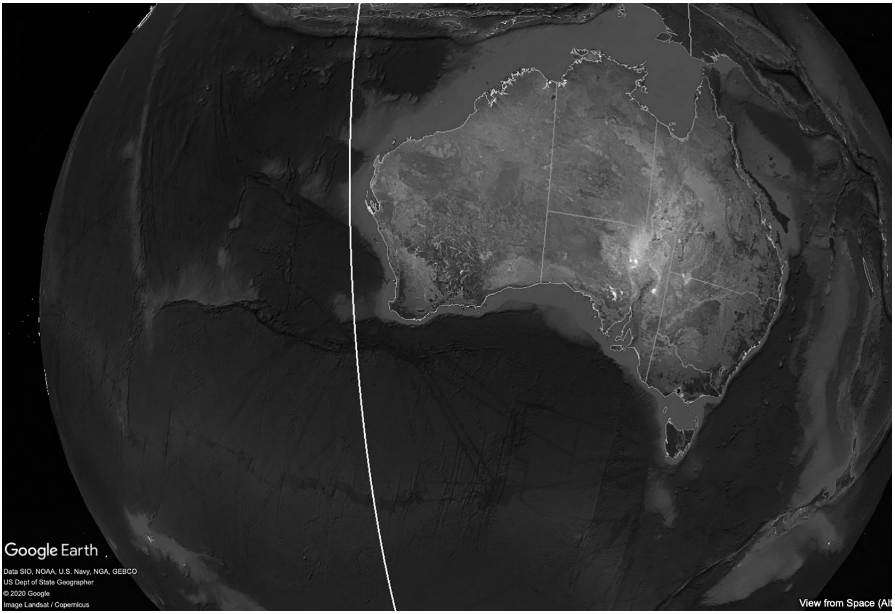


Figure 2 MoMD in relation to Australia.

Australia, which is close to the MoMD. (**See Figure 2**) A glance at the map suggests a likely reason why there is no Australian equivalent to what happened along the west coast of South and North America. The reason is simple. The geography was not conducive to mollusk relocation. The island continent of Australia has a much more limited western coastline, hence, no pathway back to preferred habitat. When the west coast of Australia moved ~1,657 miles northward from the cooler waters of the Southern Ocean into the warmer subtropical and equatorial region, cool-water loving mollusks had no place to go, and if they were unable to adapt they probably faced extinction.

My searches of Indonesia and the South China Sea region also failed to turn up any evidence of the extralimital phenomenon. This vast island archipelago has a high degree of biodiversity, which is typical of the tropics. It also boasts many thousands of miles of coastal habitat. For these reasons, one might expect that faunal communities successfully relocated after the last crustal event. Yet, my searches failed to turn up any evidence of well-preserved faunal beds in the region. Why not? In my opinion, no beds came to light because they are presently submerged beneath the sea.[81]

During the LGM, most of the region (known as the Sunda Shelf) was above sea level, and the shallow South China Sea was much smaller in extent. However, when the earth's crust moved, a large portion of the Sunda Shelf disappeared under water due to a combination of subsidence and sea level rise. The South China Sea expanded greatly, flooding coastal areas and associated faunal beds. The same phenomenon was repeated in the Caribbean and along the east coast of North America. Rising sea levels submerged North America's broad continental shelf, which probably also explains why no well-preserved faunal beds from the Late Pleistocene have been found in the area.

Southward Migration on the Other Side of the Planet?

I did locate a 1990 paper about extralimital migration along the coast of Japan, coauthored by two scientists from Hokkaido University. Fortunately, Morio Akamatsu and

Akihiko Suzuki posted their paper in English. It summarizes mollusk research originating in the 1930s, of well-preserved Pleistocene faunal beds on the northern island of Hokkaido, Japan (43° N).[82] I was intrigued because the scientists reported not one, but at least two different extralimital mollusk migrations, one in a southerly direction from Hokkaido and, surprisingly, an earlier one in a northerly direction, which they date to the early Pleistocene. The earlier migration could well signify a wholly different crustal shift event that happened more than a million years ago.

The earlier case is of interest, but from the standpoint of the present discussion, our immediate concern is the more recent southern migration. *Because if it were synchronous with the Late Pleistocene migrations in the western hemisphere, already discussed, this would be corroborative evidence and indeed, in my opinion, conclusive proof that crustal displacement is a real phenomenon heretofore unrecognized by science.* Viewed in the abstract, the idea is elegant in its simplicity and easy to summarize: On one side of the planet, mollusks migrated north (after the crust moved to the south), while on the other side they simultaneously migrated south (after the crust moved north).

Unfortunately, the evidence from Hokkaido falls short because Akamatsu and Suzuki date the relevant faunal beds to the Middle Pleistocene, (i.e., ~400,000 years BP). As the authors write in their less-than-polished English:

> "A significant feature of the Middle Pleistocene fauna is the large representation of extralimital warm water species of molluscs [sic]. About 20% of total species has modern distributional patterns that are entirely south of the fossil lacalities [sic]. Also extinct species has not yet usually been found. This fauna may be indicated [sic] a second climatic optimum event throughout the late Cenozoic time in Hokkaido."[83]

According to Akamatsu and Suzuki, the ocean temperature at Hokkaido was 17° C when the beds were deposited, which is 8° warmer than at present. The authors list fourteen different species from the Middle Pleistocene that lived in Hokkaido waters at the time, all of which are still extant but are presently found 500 or more miles to the south. This indicates the Hokkaido faunal beds were then at the latitude of Taiwan. The authors mention a "climatic optimum" as the likely cause of this warm water extralimital migration, and they suggest it "was related closely to a global oceanic event which was known in the whole of the Northern Hemisphere…"[84] In sum, the authors conclude that a global-scale event was responsible, but make no mention of a crustal shift. Their reference to a "global optimum" probably refers to an interglacial—that is, an alleged period of general planetary warming between ice ages.

Unfortunately, repeated searches failed to retrieve any other published scientific papers about southward Late Pleistocene extralimital mollusk migrations along the east coast of Asia. I partially attribute this to the rarity of well-peserved faunal beds. Also, large portions of this coastline, especially in the Siberian north, are still wild today and it's possible they have not yet been studied. So, at this time, it is not possible to reach a firm conclusion.

There are several plausible scenarios. It is possible that the Middle Pleistocene faunal community described in the paper continued to inhabit the waters around Hokkaido through the Late Pleistocene, though the evidence for a continuing occupancy, i.e., a recent faunal bed, has not yet come to light. A more likely possibility is that the fauna relocated several times in the interim. The 400,000-year gap in the record since the Middle Pleistocene is a long span of time, during which the earth's crust may have moved more than once.

Charles Hapgood identified three former North Pole positions during the last 100,000 years alone. The first of these was in the Yukon (63° N, 135° W), which he dated to 75,000 years BP.[85] The second was in the Greenland Sea (72° N, 10° E), which he dated to 50,000–55,000 years BP.[86] It is worth noting that a pole position in the Greenland Sea makes excellent sense, because this could explain the last European Ice Age. It might also explain another enduring mystery: the Greenland ice cap. Scientists have never explained why

Greenland, the largest island on Earth, supports an enormous ice field.

The large Greenland ice cap makes perfect sense, however, given the present position of the North Pole and two other likely former pole positions in the neighborhood. If Greenland had been surrounded by former pole positions, this would place it within the Arctic Circle continuously over the last 75,000–80,000 or more years. Although Hapgood misplaced his third and most recent pole position, which he believed was in Hudson's Bay (60° N, 83° W), he was on the right path. His placements were reasonable estimates, given the data available to him at the time.

Before Atlantis

In a recent book, *Before Atlantis*, aerospace engineer Mark Carlotto proposes some refinements to Hapgood's pole positions based on archaeological data and improved mapping technology.[87] Carlotto's research is the first substantial contribution to Hapgood's theory since the two books by Rand and Rose Flem-Ath, in 1995 and 2012.[88] Carlotto reasons that a former North Pole position in the Bering Sea, based on archaeological data, is an improvement over Hapgood's proposed Yukon pole position "without fundamentally changing Hapgood's climatic assumptions."[89]

Carlotto also proposes a refinement of Hapgood's Greenland Sea pole. Carlotto places it closer to Norway for similar reasons.[90] Moreover, he also identified a *fourth* pole position in North Greenland (79.43° N, 68.84° W) that was unknown to Hapgood, also based on archaeological data.[91] I will discuss these pole positions extensively in subsequent chapters.

The standard view, today, is that the massive Laurentide ice cap in North America during the LGM was simultaneous with a smaller ice cap in Northern Europe. Both ice sheets, we are told, existed concurrently, part of the same ice age. A glance at the map, however, reveals insurmountable difficulties with this standard Earth climate model. First, neither of the caps was truly polar. Both were offset far to the south. As already noted, the Laurentide ice cap supposedly reached as far south as Iowa and Indiana, placing it well within the temperate zone. This is highly improbable.

Secondly, their combined shape was weirdly oblong. Should we not expect to find a roughly circular northern ice cap bounded by the Arctic Circle? Such is the configuration of the present-day ice cap over Antarctica. The usual explanation for this troublesome anomaly is not based on hard evidence, but rather on an assumption: that the earth as a whole was then cooler. Indeed, the idea of planet-wide cooling is implicit in the phrase "Last Glacial Maximum," and this supposedly explains why the massive Laurentide ice sheet extended as far south as Indiana and Iowa. But if this is correct, should we not expect that the same cap also included eastern Siberian and Alaska (collectively known as Beringia)?

After all, portions of both of these high-latitude regions are within the Arctic Circle, far to the north of Indiana and Iowa. Surely both would have been buried under thousands of feet of ice. Some scientists rationally attempt to account for this major anomaly with the glib assertion that eastern Siberia and Alaska were deprived of moisture. In other words, they suffered from aridity due to their geographic location downwind of the Laurentide and Scandinavian ice caps.[92] But this seems a feeble argument.

Other scientists attempt to overcome the problem by fudging the estimated boundaries of the Laurentide ice cap. Some of the maps are quite creative. In the final analysis, however, facts are facts. During the LGM, eastern Siberia was essentially free from ice, apart from some mountain glaciers. Moreover, by the early years of the twentieth century, geologists understood that the same was true of Alaska. In 1909, for example, Eduard Suess acknowledged that "all accounts agree in affirming that the land about the Yukon has not been subjected to a general glaciation."[93]

This and other examples already discussed, e.g., Yosemite Valley, suggest that the phrase "glacial maximum" is freighted with hidden and unfounded assumptions, all of which need to be ferreted out. I believe that Hapgood was correct that the Laurentide and north European ice caps were actually two separate and successive ice ages. The European ice cap occurred first, followed by the Laurentide. Nor does Carlotto's new-found pole position in northern Greenland detract from this argument, but actually serves to flesh it out in greater detail. We are led ineluctably to a radical and inescapable conclusion: *The successional ice ages in Europe and North America were separated by a heretofore unrecognized displacement of the earth's crust.*

In a subsequent discussion I will identify the proper sequence of crustal displacements (and pole positions) based on some very impressive stratigraphic work done in the bone caves of Britain. Here, however, I need to mention that I disagree with Carlotto's proposed location for the most recent pole position, which I have placed on Baffin Island. Carlotto places it in Hudson's Bay (59.59° N, 80.89° W).

A simple check using the Google Earth Pro ruler tool confirms that my Baffin Island pole position is a better fit with the extralimital mollusk data.[94] Our difference of opinion on this underscores the importance of multiple lines of evidence. Although plotting the alignments of ancient sites is necessary and useful, many skeptical scientists view archeology as "soft" science. For this reason it is essential that we develop an interdisciplinary approach and back up archaeological alignments with hard science, whenever possible.

To help the reader better understand the meridian of maximum displacement (MoMD), I have generated a series of graphic images of this great circle, which are unique to the most recent crustal shift event. (**See Figures 3 and 4**) Because the MoMD defines the path of maximum movement, it is reasonable to expect that the regions along it will be especially rich in evidence. I will explore these regions in subsequent chapters.

The Battle of the Beds

In the course of searching for evidence of other extralimital migrations in Asia, I queried experts, including a paleontologist, Dr. Alan Beu, who is based in New Zealand. I briefly explained my research

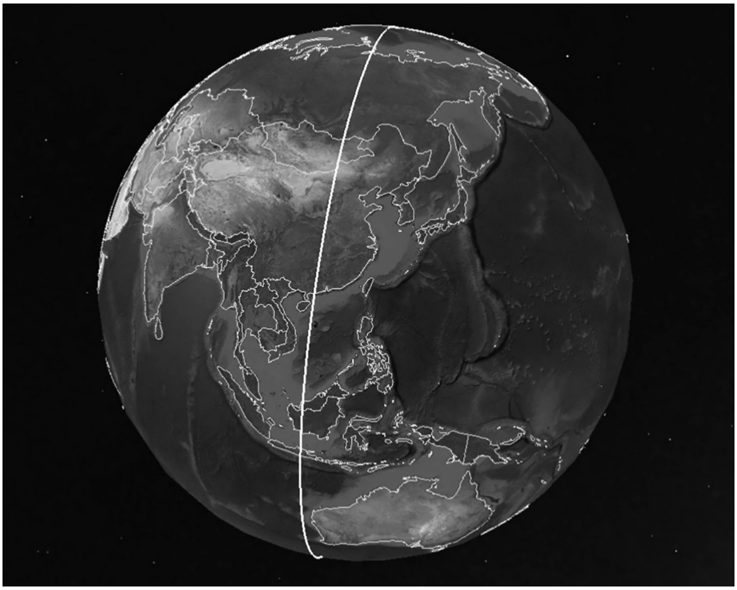


Figure 3. MoMD in relation to Southeast Asia

(Google Earth, Data SI0, NOAA, U.S. Navy, NGA, GEBCO; ©2020 GeoBasis-DE/BKG, US Dept of State Geographer,©2020 Google)

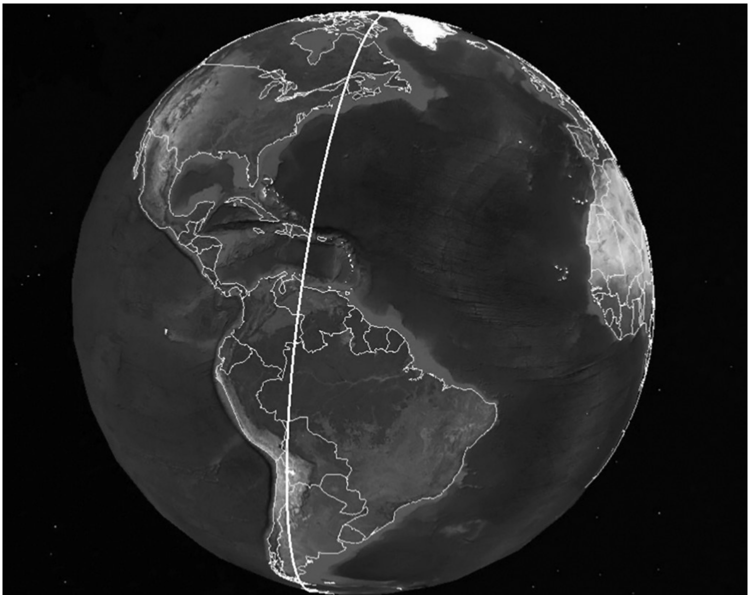


Figure 4. MoMD in relation to North and South America

(Google Earth, Data SI0, NOAA, U.S. Navy, NGA, GEBCO; ©2020 Google, US Dept of State Geographer, Image Landsat/Copemicus) to Dr. Beu, and included a link to my article, "The Oldest Anomaly in Science," a summary of Chapter Three, which the writer Graham Hancock graciously posted on his web site.[95] This prompted a lively discussion with Dr. Beu and one of his colleagues, Dr. Sven Nielsen, a university professor in Chile. Dr. Beu responded as follows:

> *Dear Mark,*
>
> *There is so much needing explanation in that table compiled by d'Orbigny that I hardly know where to start! First, all those generic names are so vastly, impossibly out of date that they are meaningless now, to present-day taxonomists. The names refer to families rather than genera; all genera have been refined and subdivided hugely since the 1840s.*
>
> *The table simply has no relevance whatever to modern names of molluscs. Also, as I told you before, it is species that migrate (as larvae), not faunas, but if whole faunas have migrated (as seems to have occurred during Pleistocene glacial-interglacial cycles), it means that most species in a fauna had planktotrophic larvae and were able to migrate in response to temperature change. The concept that the Earth's crust moved is so incredibly naïve that it is staggering to think about – it is species that shifted their individual distributions in response to Pleistocene temperature change, rather than the crust moving.*
>
> *That table desperately needs modernising, by using species and modern generic names, rather than the enormously out-of-date names listed now. It would be interesting to update it and see how relevant it is now – and I suggest you ask my colleague Professor Sven Nielsen (in Concepcion) about it. I have cc'd this message to him.*
>
> *The other huge problem with d'Orbigny's table, cited by Darwin, is the relative ages of the localities compared. The Navidad fauna is Miocene, probably early Miocene but affected by an unusual case of*

displacement of Miocene fossils into Oligocene rocks (so the fossils are around 23 to 15 million years old) whereas the Coquimbo fauna is Pliocene or perhaps early Pleistocene, around 5 to 2 million years old; these should not be compared! The climate during the early Miocene was warm world-wide, and even in New Zealand we had a tropical fauna at that time. Your concepts are naïve and require re-thinking.

Warmest good wishes, Alan[96]

I was not surprised that the standard usage of "genus" has changed over time. After all, nearly two centuries separate us from Darwin. It stands to reason that taxonomy would evolve. Because I am neither a paleontologist nor a malacologist, obviously I am not qualified to discuss such issues with Dr. Beu. Nonetheless, I hold firmly to the view that taxonomic issues do not necessarily invalidate the data. The key question is whether the evidence collected by Cuming and d'Orbigny and reported by Darwin was good data.

I also received an email from Dr Nielsen[97] who informed me that none of the mollusks from the Navidad bed survive today, apart from one species, *Acanthina karsteni*. The Navidad bed dates to the Miocene (24–16 million years BP), while the Coquimbo bed is younger. It dates to the Pliocene and possibly early Pleistocene (5–2 million years BP). Of course, it hardly matters when the various mollusk species originated. The key question is whether they still survive. And we have it on the good authority of d'Orbigny and Darwin that such is the case. So, who is right?

Nielsen informed me that he personally examined d'Orbigny's shell collection on display in a Paris museum. He also visited Darwin's collection housed in London. However, crucially, he conceded that he never saw Hugh Cuming's enormous collection housed in the British Museum of Natural History. It numbers 83,000 specimens and, to date, is the largest shell collection ever assembled by a single individual. Many of the species Cuming reported were unknown to science and still bear his name.

The matter of "who collected what" could be the key to resolving the controversy. It's my understanding that Cuming did most of the collecting, although d'Orbigny may also have contributed some specimens from the beds in Chile. But it was undoubtedly d'Orbigny who compiled the data and passed it to Darwin. D'Orbigny had been trained by Cuvier and would have immediately recognized the anomalous nature of a mollusk relocation up the coast. Indeed, why else would he bring the matter to Darwin's attention?

I also learned more about Cuming's personal involvement.[98] Cuming had immigrated to Chile from England and, after achieving success in business, pursued his life's dream. In 1827, he ordered the construction of a sailing craft custom made to his specifications, designed for offshore collecting. In 1828, Cuming took possession of the brand-new vessel, christened it *Discoverer*, and promptly sailed out of Valparaiso harbor.

He was not a beachcomber. Cuming collected using a dredge apparatus mounted on the ship, which he lowered with ropes. The method was efficient and helps to explain the huge size of his collection. In addition to being a seashell adept, he was a skilled sailor. During the years 1828-1830, Cuming ranged as far south as the island of Chiloé, Chile and as far north as Acapulco, Mexico. He even visited the Galapagos Islands. According to his biographer, Cuming maintained a log and kept accurate records. None of which, unfortunately, have survived. Although he had no formal science training, Cuming was a careful observer. Darwin respected him, judging by their correspondence.

So, it appears that Cuming mainly collected live specimens. A thorough review of his collection in the London museum by a trained malacologist could decide the matter. If the seashells Cuming gathered in northern Peru and Ecuador matched the specimens from central Chile, this would prove the species are still extant, vindicating Darwin and d'Orbigny, with implications that are earthshaking.

However, I should mention here, that we do not even need the mollusk migration data from South America to demonstrate crustal displacement. The archaeological data I have presented, in combination with the extralimital mollusk migration data from the west coast of North America, are sufficient to the task. And I designed a simple exercise to show this. Using the earth mapping software, I plotted two arcs. (**See Figure 5**) The first arc plots the distance from the Santa Cruz faunal bed (a precisely known location) to the point on Baffin Island where the alignments of the two ancient pyramids (Teotihuacan and Tiahuanacu) intersect. This point is the presumed former North Pole. The second arc plots the distance from the present mollusk habitat in Puget Sound (also known: 48° N) to the present North Pole.

*The distance from the Santa Cruz faunal bed to the former pole position on Baffin Island = 2,914 miles.

*The distance from the existing mollusk beds in Puget Sound to the present North Pole = 2,910 miles.

The arcs are a measure of latitude and are equal in distance to within about four miles. Although this test is slightly less accurate than my earlier exercise, the close

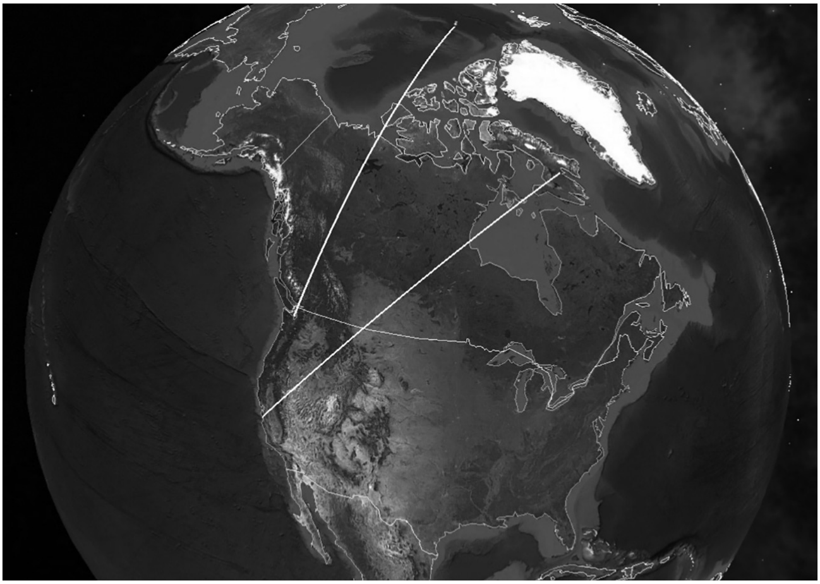


Figure 5. Plot of measurements: from Puget Sound to the current north pole, and from the Santa Cruz faunal bed to the former north pole position on Baffin Island.

(Google Earth, US Dept of State Geographer, Data SI0, NOAA, U.S. Navy; NGA, GEBCO Image Landsat/Copemicus, ©2020 Google.)

agreement nonetheless confirms that the two ancient pyramids were aligned to the true North Pole position on Baffin Island. The exercise also affirms a crustal displacement of 1,657 miles at the end of the Pleistocene, and it does so without relying on Darwin's data from South America.

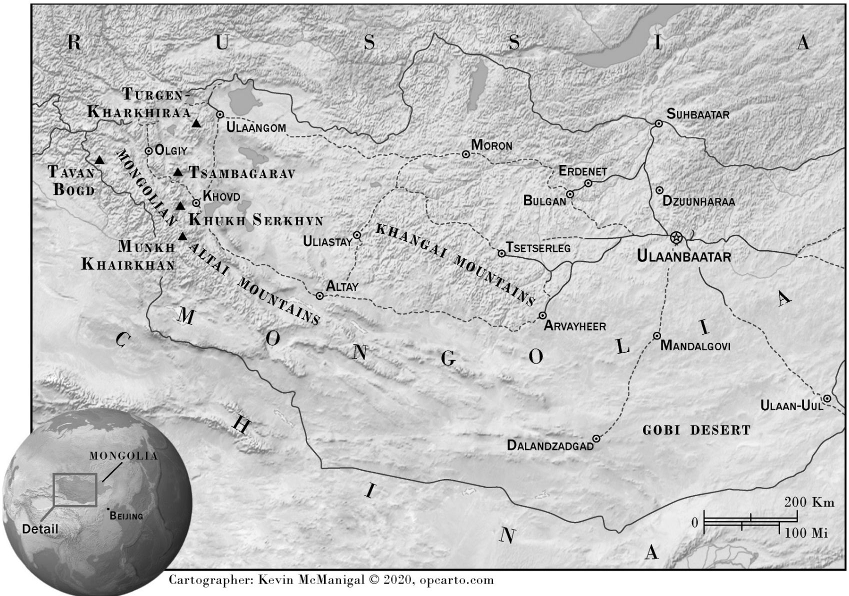
This check underscores why I feel so confident that a new Earth-climate paradigm is now unstoppable. Today, any computer literate person, and this includes most of the younger generation, can easily verify my numbers. It is ironic that although Darwin fell short of explaining evolution and drew back from catastrophism, he nonetheless still served as the unwitting catalyst for the most important scientific revolution since the apple dropped on Isaac Newton. I am not referring to evolution!

Chapter Seven: General Cooling in Central Asia During the Last Glacial Maximum (LGM)?

Today, most Earth scientists believe that a general cooling of our planet accompanied the Last Glacial Maximum (LGM) between 25,000–18,000 years BP. The idea has such a deep hold on scientists that it is taken for granted. I have already expressed deep skepticism with the standard maps that show simultaneous ice caps over much of Europe and North America. The maps imply a general cooling because they display a weirdly oblong polar zone, including a North American ice cap extending far south of the Arctic, indeed, all the way to what is now Indianapolis, Indiana, in the heart of the temperate zone.

According to the standard view, the same cooler conditions prevailed in Tibet and the rugged mountains of northern Mongolia, a remote area that has only been investigated during the last thirty years. As we are about to learn, however, recent studies call into question the presumed worldwide cooling during the LGM and point in a different direction.

In 2009, a team of Swiss and Russian scientists collected an ice core in the Altai Mountains, a remote part of Mongolia between the Siberian forests to the north and



Cartographer: Kevin McManigal © 2020, opcarto.com

Figure 1. Central Asia
(Reprinted with permission of Kevin McManigal

the deserts of central Asia to the south.[99] (**See Figure 1**) The expedition required setting up a drilling rig on the icy summit of the Tsambagarav Massif, a 13,549-foot peak in the Altai range (48° 39.34′ N, 90° 50.83′ E). The crew succeeded in drilling all the way to the bottom of the ice cap. The level site and bedrock topography below the rig indicated the glacier was stable, with minimal lateral movement. This suggested that the ice might well preserve an extended climate record.

Subsequent isotopic analysis of the 72-meter core showed that the ice at the bottom was ~6,000 years old. Ice-free conditions evidently had existed before that time. The team concluded that "most of the glaciers [in the Mongolian Altai] are not remnants of the last glacial maximum (LGM) but were formed during the second part of the Holocene."[100]

In other words, they are very recent! However, because other peaks in the Altai range team rise to more than ~14,700 feet in elevation, the team left open the possibility that the highest ice fields in the Altai Mountains *might* include remnants from the LGM.

The previous year, a Chinese-Korean team collected a 40-meter core, also from the Tsambagarav glacier. Insofar as I am aware, the results of the expedition have not yet been published. However, given the much shorter core and the 90-to-100-meter depth of the glacier where the core was taken, it is unlikely the drillers reached to the lowest and oldest ice.[101]

In 2003, a multi-national team successfully collected a deeper core from a saddle on 14,783 feet Mt. Belukha, the highest peak in the Altai mountains (49° 48′ N, 86° 34′ E), located in the Russian portion of the range. The 53-meter ice core reached all the way to bedrock. Isotopic analysis determined that the oldest ice at the bottom dated to 3,000–5,000 years BP.[102] Here again, the ice cap was recent in origin. All of the ice had been deposited during the Holocene. None was from the LGM.

Marine Isotope Stages (MIS)

The Marine Isotope Stages are a classification system for understanding past global climatic changes. The system is based on measurements of oxygen isotopes in samples of fossil plankton (foraminifera) drawn from thousands of ocean sediment cores. Isotopic analysis has shown that Oxygen16, the lighter isotope, is preferentially found in water evaporated from the oceans, some of which is then deposited as snow and ultimately ends up in glaciers. As ice sheets accumulate, the relative amount of Oxygen18, the heavier isotope, tends to build up in the oceans.

The ratio of Oxygen18 to Oxygen16 in the calcite remains of the plankton in the sediment cores therefore provides a proxy record for climate change over time. The system was first developed in the 1950s, and was a collaborative effort by a number of pioneering climatologists, including Cesare Emiliani, Harold Urey, John Imbrie, Nicholas Shackleton, Wallace Broecker, and others.

The 120,000-year time frame for my book spans only the first five of at least one hundred MIS stages, which altogether represent the last six million years. (Although MIS-5 is broken down into five sub-stages, these are not important for our purposes.)

TABLE OF MARINE ISOTOPIC STAGES
(the date is the start of that stage)

MIS-1	11,600 BP	Holocene
MIS-2	24,000 BP	Last Glacial Maximum (LGM)
MIS-3	60,000 BP	Upper Paleolithic
MIS-4	74,000 BP	
MIS-5	130,000 BP	Eemian (Interglacial)

In 2018, two scientists from the University of Washington reported the results of fieldwork in 2007 and 2010 in the Gobi-Altai mountains (45-47° N) a few hundred miles southeast of the research sites discussed above. Jigjidsurengiin Batbaatar and Alan R. Gillespie examined five glaciers in the Gobi-Altai range and concluded that all of them had retreated during the LGM. In an interview, Batbaatar told a reporter from *ScienceDaily*: "The results were so surprising that we went back to double check."[103] The scientists found abundant evidence of expanding glaciers, yes, but during a *previous,* wetter epoch (known as MIS-3), *not* during the LGM (MIS-2).[104] They concluded that arid conditions during the LGM probably explained the absence of ice.

In 2014, a multi-national team reported a similar finding based on a study of glacial moraines in several valleys in the Khangai Mountain range (47.75° N, 97.25° E), also located in Mongolia. (**See Figure 1**) The team concluded that glaciers in the area reached their maximum extent during a wetter epoch 40,000–35,000 years BP. True, the team found evidence of glaciation during the LGM, but were unable to determine if the glaciers were "a re-advance…or, alternatively, a late persistence [of the previous glaciation]."[105]

But the maximum ice coverage definitely had occurred during the previous epoch (i.e., MIS-3), not during the LGM.

These field studies pose a major problem for the standard view of planet-wide cooling at the LGM. Because the same cooling that allegedly produced a two-mile deep ice sheet in North America that reached as far south as Des Moines, Iowa, New York City, and Indianapolis, Indiana, (40° N), locations at or near sea-level, *failed* to generate even mountain glaciers in central Asia at sites 13,500 feet in elevation and 550 miles farther north (47-49° N).

The sites in the Altai range are at latitudes comparable to the central Cascades in Washington state where, today, glaciers at 10,500 feet in elevation or lower are commonplace even though we live in a warm interglacial. Indeed, where I live in Oregon, 300 or more miles to the south of central Washington state, remnant glaciers may still be found at

10,500 feet in the Cascade Range (i.e., at 43° N). The Three Sisters and Mt. Jefferson, located west of Bend, Oregon, all boast remnant mountain glaciers. True, they are presently retreating as the result of human-caused warming during the last century; however, until very recently they were stable.

Given this has been the case during an interglacial, should we not expect much more extensive glaciation at comparable latitudes during the LGM, an epoch, we are told, that was significantly colder? Indeed we should. The available data therefore indicates that something is wrong with our current science paradigm. Nor have we exhausted the evidence, as I am about to show.

The Roof of the World

The Tibetan Plateau is one of the most impressive topographic features on the surface of our planet. **(See Figure 2**) The plateau is half the size of the United States and boasts an *average* elevation of at least 14,700 feet. This is a remarkable figure because it means the average elevation over this vast region is 200 feet higher than Mount Whitney, the highest point in the lower 48 states. It is no wonder that Tibet is sometimes called the "roof of the world."

Since the early years of the twentieth century, a contentious debate has raged about the extent of glaciation during the LGM across this high region. A number of scientists made the case for extensive glaciation. A few have even argued that the whole of Tibet was covered by a gigantic sheet of ice during the LGM. Some of these scientists also believe that isostatic rebound (i.e., uplift) of the earth's crust, following the removal of this tremendous weight of ice by melting, partly explains the impressive topography.

Other scientists, however, searched and found no evidence for a general glaciation and proposed instead that during the LGM, smaller ice caps were restricted to mountain peaks and high valleys.[106] Given Tibet's huge size and geological complexity, and the relatively limited number of sites that individual scientists are able to study, the wide range of opinion among experts is probably not surprising.

The glaciers of Tibet have a long history of advancing and retreating over millennia for reasons that are not always well understood. Unraveling the record has proved neither simple nor easy. The residual evidence that glaciers leave behind when they retreat, known as terminal moraines, are next to impossible to date. Radiocarbon analysis of organic material found atop these moraines provides only a minimum date, at best. For this reason, the timing of only a few Pleistocene and Holocene glacial advances in Tibet are known with confidence.[107]

Scientists agree that the existence of an ice sheet depends on a balance of several factors: summer temperature, solar radiation, and precipitation. But the manner in which all of these factors interact can be quite complex. Although average summer temperature is the most important single factor in determining whether a glacier is stable, solar radiation is also important because this drives evaporation which, in turn, affects the total amount of precipitation, without which an ice sheet cannot advance. The highest levels of precipitation in Tibet occur along the southern

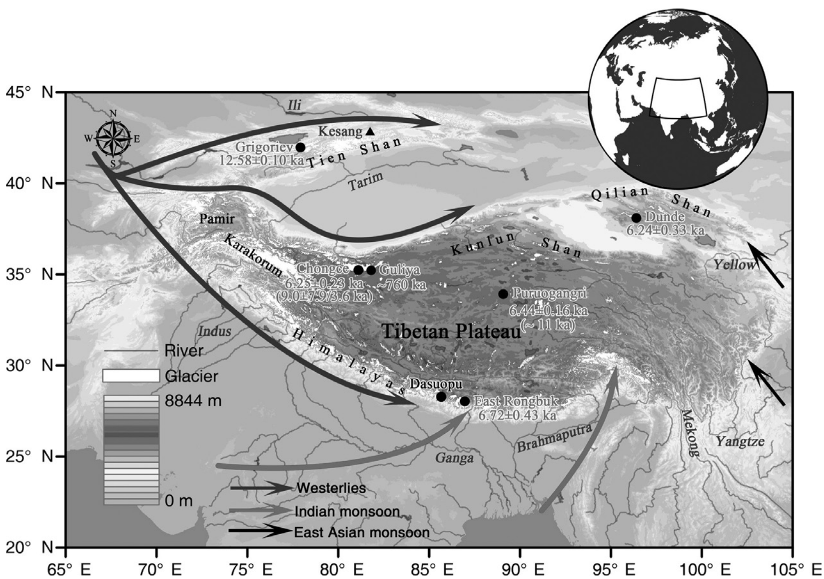


Figure 2. The Tibetan Plateau

(Reprinted with permission of Dr Shugui Hou) and, especially, the eastern margin of the Himalayas, where the summer monsoon from the Indian Ocean drops most of its moisture. As one travels westward and north into the interior of Tibet one enters a rain shadow. In this drier region westerly winds bring most of the moisture (and snow) during the winter season.

During the 1960s, Chinese scientists undertook a thorough mapping of Tibet and, by the 1980s, had reached broad agreement that glaciation during the LGM was limited to the highest mountains. By this reckoning, ice covered no more than about four percent of Tibet's total land area. This finding of much more limited glaciation is important to our discussion because it is at odds with the assumed general planetary cooling during the LGM. On a plateau as high as Tibet one might well expect to find evidence of a large ice sheet, especially during a cold epoch.

But it never happened. Moreover, as we are about to learn, deep ice cores have also provided additional compelling, I would argue, conclusive evidence.

High Elevation Ice Cores from Tibet

In recent years, scientists recovered a series of deep ice cores from seven sites on the Tibetan Plateau. In 2018, a paper by a team of Chinese scientists summarized the results of these drilling expeditions.[108] (**See Figure 2**) The first deep cores were taken from atop the Dundee ice cap in northeastern Tibet (38° 06′ N, 96° 24′ E) at an elevation of 17,470 feet. Subsequent expeditions followed at six other locations in 1992, 1997, 2000, 2001, 2007, and 2012.

Two of the sites were in the Himalayas, including several cores from the Dasuopu glacier (28° 23′N, 85° 43′E) taken in 1997 at elevations ranging as high as 23,622 feet. The 150- to 167-meter Dasuopu cores to bedrock were the highest elevation cores recovered from anywhere in Tibet. Other cores to bedrock were drilled in 2001 atop the East Rongbuk Glacier on the north slope of Mount Everest (28° 1′ N, 86° 58′ E) at an altitude of 21,384 feet. At these dizzying heights, one might well expect to find abundant ice from the LGM. Yet, such was not the case. Analysis of the cores confirmed that all of the ice had been laid down during the Holocene. There was no ice from the LGM.

Other sites included the Guliya ice cap (35° 17′ N, 81° 29′ E) in central Tibet at an elevation of 20,341 feet, and the Grigoriev cap (41° 59′ N, 77° 55′ E) near the Russian border in the western Tien Shan mountains. The Grigoriev core was taken at the rather modest elevation of 14,970 feet, a number that, while substantially higher than Mount Whitney, was still the lowest elevation site of any of the Tibetan drilling expeditions. Again, at these altitudes, one might well expect to find ice from the LGM. Yet, if isotopic dating is to be believed, *only one of the deep cores, the one taken at Guliya, recovered unambiguously ancient ice.*[109] At 308.6 meters long, it was the deepest and longest ice core taken during the seven expeditions.

The Guliya ice was dated to 500,000 years BP, or possibly older at the ice core-bedrock interface. *None of the other ice cores were pre-Holocene. All of them, including even the deepest ice at bedrock, had been laid down since the end of the LGM.*

How then do we explain the results of these ice core studies, which document extensive ice deposition in Tibet during the recent warm interglacial Holocene and its apparent absence during the LGM at a time when, meanwhile, on the *other* side of the globe, much of North America lay buried beneath an ice cap estimated at 10,000 feet deep? A cap, I might add, that extended far to the south, well into the temperate zone. Also, why did the most recent glacial epoch in Asia precede the LGM in North America by as much as 20,000 years? Some Earth scientists have even adopted a new expression, "asynchronous," to describe the discordant timing. In my opinion, the word is a euphemism and amounts to a tacit admission that the present science model has failed to explain major discrepancies in the record. "Asynchronous" even appeared in the title of a recent paper.[110]

After reviewing the scientific literature, including some of the material I have cited, Robin Blomdin, a physical geographer at Stockholm University, offered the following explanation:

> "restricted glacier extents [in Asia] during MIS 2 [the last glacial maximum or LGM] *at a time of significant glacier expansion elsewhere have been attributed to cold and dry conditions across Central Asia, as a result of the Siberian High pressure system shifting south in response to the expansion of the high-latitude ice sheets* [my emphasis]."[111]

Here, Blomdin is reiterating the aridity argument, which does not improve with repetition. Allow me to rephrase it in plain English: The presence of the Scandinavian and North American Laurentide ice caps supposedly produced a large arid zone of reduced precipitation at higher latitudes in eastern Siberia, and this explains the absence of an ice sheet there during the LGM. And the same cold, dry conditions also effectively limited glaciation in central Asia and Tibet.

Here, Blomdin seems oblivious of the Himalayan data. The Holocene dating of the cores from Everest and Dasuopu (located 75 miles to the west) are telling because the aridity argument clearly does not hold for the Himalaya Range, which receives abundant moisture during the summer monsoons. (**See Figure 2**) Both of these cores were drilled to bedrock, and the Dasuopu core was taken at 23,600 feet. Both cores should have included ice from the LGM, but they did not. How do we explain this?

Judging from the ice core data alone, one is tempted to entertain a radical idea: that the present era, i.e., the Holocene, constitutes a glacial maximum in Central Asia. At very least, it is obvious that the aridity argument stands in need of overhaul or replacement. But the root problem, I would argue, is the unstated assumption deep within the current science paradigm that needs to be exposed to the clear light of day. I am referring to the tacit assumption that the present pole positions, by some mysterious law of Nature, are and have always been an unchanging fixture of our planet. But there is no such natural law. Here, Occam's famous razor surely applies. The longstanding scientific rule of thumb holds that the simplest hypothesis is usually the best solution to a problem. I suggest that proximity to the pole, i.e., latitude, is that simplest solution.

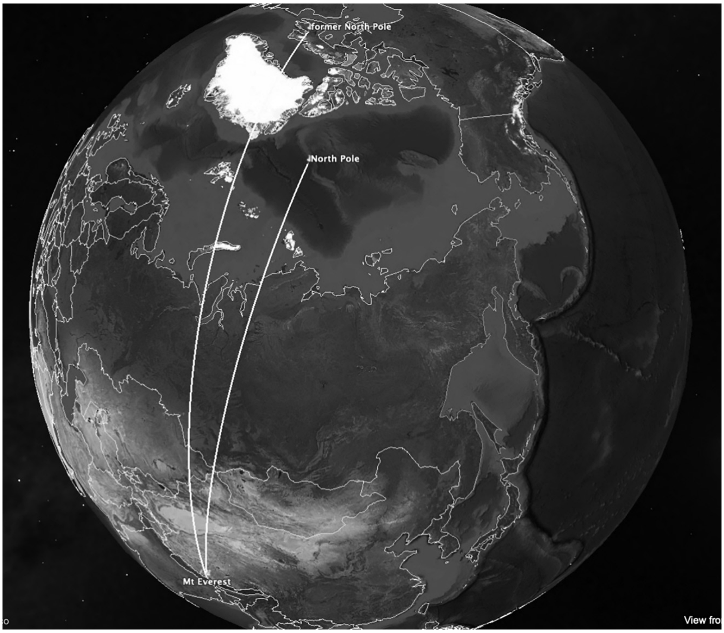


Figure 3. Plot of the distance from Mt Everest to the current north pole and to the former north pole position, showing that Everest was 1,570 miles south of its current location during the LGM.

(Google Earth, Image Landsat/Copemicus; US Dept of State Geographer; Data SI0, NOAA, U.S. Navy; NGA, GEBCO; ©2020 Google. View from Space (Altitude: 7682 mi))

I created a Google map illustrating the distance from Mt. Everest to the former North Pole position on Baffin Island identified in Chapters Four and Five. (**See Figure 3**) For sake of comparison, the graphic also displays the distance from the present North Pole. The map shows that, assuming a former pole position on Baffin Island, the highest point on Earth, Mt. Everest (~28° N), was then 1,532 miles south of its present location and very near to the equator (6° N). Although it is impossible to know exactly how this would have altered the moisture regime in the Himalayas, it is likely to have had a major effect on the summer monsoon because the Himalaya Range would then have been much farther south, at the latitude of the easterly trade winds. The snow line would have been substantially higher across the region than at present.

A more southerly location might also account for the documented drier conditions in Central Asia during the LGM. And it might even explain the expansion of glacial lakes in the Qaidam Basin in north central Tibet at the start of the LGM (25,000 years BP).[112] Surely we might expect that retreating glaciers would be accompanied by expanding glacial lakes, swollen with meltwater. And we might also expect that once the glaciers retreated, the same meltwater lakes would shrink and perhaps dry up. We are well advised, however, to exercise caution because there is as yet no firm evidence that other glacial lakes across Tibet were similarly expanding at this time. Dating the high-water lines of ancient lakes in Tibet has proved as difficult as dating terminal moraines.

Given a pole position on Baffin Island, the Altai Range (47-49° N) would have been 1,570 miles south of its present location. That would place it at a latitude just south of present-day Miami, Florida (25° 30′ N). Might this explain why Mongolian glaciers were receding during the LGM, at a time when the Laurentide ice sheet was expanding across North America? Yes, most assuredly.

To summarize: The dating of ice from deep cores taken in Central Asia points to warmer, not colder, conditions during the LGM, and this flatly contradicts the standard view of a general planetary cooling.

Chapter Eight:
The Hippos of Yorkshire

In June 1821, day laborers in Kirkdale, Yorkshire, uncovered some large bones in a limestone quarry. The men thought they were cattle bones and began using them as fill in a road construction project. That is, until a local surgeon, John Harrison, noticed that they might be fossils. In the course of extending the quarry, the workers had stumbled into an unknown natural cave.

Over the next few months, local naturalists explored the cavern and began to excavate. In the process, they identified a number of species, including stag, bison, horse, hippopotamus, woolly rhinoceros, woolly mammoth, and many smaller species. Eventually, they brought in a distinguished geologist from Oxford, William Buckland (I mentioned him in Chapter One), who no doubt was delighted by the opportunity.

Buckland had recently completed two tours of Europe during which he had visited many geological sites in Germany, France, and Italy, and similar fossil caves. Buckland had compared notes with leading naturalists and geologists, and had been privileged to inspect private collections, including one owned by Goethe. The tours had broadened his outlook, and well prepared him well to investigate the Kirkdale boneyard.[113]

Buckland had a reputation as an eccentric and this apparently included a warped sense of humor. His interest in fossils extended to the study of fossilized dung, known as coprolites. The professor actually mounted this dung collection in a coffee table with a see-through top, probably made of glass, and when entertaining dinner guests at home, he always served them on it. Only afterward would he tell them what it was. The famous coffee table eventually found its way to the Lyme Regis Museum in England, where it may still be viewed today.

Whatever his idiosyncrasies, Buckland was an able scientist. Although he agreed with George Cuvier that a deluge of immense proportions had caused a geologically recent extinction of large mammals, he found no such evidence at Kirkdale. The sediments convinced him that the animals whose bones were represented there had not been swept into the cave by a tsunami or deluge.

They had died where they lived. Nor was there any evidence of a flood. The original entrance was scarcely large enough for a man to crawl through on hands and knees, and it was much too restricted to admit a large animal, let alone a mammoth. The largest number of bones by far belonged to the spotted hyena.[114] And tooth marks on the fossils indicated the bones had been gnawed and broken. Buckland concluded that the place had once been a hyena den. Evidently a clan of hyenas, a scavenger species, had dismembered the larger animals before dragging the disarticulated parts into the cave.

In 1822, Buckland presented his findings to the Royal Society. His presentation was so detailed that it occupied three successive weekly meetings. His report stirred great interest in England and across Europe, and was widely viewed as a gold standard on how to conduct a scientific investigation.[115]

In subsequent years, many similar graveyards came to light in Britain and were independently investigated. There were limestone caves at Banwell, Burrington, Sandford Hill, Bleadon, and Hutton, and also at Oreston near Plymouth. Hippo bones were also found in river gravel at Leeds,[116] in

Derbyshire,[117] at sites in London,[118] and at Clacton in the valley of the Thames.[119] To this day, however, the sites in Yorkshire are the most northerly location for hippo bones in all of Europe.

In Wales, other boneyards were found at Cefn, Pembrokeshire, and Gower. Some of the above sites also included human artifacts.[120] The 1858 discovery at the now-famous Brixham cave in Devonshire of "rude flint implements" in association with the bones of hyena, woolly rhinoceros, and mammoth indicated that Paleolithic humans had co-inhabited Great Britain along with these animals.

According to geologist William Boyd Dawkins, this "singularly opportune discovery destroyed forever the doubts that had overhung the question of the antiquity of man."[121] I have incorporated a useful chart from Dawkins' 1874 book *Cave Hunting*, which lists the various cave sites and the species found at each. (**See Figure 1**)

Similar finds were made on the continent. George Cuvier recovered a vast quantity of fossil remains at the Gailenreuth cave in Bavaria, including the bones of hyena, lion, wolf, fox, red deer, grizzly bear, reindeer, mammoth, horse, and bison. In Belgium, bone-caves were excavated along the banks of the Meuse and at Goyet on the Samson River in the province of Namur.

The latter included the remains of an Arctic fox.[122] Hippo bones were found in Germany along the Elbe River a few miles south of Meiningen, and at two sites in Italy.[123] The French naturalist D'Ault du Mesnil also found hippo bones along with rhinoceros in the gravel beds of the Somme River at Abbeville.[124] Plentiful remains of dwarf hippos also turned up on Mediterranean islands, including Sicily, Cyprus, Crete, Malta, Sardinia, and Corsica.[125]

By the 1850s, Earth scientists were in a quandary because the Pleistocene bestiary included northern species such as the musk oxen (*Ovibos moschatus*), Arctic fox (*Alopex lagopus*), lemming (*Mus lemmus*), reindeer (*Cervus tarandus),* wolverine *(Gulo gulo*), and grizzly bear (*Ursus arctos*), *in addition to subtropical species*, including the spotted hyena (*Crocuta crocuta*), straight-tusked elephant

Species.	Gailenreuth Cave.	Kirkdale.	Victoria.	Cefn.	Plas-newydd.	Plas Heaton.	Gailfaenan.	Paviland.	Bacon's Hole.	Minchin Hole.	Bosco's Den.	Crow Hole.	Ravenscliff.	Spritsail Tor.	Long Hole.	Blackrock Fissure.	Caldy Fissure.	Coygan Cave.	Hoyle Cave.	King Arthur's Cave.
Homo palæolithicus—Palæolithic Man	×		×		×										×				×	×
Spermophilus citillus—Pouched Marmot																				
Arctomys marmotta—Common Marmot																				
Castor fiber—Beaver																				
Lepus timidus—Hare		×												×	×					
Lepus variabilis—Alpine Hare																				
Lepus cuniculus—Rabbit	×	×													×					
Lepus diluvianus—Extinct Hare																				
Lagomys pusillus—Tailless Hare																				
Mus lemmus—Lemming																				
Hystrix dorsata—Porcupine	×																			
Felis leo (*var. spelæa*)—Lion		×		×									×	×	×					×
Felis pardus—Leopard																				
Felis Lynx—Lynx																				
Felis caffer—Caffir Cat																				
Felis catus—Wild Cat	×												×		×					
Machairodus latidens																				
Gulo borealis—Glutton	×					×														
Hyæna crocuta (*var. spelæa*)—Spotted Hyæna	×	×	×	×		×	×	×	×	×		×	×	×	×	×	×	×	×	×
Hyæna striata—Striped Hyæna																				
Mustela martes—Marten													×	×	×					
Mustela putorius—Pole-cat									×					×	×					
Mustela erminea—Weasel		×							×											
Lutra vulgaris—Otter															×					
Ursus arctos—Brown Bear	×	×	×					?						×					×	
Ursus ferox—Grizzly Bear	×	×	×	×	×				×	×				×						
Ursus spelæus—Cave-Bear	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×				×
Canis lupus—Wolf	×	×	×	×	×	×		×	×	×	×	×	×	×	×	×				
Canis vulpes—Fox	×	×	×	×	×	×		×	×	×	×	×	×	×	×					
Canis lagopus—Arctic Fox																				
Elephas primigenius—Mammoth	×		×					×					×	×	×	×	×	×		×
Elephas antiquus		×		×	×				×	×		×	×	×	×					
Elephas Africanus—African Elephant																				
Equus caballus—Horse	×	×	×	×		×		×					×	×	×		×	×		×
Rhinoceros tichorhinus—Woolly Rhinoceros	×		×	×										×	×	×	×	×		
Rhinoceros hemitœchus		×		×	×				×	×		×	×		×					
Rhinoceros megarhinus																				
Bos urus—Urus																				
Bos bison—Bison	×	×	×	×	×	×		×	×	×	×	×	×	×	×		×	×		×
Ovibos moschatus—Musk Sheep																				
Capra ibex—Ibex																				
Capella rupicapra—Chamois																				
Antilope saiga—Saiga																				
Sus scrofa—Wild Boar	×	×		×				×	×	×	×	×	×	×	×					
Cervus elaphus—Stag	×	×	×	×	×				×					×	×					×
Cervus capreolus—Roe	×								×		×			×						
Cervus megaceros—Irish Elk	×	×	×	×	×									×	×					×
Cervus tarandus—Reindeer	×	×	×	×	×	×	×	×	×	×	×			×	×	×	×	×		×
Hippopotamus amphibius (*var. major*)—Hippopotamus		×		×	×								×							

Figure 1. Chart of the bone caves of Britain and the mammal species found in each.

(*Palaeoloxodon antiquus*), and hippopotamus (*Hippopotamus amphibius*). The bones of these very different faunal groups were often found in the same beds and it appeared, at least initially, that both had existed simultaneously. To be sure, excavation methods were less meticulous in those days, and the different stratigraphic layers were not always properly identified. It is worth noting that none of the still extant species in the two faunal groups presently inhabit Britain or central Europe.

Early attempts to resolve the paradox were less than satisfactory. Some scientists, including Lyell and Dawkins, argued that seasonal migrations explained the puzzling association of oppositely adapted species. In 1853, for example, Lyell pointed out that:

> There will always be points where the southern limits of an Arctic species meets the northern range of a southern species; and if one or both have migratory habits…they may each penetrate mutually far into the respective provinces of the other.[126]

Dawkins cited the well-known migrations of reindeer, elk, and wolf, species which are known to travel considerable distances. He argued that "oscillation to and fro of the animals according to the seasons" accounted for the mixed fossil beds that included both southern and northern types.[127]

The hippopotamus fossils presented a major problem, however, because hippos are not migratory. No one could say how the lumbering water-browsers had re-located from Saharan Africa to Britain and Germany. Did the animals navigate down the Nile, swim the entire length of the Mediterranean Sea to Gibraltar, then paddle north to England? The idea seemed preposterous. None of it made any sense.

Seasonal migration seemed even less likely after the French botanist Gaston de Saporta published research in 1870, showing that the puzzling association of cold and warm adapted species was not limited to the animal kingdom. Saporta had studied Pleistocene deposits in France that contained mixed assemblages of northern and southern plant species *that are never found living together in the present day.*[128] The botanical data was as anomalous as the mammalian fossils.

Obviously, plants cannot migrate with the seasons. They are only able to expand their range across the landscape in a gradual fashion, over centuries or even millennia.

Despite the hippo mystery and Saporta's new evidence, Dawkins held firm to migration. As late as 1910, he told the Royal Anthropological Society that:

> Northern and southern forms were so mingled together that there can be no doubt that they lived at the same time. The spotted hyena, for example, in the caves preyed upon the reindeer as well as the hippopotamus. This mixture of animals can only be explained by the migrating of these animals at different seasons.[129]

Perhaps it is not surprising that a number of prominent scientists rejected the seasonal migration hypothesis. Louis Agassiz was one of these. In 1839, he had proposed a new theory of the ice ages and in accord with his theory, he argued that rapid climate change explained the sudden replacement of southern forms by cold-adapted northern ones.[130]

A well known geology professor from Edinburgh, James Geikie, also advanced the ice age theory. Geikie had gained valuable field experience as a member of the British geological survey team, and he observed that too many bulky southern animals were involved, including several species of elephant and rhinoceros, to support the migration hypothesis.[131] To the professor it was self-evident that the cold and warm-adapted species had never co-habited Europe at the same time.[132]

The Pleistocene, Geikie noted, was characterized by alternating periods of glacial advance and retreat, and during the latter interglacial phase, as this stage had come to be known, the climate of central Europe had been much warmer. Surely the fossils of ancient hippos, elephants, and rhinos dated to one of these warmer periods which apparently had lasted for thousands of years. With the return of the next ice age, the southern fauna had simply retreated and been replaced by the cold-adapted northern species. Local or regional extinction occurred when a species could not adapt or was unable to relocate to suitable habitat. Geikie's interpretation of the Pleistocene cave fossils from Britain and Europe foreshadowed the evolution of scientific thinking down to the present day.

The current science model, however, did not really take shape until the advent of isotopic dating in the late 1940s and early 1950s. The promising new methodology made it possible, for the first time, to determine the age of organic material, including fossils, within a reasonable margin of error. Although problems with the new methodology have emerged in its practical application, some of them serious, the method has turned out to be valid in principle. Crucially, the isotopic dating of the cave fossils confirmed that Geikie was right: The northern and southern adapted species had never shared the land in the same epoch, nor had they migrated seasonally. They had lived at different times.

In 1998, calcite from the Kirkdale cave was dated to 121,000 years BP, indicating that the hippopotamus occupied Yorkshire during the warm interglacial period known as the Eemian.[133] (In Europe it is called the Riss-Wurm, while in England it is known as the Ipswichian interglacial. US scientists refer to it as the Sangamon.) In 1985, wolverine bones from Stump Cross Cave in northern England were dated to 83,000 years BP (plus/minus 6,000 years), indicating that northern Europe had transitioned from a warm to a cold climate during this time period.[134] The wolverine obviously is a northern species. But what caused the climate in Yorkshire to deteriorate? Why did it turn cold?

The Eemian

In 2008 a team of Earth scientists representing fourteen nations launched an expedition to find some answers. They called themselves the North Greenland Eemian Ice Drilling project, or NEEM for short, and were ably led by scientists from the Niels Bohr Institute in Copenhagen. During the summer of 2008, the team constructed a state-of-the-art

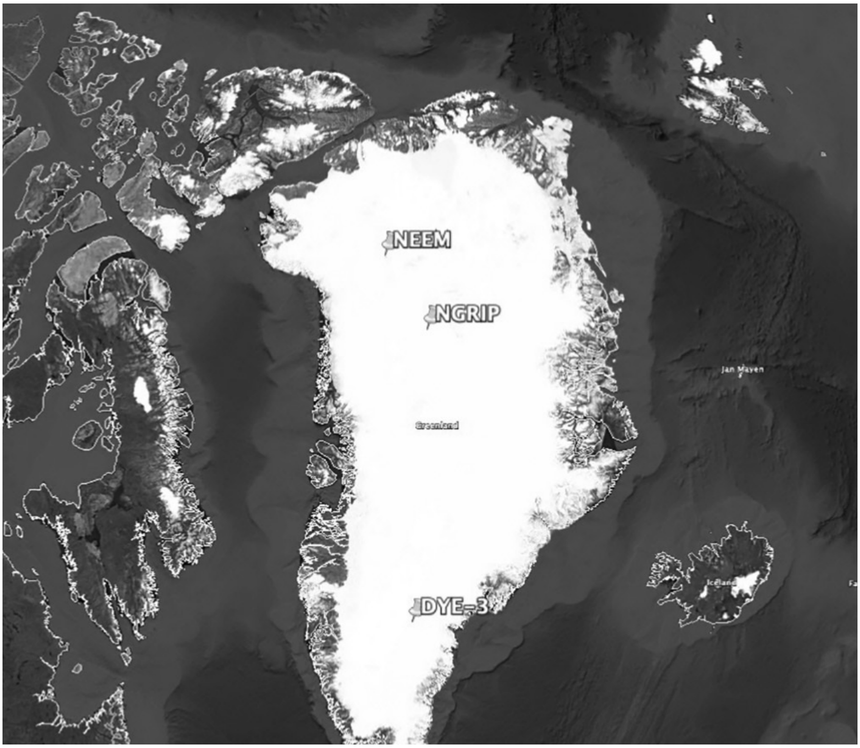


Figure 2 Map of Greenland showing ice core drilling sites.

(Google Earth Image U.S.. Geological Survey; ©2020 Google; Image IBCAO; Image Landsat/Copernicus)

drilling facility atop the Greenland ice cap (77° 27'N, 51° 3.6'W). (**See Figure 2**) Their plan was to bore 8,350 feet down through the ice sheet to bedrock and recover ice from the last interglacial, or Eemian, period, 128,500–114,000 years BP. Most of the ice in Greenland is recent in origin, laid down during the Holocene.

The Eemian ice is much deeper down, near the bottom of the cap, and was deemed especially important because temperatures at that time were several degrees Celsius warmer than at present. For this reason, it was thought that the Eemian ice probably held important information that might help our civilization come to terms with the rapid warming presently underway on our planet. Jim White, a professor at the University of Colorado and the leader of the US contingent, put it this way: "The Eemian period is the best analog we have for future warming on earth."[135]

The same data was also vital to the issues I am exploring in this book.

The actual drilling started in 2009. By the end of the first season in late August the NEEM group had recovered an ice core more than a mile long: a world record for seasonal drilling. The following summer, the team returned to the site and successfully reached the bottom of the Greenland cap. The 8,000 plus foot ice core was measured, cut into sections, processed, and shipped out to numerous labs for chemical and isotopic analysis.

Although the research is ongoing, we have already learned the Eemian was warmer than previously thought. The ice cores indicate that temperatures in Greenland were 8 degrees Celsius warmer than at present, and this caused intense surface melting of the ice sheet. The evidence for this warming is visible in the ice core as layers of refrozen meltwater. After pooling on the surface, evidently much of the meltwater penetrated back down into the snow and refroze. There was also shrinkage around the margins of the ice sheet. According to NEEM, the mean world temperature was then about 2° Centigrade warmer than at present.[136]

The cap responded to the prolonged warmer temperatures by losing mass. According to NEEM scientists, at the start of the Eemian, the surface of the ice sheet was about 650 feet above its present height. After 6,000 years of warming, i.e., at 122,000 years BP, the surface had dropped nearly 1,100 feet and was 425 feet below its present height. Even so, during these 6,000 years of interglacial melting the Greenland ice sheet lost only about 25% of its total volume and was stable thereafter during the remainder of the Eemian.[137]

I must admit to skepticism about the interpretation of this new data. Because, although the data no doubt accurately describes conditions in northern Greenland where the NEEM ice core was taken, the attempt to generalize is not consistent with other cores recovered from central and southern Greenland. In 2003, an earlier drilling project (the North Greenland Ice Core Project, or NGRIP) recovered a

10,121 foot-long core to bedrock at a site about 174 miles south of NEEM.[138] The NGRIP site (75° 6′ N, 42° 19′ W) was located on the summit of the Greenland cap where snow accumulation is greater; for this reason the depth of the core at bedrock was much deeper. (**See Figure 2**) Yet, even at bedrock the ice core included only the last few thousand years of the Eemian.[139]

This points to extreme melting in the distant past and suggests that a major reduction of the mass of the central Greenland ice cap occurred during the Eemian. It may even have disappeared entirely.

In 1981, another 6,686-foot-deep core was recovered from a site known as DYE-3 in southern Greenland. The drill site (65° 11′ N, 43° 49′ W) was located about twenty-six miles east of the Greenland summit. At bedrock the core reached back no farther than about 90,000 years BP.[140] The total absence of ice from the Eemian points even more emphatically to the same conclusion: Melting was extreme in southern Greenland during the Eemian. It's even likely a complete deglaciation occurred.

A NEEM scientist informed me that a small amount of melting beneath the Greenland ice cap ice is normal, independent of climatic conditions. The cause is geothermal heat, and the melting is slight, only about 0.275 inches per year. At this melt rate, the sheet would lose about twenty-three vertical feet of ice every 1,000 years. The loss from below due to geothermal melting only becomes significant over long periods of time.[141]

Analysis of the NEEM core indicates that atmospheric methane spiked sharply during the Eemian, in concert with rising air temperature. No doubt, frozen methane (clathrate) deposits on shallow continental shelves and below permafrost in the polar regions were melting and getting into the atmosphere at that time, just as they are today. The process was self-limiting, however. According to NEEM scientists, once the ice sheet stabilized, for reasons that are still unclear, methane levels again dropped.[142]

Assuming the data is correct, it offers some hope that if our civilization can get its act together and transition away from carbon-based fuels to clean energy alternatives soon enough, the present spiking of atmospheric methane levels in the Arctic may subside. But we still do not understand why methane levels stabilized during the Eemian, after sharply increasing for the first 6,000 years of the interglacial.

The Eemian is also important for another reason: over the entirety of the 2 million-year-long Pleistocene the highest known sea levels occurred during this period.

One hundred twenty thousand years ago, the eustatic level of the world ocean was as much as twenty-six feet higher than at present, according to NEEM.[143] This extraordinary fact is another reason why Earth scientists were eager to recover a deep ice core from Greenland. World sea levels are predicted to rise significantly in the near future because of human-caused global warming, with flooding of coastal cities and low-lying areas. Indeed, sea level is *already* rising. It is no wonder that scientists were eager to study a historical precedent and learn from it.

In my opinion, however, this is where the present science model breaks down. I do not agree that the average world temperature was two degrees Centigrade higher during the Eemian than at present, for the same reason that I do not accept the standard view of a general planetary cooling during the LGM. I explained my reasoning in the previous chapter but it bears repeating. The eight-degree Celsius warming in Greenland during the Eemian, which I agree was real enough, has prompted Earth scientists to extrapolate incorrectly that the average world temperature for this reason must *also* have been higher. In my opinion, however, such a deduction is faulty and misinterprets the available data. At issue, I believe, is the unstated and unexamined assumption deep within the present science model that the north/south pole positions are constant and unchanging. But no natural law mandates this.

The only immutable law of Nature is that we live in a dynamic universe in which change is the only constant. Nor is there any natural law limiting the rate of change. Although we should expect change to be uniformly gradual the great majority of the time, there is no credible scientific basis for assuming that disturbance events cannot, on rare occasions, be global in extent and catastrophic in scale. As before, I will defer to archeology and allow ancient sites to point the way. The data speaks for itself.

Credit for some of the research I am about to present goes to aerospace engineer Mark Carlotto who has extensively studied the alignments of ancient pyramids and temples. While many of the ancient sites are aligned to the cardinal directions, Carlotto found (as I did) that some are not. Some, like the pyramids at Teotihuacan and Tiahuanacu, which I introduced in Chapter Four, are misaligned for reasons that archeology has failed to explain. There is no disputing the azimuths. It is easy to show that the present alignments are skewed. Any computer literate person can confirm this to his or her satisfaction using Earth mapping software.

It appears to be a mark of human civilization that our species builds cities and structures aligned to the cardinal directions. The pyramids of Giza are a prime example. Most of the pyramids and temples in Egypt that are officially dated to the Old Kingdom, from Abu Ruwash south to Meidum, are aligned to the same north-south grid as the Great Pyramid. Yet, as I have shown, a number of sites, including the mysterious displaced pyramid at the Userkaf Sun Temple at Abusir and the nameless ruin located nearby discussed in Chapter Four, were built on a different grid that is not explainable in terms of solstice or equinox points. Recently, I found another case, the pyramid complex of Sekhemkhet at Saqqara. It is also skewed west of north,and for this reason surely long pre-dates the nearby step pyramid constructed by the Pharaoh Djoser. (**See Figure 3**)

The west-of-north Egyptian alignments are plainly anomalous and deserve to be the focus of a concerted effort to unravel the circumstances of their origin. The matter should have become a hot topic yesterday!

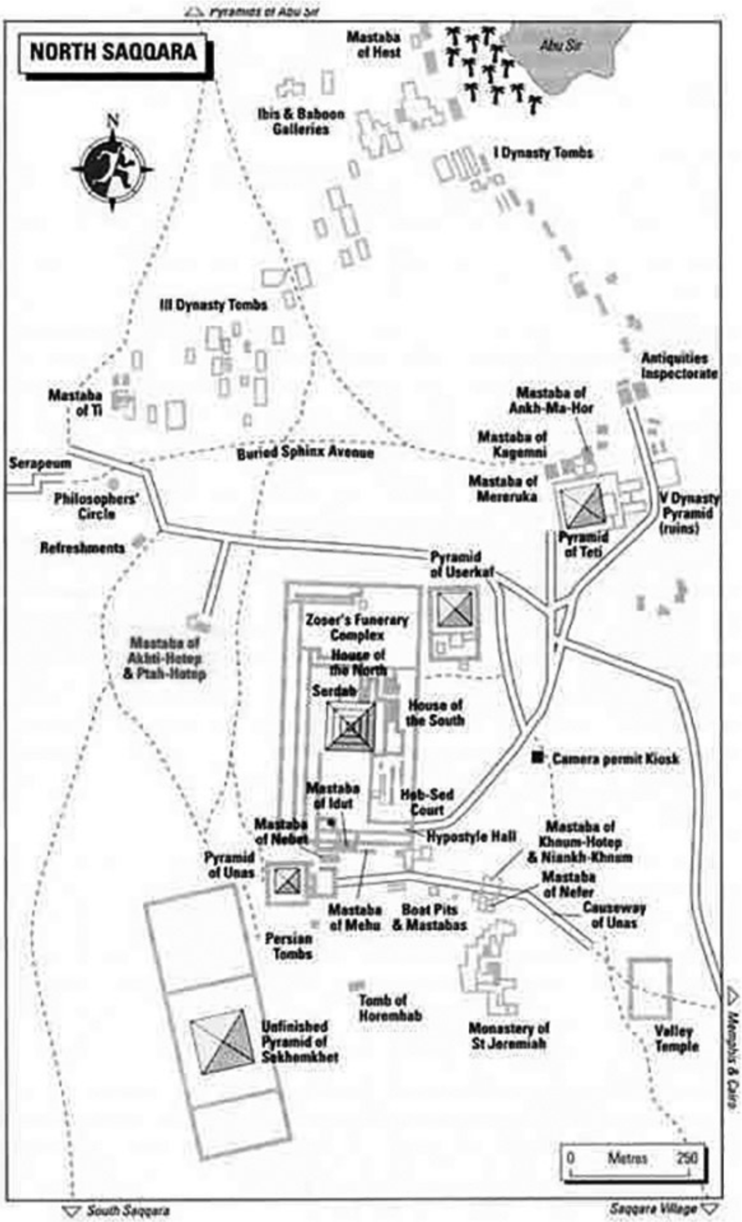


Figure 3. Map of Saqqara, Egypt showing Djoser Complex (Stepped Pyramid) aligned to current north pole and the nearby Pyramid of Sekhemkhet ruin aligned west of north (to the North Greenland pole position).
(With permission of Rough Guides)

Chapter Nine: Carlotto Revises Hapgood

In 1970, Charles Hapgood published a thoroughly revised edition of his earlier book, *Earth's Shifting Crust* (1958). Over the intervening years, Hapgood's views about crustal displacement evolved so far beyond his earlier work that he opted for a new title. The revised book was rechristened, *The Path of the Pole*. In the second volume Hapgood proposes two former North Pole positions (in addition to one in Hudson's Bay), based on the best available data at the time. The first of these pole positions was in the Canadian Yukon, the other in the Greenland Sea.

In his 2018 book, *Before Atlantis*, Mark Carlotto offers a refined placement of these pole positions "without fundamentally changing Hapgood's climate assumptions."[144] Carlotto bases the modified pole locations on archaeological data that was unavailable to Hapgood. Nor did Hapgood enjoy the many benefits of the Internet, including Google Earth. Carlotto's revision of the Greenland Sea pole position is relatively minor. He moves it closer to Norway. However, his modified placement of Hapgood's Yukon pole position in the Bering Sea represents a major change and, in my opinion, is a significant advance. As I am about to show, both of these former and successive pole positions are consistent with the faunal data recovered from Kirkdale cave and other similar boneyards in Britain and central Europe.

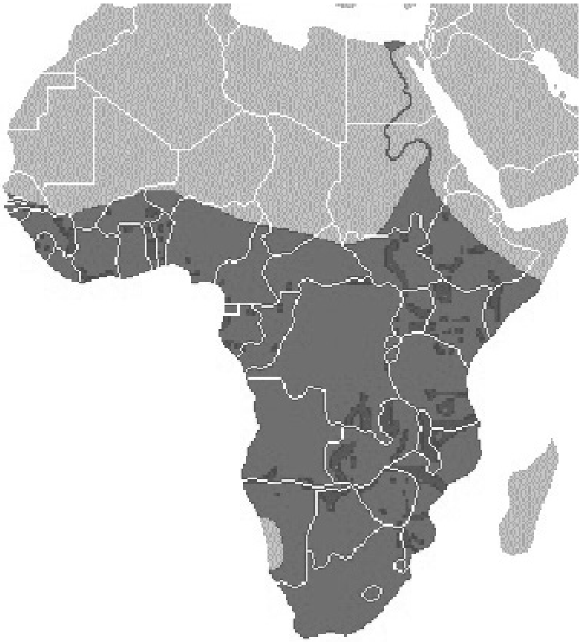


Figure 1. Map of Africa showing present range of Hippopotamus
(Courtesy of Wikipedia)

Before delving into the archaeological data, however, let us review the climatic implications of a North Pole position in the Bering Sea (at 56° 13′32.7″ N, 177° 04′43″ W) during the Eemian. Such a pole position would place Kirkdale cave and the hippo fossil site along the Elbe River, Germany at 17°–20° N latitude—in other words, well within the present day African habitat range of the hippopotamus. I have attached a map showing the current range of the species. (**See Figure 1**) The map plainly shows that but for the Sahara desert, hippos would be found today as far north as the Mediterranean.

As we know, the desertification of North Africa occurred during the Holocene, in other words, in relatively recent times. It's quite possible the Sahara did not exist during the Eemian. Even today, the valley of the Nile River affords suitable hippo habitat as far north as the Nile delta where the river empties into the Mediterranean. Although humans have extirpated the dangerous hippo (as well as the notorious Nile crocodile) downstream from the cataracts at

Aswan, suitable habitat still exists in Egypt along the Nile and but for human appropriation of the ecosystem would still support sizable populations of both species. As already noted, fossil remains of a related dwarf hippo have been found on a number of islands in the Mediterranean, which also tells us that the hippopotamus originally had a wide range and evolved to fill numerous niche habitats.[145]

Based on their analysis of the NEEM ice core data, scientists participating in the NEEM project were able to estimate the amount of ice loss due to melting of the Greenland ice cap during the Eemian. They found that Greenland can account for no more than half (and perhaps less than half) of the extraordinarily high sea stand that occurred then.

During the last interglacial, 120,000 years ago, sea levels were as much as twenty-six feet higher than today and were the highest sea levels known in the Pleistocene. Scientists concluded that melting of Antarctica must therefore be responsible for the remainder of the sea level rise at the time.[146] On this basis, they concluded (*incorrectly,* in my view) that the Eemian warming was a planet-wide phenomenon, and that world-wide temperatures averaged about two degrees Celsius higher than today. I believe they were led into this error by the limiting belief (actually, their unexamined assumption) that north and south pole positions are constant and unchanging.

I would agree that heavy melting of Antarctica contributed to the highest known sea stand during the Pleistocene, but *not because average global temperatures were two degrees Celsius higher. Rather, the high sea stand was due to the oceanic locations of both north and south pole positions.* (**See Figure 2**) As I have indicated, the North Pole position was then in the Bering Sea, and the South Pole was located in the south Atlantic, more than 950 miles from the nearest continental landmass. As we know, an ice sheet requires a continent, and will not form above open water. The textbook example is the present position of the North Pole in the midst of the Arctic ocean, which scarcely supports a seasonal ice pack, let alone a 10,000-foot-deep ice sheet.

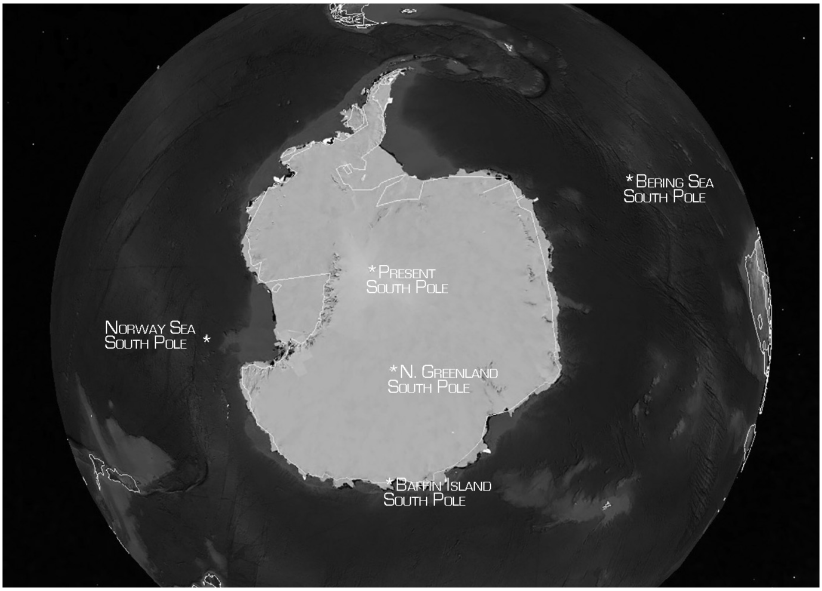


Figure 2. Map of Antarctica showing current South Pole and four previous south pole positions

(Google Earth; Image U. S. Geological Survey; US Dept of State Geographer; Data SI0, NOAA, U.S. Navy, NGA, GEBCO; Image Landsat/Copemicus. View from Space (Altitude: 6989 mi))

During the Eemian, most Antarctic polar ice melted because the South Pole was then 2,341 miles north of its present location. There was very little continental land mass within the south polar zone to accumulate new snow and ice. Moreover, a similar situation prevailed in the north polar zone. Although the Arctic Circle then included portions of East Siberia and Alaska, the pole position was in the midst of the Bering Sea. As a result, the total amount of continental landmass within the north polar zone was relatively small. Moreover, at the time, Greenland was 2,200 miles south of its present location, which easily explains the much higher average temperatures there and the heavy melting. Southern Greenland was then at 32° N, which is the latitude of Savannah, Georgia.

In light of all of this, the assertion by NEEM scientists that Greenland lost only 25% of its mass during the Interglacial cannot be correct. That might have been true in northern Greenland, which was then at the latitude of British Columbia. But Greenland is by far the largest island on Earth, and presently extends over 1,650 miles of latitude from its north tip to its southern cape. For this reason we would expect substantially higher temperatures in central and southern Greenland during the Eemian, when compared with the north.[147]

I strongly suspect that the southern Greenland ice sheet disappeared entirely during this period. Assuming, however, that NEEM scientists are correct that the polar ice caps stabilized 6,000 years into the Eemian, we still do not know why. Did the polar zones stabilize after the most vulnerable ice disappeared? Or did yet another crustal displacement event occur, the result of which moved Greenland north again? The issue is one of today's intriguing scientific mysteries and has special importance because of our present dire existential moment on a rapidly warming planet.

Carlotto's Ancient Sites

Now for the archeology: Carlotto identified the former pole position in the Bering Sea by plotting the alignments of megalithic sites in the Mediterranean, Mideast, and Peru. The Peruvian sites include Ollantaytambo, the Coricancha in Cusco, Machu Picchu, and the Chincana labyrinth on the Island of the Sun in Lake Titicaca.[148] If Carlotto is correct, all of these sites long predate the Incas and are among the oldest archaeological sites on our planet. A North Pole position in the Bering Sea would place Cusco at 19° S, which is 5.5° (377 miles) south of its present location, and would make Cusco (in Quechua: "navel of the earth") the true cradle of human civilization in South America, not Tiahuanacu as Arthur Posnansky believed.

In Chapter Four I showed that the Akapana pyramid at Tiahuanacu, Bolivia, is aligned to the former pole position on Baffin Island that was current until the end of the Pleistocene, when the earth's crust shifted 1,657 miles. If this is correct, *then Tiahuanacu must be tens of thousands of years younger than the megalithic sites in Peru, including Machu Picchu.* Although we do not yet have a precise date for the most recent crustal shift event, my Akapana alignment is consistent with Carlotto's research.

Carlotto's Peruvian alignments also include two of the famous Nazca lines, which are a mysterious assortment of geoglyphs and geometric designs located near the town of Nazca in southern Peru. Hence the name. The Nazca lines only came to light in the twentieth century after the invention of the airplane.[149] At ground level they are inconspicuous—indeed, all but invisible. Laid out over an area of about 200 square miles, they must be viewed from above to be seen clearly. Although some are complex, the manner of their construction was simple. The lines and figures were made by carefully arranging small pebbles on the surface of the desert.

There are three types. Some are simple lines that run straight as an arrow across the barren Altiplano. There are about 800 of these straight lines, and they point in various directions. The longest stretches for about fourteen miles. There are also seventy figures known as geoglyphs, which were created in the likeness of different animals, including birds, insects, and mammals. Apparently, there is even a whale. And there are 150 precise geometrical shapes.

No one knows who created the Nazca lines.[150] According to Carlotto (and this is astonishing) one of them is perfectly aligned to the Bering Sea pole position, and another is similarly aligned to the Norway Sea pole position. Carlotto's discovery of these Nazca alignments was a stroke of genius. And it should be a wake-up call to the scientific community. (**See Figure 3**)

The spot-on alignment of this Nazca line with the Bering Sea pole position surely means this line must date to roughly 120,000 years BP. It dates, in other words, to the last Interglacial. Carlotto also found evidence that the lines are integrated with the layout of Machu Picchu and other megalithic sites in and around Cusco. If he is correct, this would make the incredible polygonal walls at Cusco, Machu Picchu, and Ollantaytambo vastly older than anyone has dared to imagine. The mind reels at such antiquity. How many state-of-the-art structures built in our time will be standing and still serviceable 10,000 years from now, let alone 120,000? None, I would wager.

According to Carlotto, one of the straight Nazca lines points to Cusco. However, when I checked it, I found that

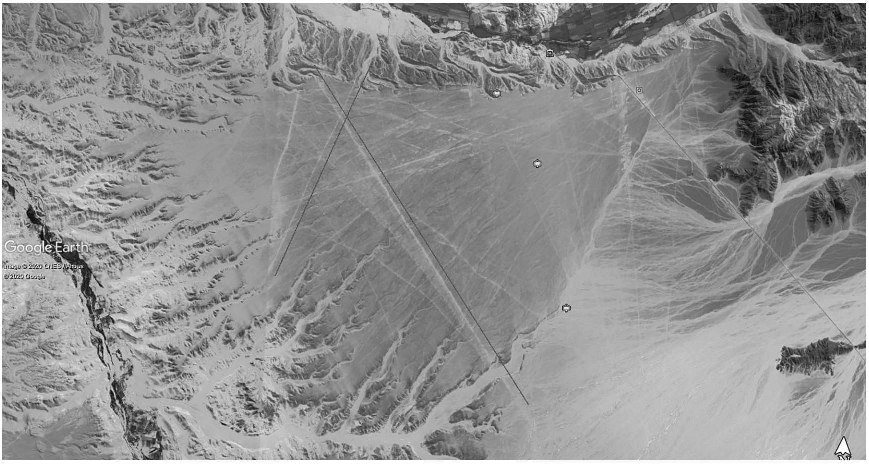


Figure 3. Nazca lines pointing to Bering Sea and Norway Sea north pole positions.
(Google Earth; Image ©2020 CNES/Airbus; ©2020 Google.)

it actually points to the nearby town of Pisac, which also boasts some extremely well-constructed megalithic walls and structures. In any event, the line does appear to confirm a historic link between Nazca and Peru's megalithic sites.

Before I move on to Carlotto's other alignments, I need to mention another reason why I launched this book with a discussion of Charles Darwin's epic voyage of the Beagle. Irrespective of whether Darwin's failure to visit Cusco was due to benign neglect or insuperable logistical difficulties, the omission was of incalculable significance from the standpoint of science. If Darwin had visited Cusco, I feel strongly that he would have arrived at some rather different conclusions, and these would have had important consequences. On his return to England, Darwin would have informed his scientific colleagues about Cusco's nearly indestructible earthquake-proof polygonal walls. "Informed" is an understatement.

My wording here is intentionally conservative. It would be hard to exaggerate the emotional and psychological impact of those walls on an open-minded Westerner. I myself have seen nothing comparable, apart from a few sites in Egypt, including the Osireon at Abydos and the Valley Temple at Giza.

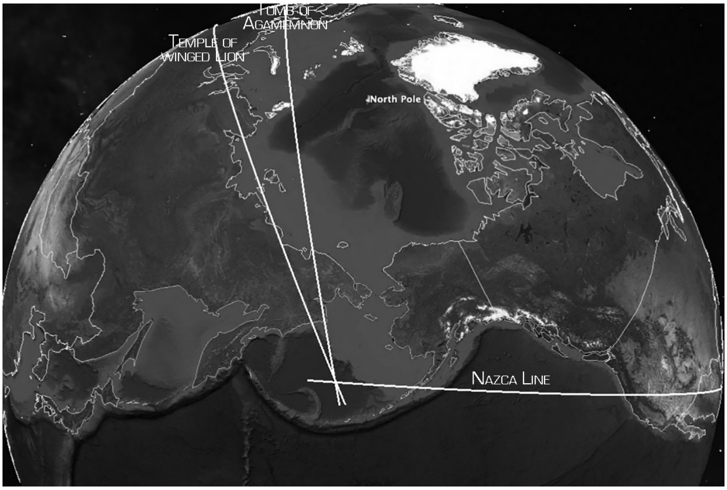


Figure 4. Plot of the three most accurate alignments to the Bering Sea north pole position. From left to right: Temple of the Winged Lion, Tomb of Agamemnon, and Nazca line

(Google Earth; US Dept of State Geographer; ©2020 Google; Image Landsat/ Copemicus; Data SI0, NOAA, U.S. Navy, NGA, GEBCO; View from Space (Altitude: 4856 mi))

The fact that Machu Picchu was not yet known to Europeans in the 19th century (at the time of Darwin's voyage) in no way alters this estimation. The megalithic walls of Ollantaytambo, the Coricancha, Sacsaywaman, and many other sites, including Pisac, as noted, were known and are equally impressive. Who can say? Perhaps Lyell and others would have been persuaded to make the expensive, arduous and, at that time, perilous journey to South America to see for themselves. At very least, Cusco would have enriched Darwin's voyage of discovery beyond measure, thereby influencing the trajectory of science. Today, we would live in a more enlightened world than is presently the case.

Carlotto also identified several sites in the Mediterranean and Mideast, **(See figure 4)** which are also aligned to the Bering Sea pole. One of the most impressive is Temple of the Winged Lion at Petra, Jordan.[151] I already knew from my own research about Petra's historical importance as a trading hub. The city was one of the western termini of the famed Silk Road that reached from Palestine to the Far East. But I never guessed that Petra might pre-date the pyramids of

Giza. The scholar Dan Gibson thinks Petra was the original spiritual center of the Nabataean people, and he claims that, before the rise of Islam, all mosques were aligned to Petra.[152]

When Carlotto studied the alignments of several of the oldest known mosques using Google Earth Pro, he found this indeed to be the case. If Carlotto and Gibson are correct, the Nabataean culture is vastly older than any of us have imagined. At the time of a Bering Sea North Pole position, Petra would have been on the Equator. Could it actually date to 120,000 years BP?

Another site aligned to the Bering Sea pole is the famed palace of Knossos on Crete, first excavated in 1900-1905 by Sir Arthur Evans, who drew his inspiration from Heinrich Schliemann's work at Mycenae and Troy, based on Homer. Using the earth mapping software, I confirmed that Knossos is aligned ~12° east of north, and definitely points to the Bering Sea pole position.[153]

Another of Carlotto's ancient sites is the famous Tomb of Agamemnon in Greece, the entrance of which is a descending avenue weirdly oriented 11° north of west. Carlotto conjectures that the tomb was originally aligned to the Bering Sea pole, in which case the entrance once faced due east.[154] When I plotted these alignments, including Nazca, the palace of Knossos, the Tomb of Agamemnon and the Temple of the Winged Lion, I found they are tightly grouped, within an error of only about ten to fifteen miles.

Carlotto also proposes that two Egyptian sites, the Amun temple at Dangeil, Sudan, and another at Siwa, Egypt, are similarly aligned to the Bering Sea pole.[155]

A simple test could determine if Carlotto's pole position in the Bering Sea is correct. An ice drilling expedition should be organized, as soon as possible, and dispatched to the Alaska Range. If Carlotto is right, an ice core taken to bedrock from the deepest ice field on Mt. Denali will show that Alaska was in the grip of an ice age at the time of the Eemian interglacial in Europe.

In that case, Charles Hapgood will have reached out from the grave to overthrow the prevailing Earth-climate model. Unfortunately, none of the ice cores so far recovered from Alaskan glaciers date to before the Holocene. Snow accumulation is heavy in the Alaska Range, and even the deepest cores taken, thus far, date back only a few thousand years.[156]

The Norway Sea Pole Position

Carlotto's proposed North Pole position in the Norway Sea, located about 214 miles from the Norwegian coast (69° 4′40″ N, 05° 54′55″ E), easily accounts for the European Ice Age. This pole position would place Kirkdale cave in Yorkshire, England, more than 300 miles north of the Arctic Circle, well within the polar zone. The same is true of central Europe. This would account for the fossils of the northern faunal group recovered in the cave deposits of Britain and on the continent. Is it mere coincidence that this pole position also happens to be at the precise center of the estimated maximum extent of the European ice cap? No, I think not. (**See Figures 5 and 6**)

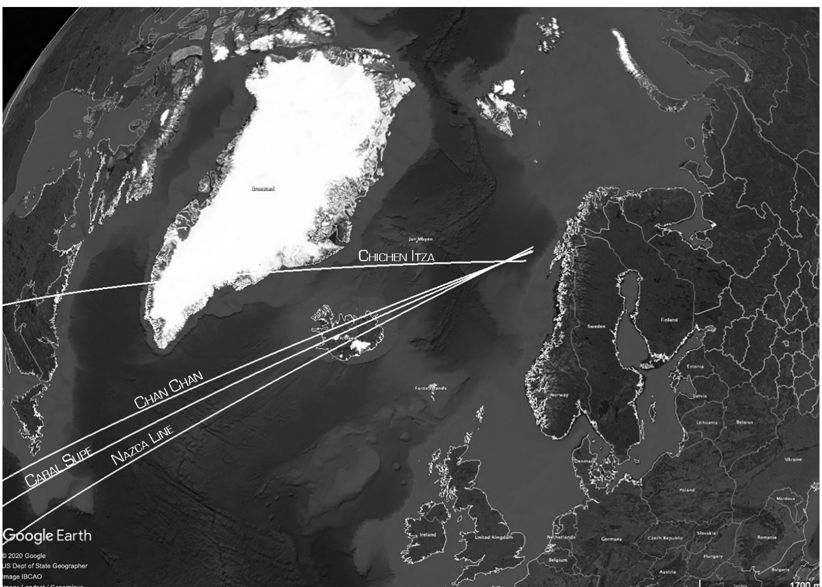


Figure 5. Plot of four ancient alignments to the Norway Sea north pole position. From left to right: Chichen Itza, Chan Chan, Caral Supe, and Nazca line.

(Google Earth; Image Landsat/Copemicus; Data SI0, NOAA, U.S. Navy; NGA, GEBCO; ©2020 Google)

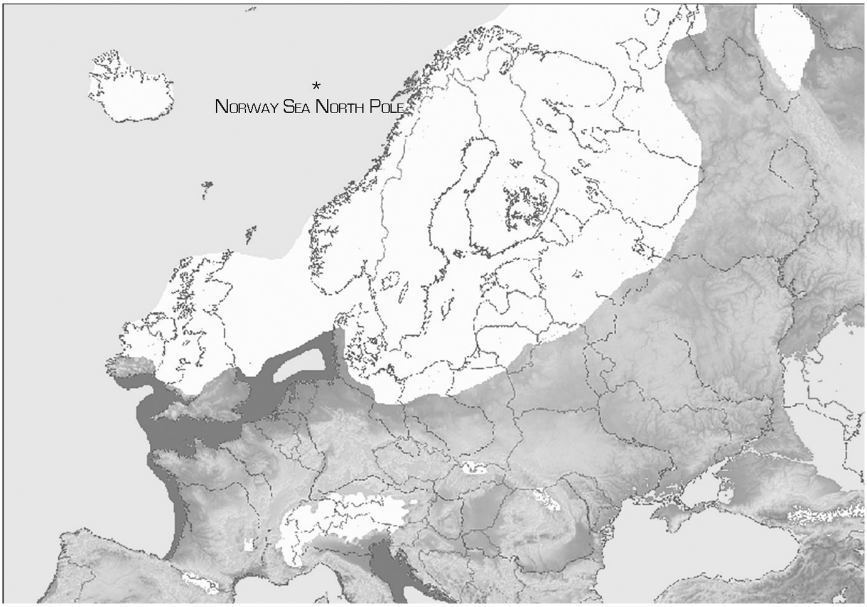


Figure 6. Map showing the extent of the ice sheet during the European Ice Age. (Wikipedia)

Carlotto found that numerous archaeological sites in the Americas are aligned to this pole position.[157] When I plotted four of them I was blown away. Figure 5 shows the perfect matching alignments (from left to right) of Chichen Itza, Yucatan, Chan Chan, Peru, Caral Supe, Peru, and at far right the *other* Nazca line, that I already mentioned. Before reading Carlotto's book, I had never heard of Chan Chan and was only peripherally aware of Caral Supe. The spot-on match prompted me to familiarize myself with these two sites, which are among the oldest in Peru. Both are located along the desert coast.

The vast scale of Chan Chan, near present-day Trujillo, is a certain indicator of its historical importance. The city's urban center was sixteen square miles, which is impressive enough. But the city as a whole sprawled far beyond this core area, totaling about 140 square miles. Caral Supe, located 120 miles north of Lima, was smaller, though still large, and occupied more than thirty-five square miles. The impressive size of these ancient cities indicates that the coast of Peru, like the region around Lake Titicaca, once supported a much larger population than at present. According to Carlotto, several lesser archaeological sites in Peru are also aligned to Caral Supe in the same way Arab mosques were formerly aligned to Petra—another indicator of its importance. These associated alignments plainly document the existence of incredibly ancient civilizations in South America about which we moderns know almost nothing.

During his five-year epic voyage abroad the HMS Beagle, Charles Darwin visited the desert coast of both Chile and Peru, including native ruins in the Atacama Desert where local residents told him they had found old corn cobs, evidence of past agriculture.[158] Darwin describes his puzzlement on learning about this, and his shock at finding ruined structures built of adobe, i.e. mud, despite the total absence of water within many miles.

The coast of Peru and Chile, especially the Atacama, is one of the driest places on Earth. Darwin also saw dry riverbeds, evidence of former rivers flowing out of the Andes, and he conjectures in his memoir that the recent rise of the Andes perhaps altered the climate for the worse, or otherwise negatively impacted the water table. Evidently it never occurred to Darwin that the sites he found so puzzling might once have been located many miles to the north, perhaps at the latitude of present-day Ecuador where rainfall is plentiful, agriculture general, and adobe construction commonplace.

The four sites plotted in Figure 5 are as perfect a match as the pyramids of Teotihuacan and Tiahuanacu discussed in Chapters Four and Five. I showed that both are spot on (and synchronized) with the extralimital mollusk data set. *But Carlotto's plot is even more impressive because it includes not two, but four alignments.* Indeed, the match is spectacular, a thing of beauty, and it cannot be due to coincidence.

Carlotto also mentions a fifth site, the ancient Brihadisvara Temple located at Thanjavur in south India. However, when I checked the alignment, I found it to be less accurate.

To summarize: The archaeological and fossil evidence for two former pole positions in the Bering Sea and Norway Sea is compelling. This new evidence shows beyond any doubt that the natural history of our planet and our own human history are inseparably linked. Obviously our understanding of both stands in drastic need of revision. Mainstream archeology has scarcely guessed at the actual antiquity of human civilization. High civilizations have plainly co-existed on our planet alongside more primitive hunting and gathering societies for tens of thousands of years. The estimated age of the previously unknown high culture on the coast of Peru and in Petra is 83,000 years BP, based on isotopic dating by Sutcliffe et al. of wolverine remains from Stump Cross Caverns in north England.[159] This also dates the European Ice Age.

But Petra and Cusco are much older than this, possibly by as much as 30,000–40,000 years.

The perfect alignment of Chichen Itza with the Norway Sea pole also tells us that the ancestor civilization to the Mayans likewise dates to extreme antiquity.

Obviously I was mistaken in Chapter Four when I concluded that the pyramids at Teotihuacan are the oldest structures in Central America. Not so. The perfect alignment of Chichen Itza with the Norway Sea pole indicates that Chichen Itza is vastly older than Teotihuacan. The ancestors of the Mayans plainly long predated the Toltecs and Aztecs.

I was also mistaken in my conjecture that earthquakes or local tectonic movements account for the alignment groupings identified by Anthony Aveni. It is more likely that the alignments vary because some of them were originally aligned to a previous pole position. Evidently, the slippage of the earth's crust occurs at a much deeper level, far below the shallow lithosphere.

Chapter Ten:
Gaffney revises Carlotto

In his 2018 book *Before Atlantis*, aerospace engineer Mark Carlotto presents a model for human history spanning the last 120,000 years. The framework includes four successive world ages, each truly apocalyptic because it begins and ends with a displacement of the earth's crust. Human civilization rises from the ashes of the former age, develops slowly to maturity, and blossoms into a high society that flourishes for a time. Yet each ends in collapse, the result of another cataclysmic shift of the earth's crust.

If Carlotto is correct, at least four successive world ages have arisen and fallen in this way, each corresponding with a different North Pole position. In chronological order, these are: the Bering Sea pole (120,000 years BP); the Norway Sea pole; the North Greenland pole; and, finally, the Hudson's Bay pole (starting about 50,000 years BP). According to Carlotto, the fourth and most recent pole position in Hudson's Bay was current throughout MIS-3 and MIS-2 (the LGM), until a crustal displacement event at the end of the Pleistocene moved the pole to its present location in the Arctic Ocean. That cataclysmic Earth change ushered in the present world age, usually known as the Holocene, though some now refer to it as the Anthropocene.

Figure 1. Photo taken in April 2019 showing the Temple of Dendera, Egypt, built upon a former temple. One of our guides told us it was customary in the ancient world for pilgrims to scratch particles from the wall of a devotional site, then take the scrapings home and add it to their bread. Hence the scoop marks.

Carlotto's model is elegant in its simplicity and is based on dozens of carefully plotted archaeological alignments. He believes that ancient sites were often aligned to the cardinal directions and subsequent reconstructions typically preserved the original orientation. I agree with this view. During a recent two-week tour of ancient sites in Egypt, I visited several temples that very plainly had been rebuilt upon older foundations. (**See Figure 1**) Although alignment accuracy varies widely from site to site, in some cases the matches are remarkably accurate, even spot on.

I believe these spectacular alignments are powerful evidence of a former high civilization.

As noted in the previous discussion, Carlotto has thoughtfully revised two of the pole positions originally proposed by Charles Hapgood (one in the Yukon, the other in the Greenland Sea) without compromising the climatic data. His revisions are an important advance over Hapgood's work. Carlotto also introduced a fourth pole position (in North Greenland) that was unknown to Hapgood, based on a wealth of archaeological data. This is another major contribution.

I agree with Carlotto's historical framework based on cataclysmic Earth changes. However, I propose a few additional modifications. As noted, I disagree with Carlotto's placement of the fourth pole position in Hudson's Bay. In Chapter Four I identified an alternative location on Baffin Island, based on multiple lines of evidence including archaeological data *and* extralimital mollusk data. I stand by this research.

Compelling evidence published in 2001 also suggests that Carlotto's North Greenland pole position is out of sequence. This data indicates that the North Greenland pole position preceded the Norway Sea pole position. In a moment, I will discuss this important evidence. Here then, in brief, is my revised sequence of pole positions (and world ages), starting with the oldest, spanning the last 120,000 years: The Bering Sea pole, the North Greenland pole, the Norway Sea pole, the Baffin Island pole, and finally, our present pole in the Arctic Sea.

The Bone Caves Revisited

Throughout the 20th century and in recent years, excavation work continued in the bone caves of England and Europe. Improved methodologies enabled scientists to take stratigraphic analysis to the next level. The fossil record turned out to be much more complex than was originally believed. The initial resolution of faunal assemblages into southern and northern species was further differentiated. As of today, scientists have identified five separate and distinct faunal groupings, the so-called mammalian assemblages (the technical term is Mammal Assemblage Zones, or MAZs), each one representative of a distinctly different stratigraphic bed with its associated climate. The faunal assemblages (based on the stratigraphy of the caves) thusly determine the climatic sequence. Scientists have named the mammalian assemblages after the cave or site that is most representative of each.

What researchers have failed to recognize thus far, however, and what I am introducing in this chapter, is the revelatory idea that each of these five assemblages (together with its unique and corresponding climate) *also correlates with a former pole position.* In other words, the stratigraphic research that continued in the bone caves over the nearly 200-year-period since Buckland visited Kirkdale Cave adds up to a compelling case for a series of crustal displacement events during the last 120,000 years. Science has come full circle and now supports Charles Hapgood! The climatic sequence mirrors the successive pole positions. If I am right, the stage has been set for a next round of discoveries in the near future that will blow our minds.

Before I discuss the assemblages, however, I need to express a huge debt of thanks to the interdisciplinary team responsible for this outstanding research. Mabs Gilmour, the late Andrew Currant, the late Roger Jacobi, and Chris Stringer have yet to receive the recognition they deserve for some fine work. Their synthesis was the result of decades of meticulous research and, in my humble opinion, was deserving of a Nobel Prize. These scientists (and others who preceded them) spent untold hours on their hands and knees in the cramped quarters of damp and dark bone caves sifting through the stratigraphic record, trying to make sense of it all.

They also reviewed earlier fossil studies. The leaders of the team, Andrew Currant and Roger Jacobi, both since deceased, summarized their findings in a 2001 paper that is essential reading for this discussion. For the reader's convenience, I have obtained permission to attach their important paper at the end of this book. (**See the Appendix**) I encourage readers to become familiar with it.

Credit also goes to a Ukrainian scientist, I.G. Pidoplichko, who developed a similar approach as early as the 1950s. Pidoplichko's papers are in Ukrainian and Russian, however, so are not easily accessible.[160]

Currant and Jacobi succeeded in obtaining isotopic dates from the sites I am about to discuss. Fossils recovered from cave stalagmites were isotopically dated using the uranium method. The good news is that these flow-stone (or speleothem) dates are more accurate than similarly dated fossils from open sites exposed to the elements. The isotopic dates from the bone caves now provide a sound basis for determining the proper chronology of pole positions over the last 120,000 years.

This means we can now properly date the European Ice Age and the different ages of man—an exciting prospect! The empirical evidence supports Carlotto's model of successive world ages. For the first time since the dawn of archeology, we are on the threshold of reconstructing the deep history of our species.

I already discussed the faunal assemblage from Kirkdale cave, in Chapter Eight.[161] The by-now familiar assemblage was the first to be identified in the early days of cave exploration, and it features the unique combination of the hippopotamus, spotted hyena, and straight-tusked elephant. This subtropical faunal group is presently known as the Joint-Mitnor Cave MAZ, after the most exemplary cave deposit. Currant and Jacobi's 2001 paper includes a list of the associated species. (**See the Appendix, Table 1**) Henceforth, I will reference the species lists and sites presented in their paper.

The Joint-Mitnor Cave MAZ dates to the Eemian, or last Interglacial, 120,000 years BP, when Britain was isolated from Europe by the highest sea stand known during the Pleistocene. As noted, this faunal group is an excellent fit with Carlotto's Bering Sea pole position, placing Kirkdale Cave at a latitude of ~20° N. At the time, a warm to subtropical climate prevailed in Britain, much like that of north Africa today.

Out of Sequence

The second assemblage, the Bacon-Hole MAZ, dates to a later period when Britain enjoyed a temperate climate. Although eleven species from the former MAZ, including the spotted hyena, persist, notably, the hippo has now dropped out. (**See Appendix One, Table 2**). The presence of the northern vole (*Microtus oeconomus*) also distinguishes this assemblage from the preceding one and indicates a cooler climate. So does the appearance of the woolly mammoth (*Mammuthus primigenius*), which also means that a land bridge joined Britain and Europe during this time. The land bridge indicates a substantial drop in sea level, which is consistent with the slow accumulation of an ice sheet centered around the new North Pole position in North Greenland.[162] A new ice cap was also forming around the new South Pole position on the landmass of Antarctica. As these ice caps developed, the former high sea stand of the Eemian receded.

The temperate climate in Britain associated with this assemblage, however, is at odds with Carlotto's sequence of world ages and pole positions. Carlotto places the Norway Sea pole before the North Greenland pole. Notice, this implies a huge ~3,790 mile displacement of the crust from the Bering Sea pole to the Norway Sea pole, which would have plunged Europe into an ice age.[163] Had it occurred, such a displacement would have been more than twice as great as the most recent 1,657 mile movement of the former pole on Baffin Island to its present location. The cataclysmic scale of such an Earth change is beyond reckoning and would have brought our species to its knees.

The stratigraphy, however, determines the proper chronology. A North Pole position in the Norway Sea would place Kirkdale Cave at a latitude of 75° N, indicating a sub-arctic climate. But this is incompatible with the presence of the spotted hyena in the UK during this period. The hyena was (and continues to be) an opportunistic and highly adaptable species. During the Pleistocene it flourished in tropical and subtropical Africa (as it still does today), and evidently also managed to do just fine in temperate Europe. But the hyena is most definitely not a sub-arctic species.

Mabs Gilmour obtained an isotopic date of 87,000 years BP (with only a small margin of error) for a fossil removed from a stalagmite deposited directly above the Bacon-Hole faunal deposit, thereby providing a minimum date for this assemblage.[164] The date leaves no doubt about the proper sequence and places the Bacon-Hole assemblage *after* the Bering Sea pole position. Carlotto's placement must therefore be out of sequence.

Recently, I introduced Carlotto to Currant and Jacobi's 2001 paper. After reviewing it, Carlotto was persuaded and modified his sequence of pole positions accordingly.[165]

The third mammalian assemblage, known as the Banwell Cave MAZ, correlates climatically with Carlotto's Norway Sea pole position and the European Ice Age. This faunal group is consistent though less diverse and includes a number of species presently found at higher latitudes in North America. (**See the Appendix, Tables 3 and 4**). The remains of bison and reindeer dominate these cave deposits. But the assemblage also includes Arctic fox, wolverine, brown bear, and northern vole. The sheer abundance of fossils and the large number of sites associated with this MAZ indicate a stable faunal community over a substantial time frame.

Scientists have selected Banwell Cave as the defining locality for this assemblage. During this period, sea level had risen again. Britain was isolated and endured a much colder climate than before.

Currant and Jacobi describe the climatic change from Bacon Hole to Banwell Cave, as follows: "We consider the change from the apparently temperate fauna represented by the Bacon Hole mammal assemblage-zone to the apparently boreal fauna represented by the Banwell Bone Cave mammal assemblage-zone to be a major event. Here we see a fundamental switch from a temperate grassland fauna to one that would normally be interpreted as a cold stage fauna."[166] In short, the stratigraphy is consistent with a cataclysmic Earth change event.

In the previous chapter, I mentioned that wolverine bones from Stump Cross Cavern, which is also representative of this assemblage, were isotopically dated to 83,000 years BP.[167] Unfortunately, that date is marred by a 6,000-year (plus/minus) margin of uncertainty. The good news is that the interdisciplinary team was able to obtain a more reliable isotopic date of 73,856 years BP from the same stalagmite, with a much smaller margin of error.[168] The flowstone sample was taken directly above a wolverine tooth, thereby providing an estimate for the European Ice Age.

At first blush, the Norway Sea pole implies an oddity: a glacial maximum in Europe contemporaneous with a relatively high global sea stand. Aren't the two contradictory? Don't we normally associate a high sea level with a warm interglacial like the Eemian? *Yes, we do, but only because of our bad habit of assuming that pole positions are fixed and unchanging.* Here, the problem is not the natural world, but our false frame of reference based on unfounded assumptions that we take for granted. A false frame of reference will bias our thinking and lead us into error nearly every time. In this case, the therapeutic antidote is a new spatial awareness.

The matter is easily explained. The European ice age was contemporaneous with a relatively high sea stand because, as during the Eemian Interglacial, both north and south pole positions were then "at sea." (**See Figure 2, Chapter Nine, page 116**) As a result, there was relatively little continental landmass within the two polar zones (though more than during the Eemian), hence, a reduced opportunity for polar ice caps to form. We need only remind ourselves that an ice age is always happening somewhere on our planet. Is it really so surprising that the "somewhere" invariably turns out to be within the polar zones? Although vegetation and climatic zones are a constant feature of our planet, the position of continental land masses in relation to these zones is not irrevocable. As landmasses shift in sync with pole changes, climatic and vegetation zones reconstitute themselves accordingly. In Chapter Thirteen I will present compelling evidence that just such a vegetation shift occurred in Siberia at the end of the Pleistocene.

The fourth mammalian assemblage is named after the faunal bed at Pin Hole, Creswell Crags, in Derbyshire. (**See the Appendix, Table 5**) According to Currant and Jacobi, one of the beds in Pin Hole Cave yielded isotopic dates between 38,000 and 50,000 years BP.[169] This assemblage features continental species such as the woolly mammoth, horse, and woolly rhinoceros, indicating that global sea level had fallen decisively. A land bridge once again connected Britain with Europe during this period.

The spotted hyena is present again in abundance.

Crucially, a dozen hyena fossils from five different sites in the Creswell Crags area produced radiocarbon dates ranging from 42,000 years BP (plus or minus 3,000 years) to 22,880 years BP (plus or minus 240 years), confirming the spotted hyena's continuous and ubiquitous presence in Britain over this long time frame.[170] (**See the Appendix, Table 6**) A similar range of radiocarbon dated spotted hyena fossils from various locations in central Europe shows that the species was also abundant on the continent.[171] In a moment, I will explain why this evidence is so important.

The fifth and final assemblage dates to the transition period between Late Pleistocene and Holocene, i.e., 12,900–9,900 years BP, and is distinguished by the presence of humans in a very definable hunting context.[172] This mammalian assemblage has been termed the Gough's Cave MAZ after the most representative site. The mammalian fauna from Gough's Cave is similar to the Pin-Hole fauna that precedes it, except that now bison, spotted hyena, and woolly rhinoceros have dropped out of the assemblage.

The presence of the woolly mammoth at this stage is now only artifactual. There is evidence of butchery and deliberate breakage. So, it is possible that humans transported the mammoth bones into the cave.

At this time, the huge Laurentide ice sheet over North America was melting rapidly and sea levels were rising. Britain was already or would soon become an island. The rising seas may have isolated a residual mammoth population in Britain, which was able to persist for a time, until humans hunted it to extinction. The local extirpation, however, does not mean that human hunting brought about the final extinction of the mammoth. I will cover this issue in more detail in a later discussion.

Here, then, is my final chronological sequence of pole positions, correlated with mammalian assemblages and climate. It is important to realize that although the isotopically dated fossils provide the proper sequence and "put us in the ballpark" with respect to each world age (and pole position), they are of no help in dating the actual crustal displacement events. The dates bracketing the ages (in the second column) are estimates only.

Chronological Sequence of Pole Positions

Joint-Mitnor	130,000 - 111,000 yrs BP	Bering Sea Pole	Eemian - subtropical
Bacon Hole	110,000 - ~80,000 yrs BP	N. Greenland Pole	temperate
Banwell Cave	~79,000 - ~50,000 yrs BP	Norway Sea Pole	European Ice Age
Pin Hole & Dimlington	~49,000 - ~11,500 yrs BP	Baffin Island Pole	temperate
Gough's Cave			Holocene

Ruling Out a Contemporaneous Ice Age

Although some scientists have glossed over the fact,[173] the well-documented presence of the spotted hyena in Britain and central Europe during the early part of the LGM is an insuperable problem for the present Earth-climate model. Although the spotted hyena is an opportunistic species and flourishes across a wide range of habitats and climatic zones, from temperate to subtropical and tropical, there is no possibility the spotted hyena could have survived the European Ice Age. Therefore, the confirmed presence of the spotted hyena in Britain and central Europe during the LGM is anomalous from the standpoint of the present science model, and supports my earlier contention that the North American and European Ice Ages were successive, not contemporaneous.

A wealth of other data from northern Europe points to the same conclusion. For example, during the late 20th century, scientists discovered rich faunal deposits in two marine caves at Hamnsundhelleren and Skjonghelleren along the Norwegian coast. These faunal assemblages include bones of reindeer (*Rangifer tarandis*) and ptarmigan (*Lagopus*). The presence of these two species means the Norway coast was ice free between 50,000–30,000 years BP.

Ice free conditions also prevailed inland. Recently, two musk oxen vertebrae from south central Norway were radiocarbon dated to 41,000–36,000 years BP (to a 95.4%

probability). This means central Norway was unglaciated at this time. The non-fossilized bones were found in 1913 during construction of the Dovre railway line at Innset (62° 43′ N, 9° 58″ E), and had been in storage at the Paleontological Museum in Oslo. Recently, Anne Karin Hufthammer, a museum official, re-examined the bones, obtained samples and arranged for them to be carbon dated.[174]

In 2011, a team led by Pirkko Ukkonen, a scientist at the Finnish Museum of Natural History, reviewed all of the known mammoth remains from northern Europe. The dataset includes 402 specimens from Sweden, Denmark, Germany, Poland, Lithuania, Latvia, Estonia, and Finland.[175] Out of this total, 128 specimens had been isotopically dated, the oldest dating to ~50,000 years BP. One of them in particular stands out.

Ukkonen carbon dated a molar from a woolly mammoth (*Mammuthus primigenius*), taken from a partial skeleton recovered in a gravel deposit at Pilgrimstadt in central Sweden, to 25,900 years BP (plus or minus 200 years), which is approximately the start of the LGM. Discovery of the partial skeleton was first reported in 1945. The molar is the youngest specimen recovered, to date, from the Pilgrimstadt site, and the most northerly mammoth specimen ever found in Sweden or Norway. Assuming the date is accurate, the presence of the woolly mammoth in central Sweden at the start of the LGM points to ice-free conditions at this time. Although experts now agree that the mammoth evolved some cold adaptations, it was a temperate species, not an Arctic one.

The fossil record indicates that the mammoth steppe not only included parts of Sweden, but also Denmark, Germany, Poland, and the Baltics (including much of the Baltic Sea, which was then dry land). Evidently it even extended to Finland, judging from at least ten mammoth specimens recovered from various Finnish sites. These include tusks, molars, and several large bones: a humerus, an ulna, and a femur.

A molar unearthed at Nilsia in 1873 yielded a radiocarbon date of 22,420 years BP (plus/minus 315 years), which, if accurate, is extremely important due to the location. Nilsia is in central Finland at a latitude of 63° N, well within the core area of the Scandinavian ice sheet that supposedly reached its maximum extent between 26,000–19,000 years BP.[176] The anomalous presence of a mammoth in central Finland at this time is therefore a major problem for the current ice age model, which assumes contemporaneous ice ages in North America and Europe during the LGM.

But the most northerly mammoth specimen ever found in Europe is a molar discovered in 1750 at Lijoki, Finland. Lijoki is located on the Arctic Circle and is north of the Bay of Bothnia. The molar was radiocarbon dated to 31,970 years BP (plus/minus 900 years). Assuming the date is accurate, this means that northern Finland was ice free at this time.

A 2007 paper by a team of geologists summarizes a core drilling operation in the Sokli basin in Finnish Lapland (67° 48′N, 29° 18′ E).[177] Sokli is a rarity because it is one of only two sedimentary deposits in western Europe (the other being Oerel in northern Germany) with a continuous stratigraphic record all the way back to the Eemian. The drill site is located north of the Arctic Circle, well within the permafrost zone, and was supposedly covered by the Scandinavian ice sheet during the LGM. Yet, the authors were able to recover a series of undisturbed 100-foot deep sediment cores documenting five major climate cycles, including every climate change since the Eemian interglacial. A large ice sheet will generally abrade, crush, erode, or otherwise destroy whatever lies beneath it. But nothing like this happened at Sokli.

The authors attribute the preservation of the local stratigraphy to unique bedrock conditions, *and* to a fluke: "limited glacial erosion due to low ice velocities." It so happened that the Sokli basin was located, by chance, on the glacial divide, at precisely the point where little or no underlying movement of the Scandinavian ice sheet occurred. Although this may be true, the case also points to milder conditions and a much more limited glaciation in northern Europe during the LGM than we have been led to believe. It is even possible there was no ice sheet whatsoever at Sokli at this time.

Other recent investigators arrived at a similar conclusion. One team led by botanist Helena Alexanderson re-excavated the Pilgrimstadt gravel site in central Sweden and collected ten samples of mineral and organic rich sediments. They chose Pilgrimstadt because its central location "has implications for the Scandinavian ice sheet as a whole."[178] The samples were dated using the Optical Stimulated Luminescence (OSL) method. Formerly, the site had been assigned an Early Weichselian date of 74,000 years BP. But the new OSL average sample date of 44,000 years BP (plus or minus 6,000 years) means the deposits could be 30,000 years younger.

If the younger date holds up, the sediments at Pilgrimstadt correlate with one of the warmest and/or longest interstadials in Greenland and northern Europe during MIS-3. The OSL data from Pilgrimstadt is important because of its location within the supposed core area of the European ice sheet. In the authors' own words: "An ice-free Pilgrimstadt at ~50,000–40,000 years BP requires that the Scandinavian ice sheet at that time was restricted, possibly limited to the highest mountains, i.e., much smaller than previously believed."[179]

This accords with recently published work by other investigators and research teams.[180] In 2012, for example, a team of three geologists dated a sediment-sequence at Idre in west-central Sweden also using the OSL method. The geologists determined that the glacial sediments had been deposited during a deglaciation (meaning: ice free) phase no earlier than 41,000 years BP.[181] Their conclusion: Central Sweden was ice free for a prolonged period during MIS-3, i.e., between 50,000–30,000 years BP.

These findings are consistent with a revised model of successive pole positions in the Norway Sea and on Baffin Island. For example, Pilgrimstadt, Sweden, presently at a latitude of 63°, was truly in the deep freeze during the European Ice Age. It was then just 495 miles from the North Pole in the Norway Sea. After a crustal displacement moved the pole to Baffin Island, Pilgrimstadt was at a latitude of ~57° N, 416 miles *south* of its present location. This means that central Sweden actually enjoyed a warmer climate during the LGM than at present! I am well aware that some readers may find this conclusion controversial and hard to accept. In my defense, I simply remind the reader that glacial moraines and erratic rocks are extremely difficult to date absolutely. It is one of the primary reasons why our current model of the Ice Ages is in disarray, largely based, as it is, on conjecture and guesswork, not to mention the standard unsupported assumption that pole positions are immutable.

The above findings support the view of Currant and Jacobi's interdisciplinary team that a continental climate prevailed in Britain during the lengthy period of the Pin-Hole MAZ, including the LGM, when the pole was located on Baffin Island. At this time, Kirkdale cave (56° N) and Pilgrimstadt, Sweden (57° N), both enjoyed a similar temperate climate. England was then the western outpost of a vast steppe ecosystem that included northern Europe and reached all the way across Asia to Alaska. The steppe featured large herds of woolly mammoths, woolly rhinoceros, wild horse, bison, reindeer, and other extinct megafauna. The Baffin Island pole position also explains the ubiquitous presence of the spotted hyena in Britain and central Europe.

In Chapters Twelve through Fourteen, I will examine the mammoth steppe in much greater detail.

If Currant and Jacobi's cave stratigraphy is correct, the European and North American ice ages were successive, not contemporaneous. The European ice age occurred first and was followed, tens of thousands of years later, by the North American ice age. Both ice ages (and world ages) were separated by a cataclysmic slippage of the earth's crust sometime between 49,000–52,000 years BP. This event moved the position of the pole ~1,866 miles from the Norway Sea to Baffin Island. Thereafter, the ice sheet in northern Europe quickly retreated and a new ice sheet (the Laurentide) began to develop over North America. This slippage was significantly greater in magnitude than the 1,657-mile crustal shift at the end of the Pleistocene.

Cave stratigraphy is a challenging field. Caves are difficult places to work in, even under the best of circumstances. Investigators face numerous logistical challenges. Scientific research itself is a part of the problem, because even the most careful excavation permanently degrades a site. Although this type of destruction is an unavoidable trade off, unfortunately, some of the early excavators greatly aggravated the problem through their haste and crude methodology. Not all of them, of course. William Buckland, as noted, did exemplary work at Kirkdale cave. And reportedly so did J.L. Widger at a number of cave locations in the 19th century.

Given the challenges, one has to admire the grit of scientists who wrestle with stratigraphic issues on a daily basis. It is for this reason that I will conclude this chapter with Currant and Jacobi's qualifying remarks, which I fully endorse, here reprinted in toto:

> "We have tried, as far as possible, to use the well established principles of biostratigraphy as they are more generally applied to the rest of the fossiliferous geological succession, *but the highly fragmented nature of the Quaternary terrestrial record stretches some of the nicer points of standard practice to their practical limits. The actual sequences represented are often of very short duration, making evidence for the direct stratigraphic relationship between some of our proposed assemblage-zones quite hard to establish. The links we have used are sometimes based on inferences derived from lithostratigraphy and absolute dating* [my italics], and although the purist may not approve of this methodology, no progress in this difficult field would be possible without some degree of pragmatic compromise.
>
> "We feel that it is more important to the user that this model is robust and usable rather than appearing to be intellectually elegant in its construction. At the end of the day, we believe that we have come up with a testable biostratigraphic model. Indeed, we have tested it ourselves at site after site and on collection after collection. Absolute dating programs have been instigated specifically to check parts of this framework and so far it has held

together very well. We believe very strongly that the type locality concept is essential to this kind of terrestrial sequence biostratigraphy, particularly with such a fragmented record, and it is hoped that the type localities selected here will be used as the basis for future improvements in the resolution of this model."[182]

Chapter Eleven
The Mysterious High Civilization of the Andes

At this point, I was still not necessarily convinced I had established the proper sequence of pole positions. I felt I needed more supporting evidence. I had no issue with the faunal assemblages. That much was set, thanks to the isotopic dates establishing the chronology. But I still had some lingering doubts about how the various pole positions related to the respective assemblages. How could I be certain, for example, that the North Greenland pole corresponded with the Bacon Hole assemblage? There was a possibility Bacon Hole corresponded instead with a still unknown pole position. Maybe there had been *five* crustal displacement events since the Eemian instead of *four*, one of which, possibly, had not yet been identified. I thought this unlikely. I had seen no archaeological evidence for another pole position, but this did not necessarily rule out the possibility.

I found it curious and suggestive that the North Greenland and Baffin Island pole positions *both* placed Britain at approximately the same latitude of 56.5° N. For this reason, Britain enjoyed approximately the same temperate climate during both periods. I was aware that a displacement event can leave a region at the same distance from the pole as before, hence, at the same latitude. It came down to the luck of the draw. In such a case, both climate and the matching faunal assemblage would remain unchanged. There were a number of hypotheticals.

I was aware of some data pointing to a steep fall in world sea level at 31,000 years BP.[183] Did this point to a crustal displacement event at that time? What if the North Greenland pole had immediately preceded the Baffin Island pole? In that case, the same temperate climate would have prevailed in the UK during both periods, despite a crustal displacement event and the Pin Hole assemblage would have persisted from ~49,000 years BP to the end of the Pleistocene. Might this be cloaking a still unidentified pole position (who knows where) that corresponded with the Bacon Hole assemblage?

To answer these questions and, hopefully, resolve the matter, I devised two exercises. The first would test whether or not another (fifth) crustal shift occurred at 31,000 years BP. The second would compare the different pole positions with respect to sea level.

The first exercise was straightforward. I simply plotted the known locations of 229 carbon-dated mammoth specimens from Asia. Russian scientists compiled this data in 2003.[184] I sorted the dated specimens into two groups: those dated *after* 25,000 BP and those dated *before* 35,000 years BP. To exclude any fuzziness, I chose to ignore all of the specimens dated in between. I wanted two discrete data sets, cleanly separated in time, with no overlap. This done, I generated two Google Earth maps and studied them side by side. If a crustal shift occurred ~31,000 years BP, the two plots should look different.

A shift would produce a marked change in the distribution of mammoth sites. But there was no discernible difference. Both maps showed the same distribution of plotted sites. Indeed, many of the sites had yielded specimens from both periods. Although the pre-35,000-year BP data set was a smaller sample, this seemed inconsequential. The two plotted maps of Siberia looked identical. I concluded on this basis that the earth's crust did not move throughout MIS-3 and MIS-2, at any rate, not until the end of the Pleistocene.

The second exercise was more complex and much more tedious.

Today, there is broad consensus in the science community that ocean levels fluctuate up and down in concert with waxing and waning polar ice sheets. It follows that by measuring the volume of polar ice, we can discern changes in sea level. Of course, prehistoric ice sheets and glaciations are beyond the reach of present-day orbiting satellites. So, another means must be found to unravel the deep past. I developed a simple way to address this.

As noted, ice caps do not form above the open sea. Arctic sea ice is generally no deeper than ten to twelve feet. Yet, this depth of sea ice is sufficient to insulate sea water below the ice from the frigid air temperatures above it during the long polar winters. Although it is true that the ice sheets in the oceans surrounding Antarctica are deeper, this is only because of the underlying support provided by Antarctica's continental shelves. The massive, barely floating, ice sheets are also fed and sustained by immense glaciers (the largest on Earth) that reach hundreds of miles down to the sea.

The enormous Laurentide ice sheet centered on North America during the LGM reached depths in excess of 10,000 feet, which is comparable to the present depth of the existing Antarctic ice sheet. But an even larger ice cap is believed to have existed during the so called "penultimate" glaciation prior to the Eemian, i.e., between 190,000–130,000 years BP.[185]

As noted, the relative absence of significant continental landmass within the polar zones at the time of the Bering Sea pole position explains the record high sea stand during the Eemian interglacial. A second lower, but still relatively high, sea stand occurred at the time of the Norway Sea pole position, and coincides with the European Ice Age. At other times when sea level was lower, land bridges joined Britain with Europe and Alaska with Siberia.

All of this suggested a "quick and dirty" method for estimating relative sea level for a given pole position. Because the total volume of polar ice correlates with sea level, and because polar land mass correlates with the volume of ice, it should therefore be possible to guesstimate relative sea level simply by measuring the total continental land mass within the polar zones. After some trials, I found I could easily accomplish this using Google Earth Pro.

The "quick and dirty" method I developed cannot provide an absolute number for sea level rise or fall. But I judged that even a proportional estimate of sea level would be adequate to pair each faunal assemblage with its matching pole position, thereby confirming the correct sequence. And if the relative sea level changes determined by measuring polar land mass also happened to match the isotopically dated sequence of mammalian assemblages, so much the better. This would provide additional support for Hapgood's theory.

Fortunately, Google Earth Pro features a simple and easy-to-use software tool for accurately measuring polygons on the Earth's surface. I will not bore the reader with the details. See the following note for a description of how I went about measuring the continental land mass in each polar zone.[186]

The total surface area of the planet within each polar zone is known: 7,700,000 square miles. Therefore, the total area for both polar zones, i.e., north and south, is twice this amount, or 15,400,000. See the summary table listing the relevant data for the four previous pole positions. The table also includes a column (at the far right) listing the total amount of ocean area (in square miles) for each pair of polar zones, because I found this equivalent way of expressing the same data to be useful.

Pole position sea level		**Polar land area (sq. miles)**	**Polar ocean area (sq. miles)**
Bering Sea pole	(highest)	2,661,008	12,738,992
North Greenland pole		7,729,364	7,670,636
Norway Sea pole	(high)	5,910,679	9,489,321
Baffin Island pole		7,676,616	7,723,384

So, let's review the figures and what they signify. As expected, the Bering Sea pole and its highest sea stand correlates with the smallest amount of polar land area, i.e. 2,661,008 square miles. The Norway Sea pole and its relatively high sea stand correlates with the next smallest polar land area. The North Greenland and Baffin Island poles and their lower sea levels correlate with larger ice caps, hence significantly more land mass within the polar zones.

The numbers ran true to expectations and are consistent with the existence of land bridges (Beringia and the UK-Europe land bridge) during both periods. Based on this proportional data, I concluded that the sequence as shown is correct. The North Greenland pole followed the Bering Sea pole chronologically and definitely correlates with the Bacon-Hole faunal assemblage. At that time, world sea levels were between 128-160 feet lower than at present. This was at or near the flooding threshold of the North Sea and English Channel.[187]

The True North Greenland Pole Position

Mark Carlotto found that numerous ancient sites were aligned to the North Greenland pole. His estimated placement of its position (79° 43′ N, 63° 51′ W) was a compromise, an attempt in his own words "to try to bring all of the sites into alignment…"[188] The various plotted alignments spread out like scattershot around it. (**See Figure 1**) The sites include Tenochtitlan (Mexico City), the Tower of Babel (Babylon), the Parthenon (Greece), the Temple of Jupiter (Baalbek, Lebanon), the Western Wall (Jerusalem), the Pyramid of Teti (Egypt), Ahu Tahai (on Easter Island), and a site in Micronesia. To this list I would add a discovery of my own: the pyramid of Sekhemket at Saqqara, Egypt.

As this book was about to go to press, I realized that the Pumapunku pyramid that vexed me in Chapter Four is also aligned to the North Greenland pole position. I did not plot it in Figure 1 because this discovery occurred at the last minute.

I was already aware that accuracy varies widely from site to site. Some ancient sites are amazingly accurate, others much less so. For example, the alignment of the Temple of Jupiter at Baalbek misses Carlotto's North Greenland Pole position by ~83 miles, passing far south of it, while the Pyramid of Teti misses by ~53 miles, passing to the north.

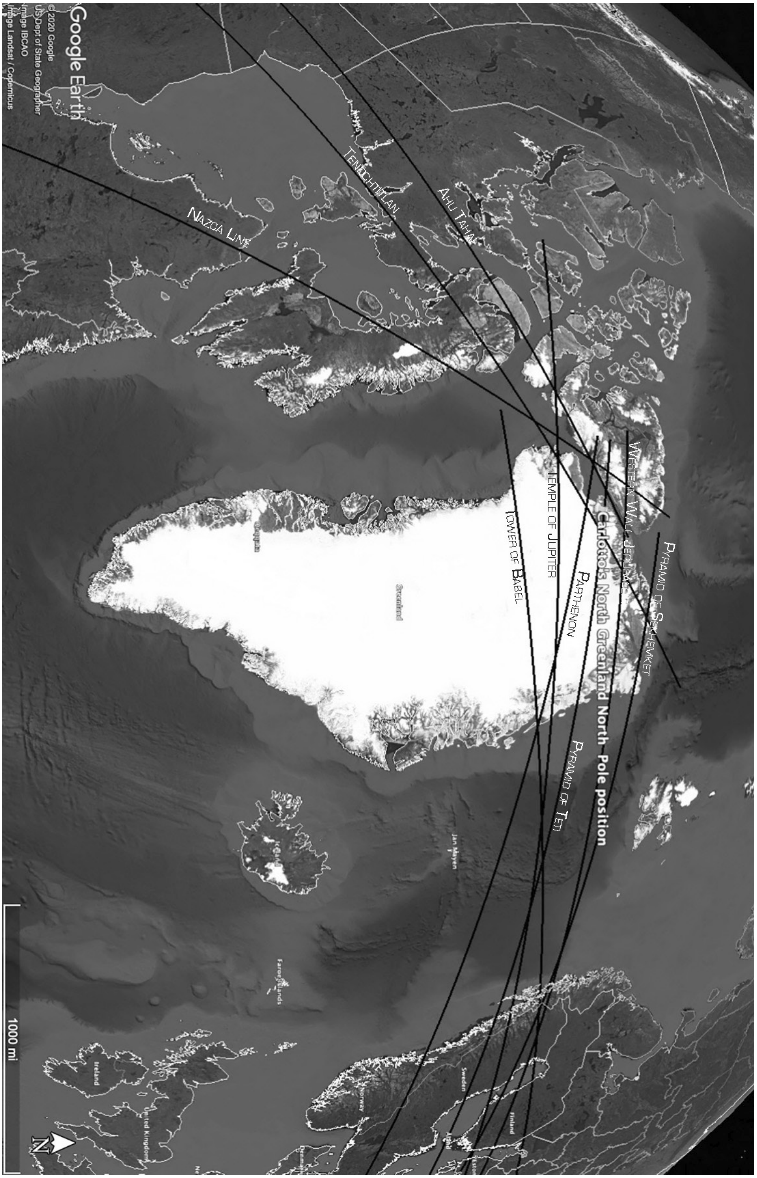


Figure 1 Plot of ancient sites aligned to the North Greenland pole position.

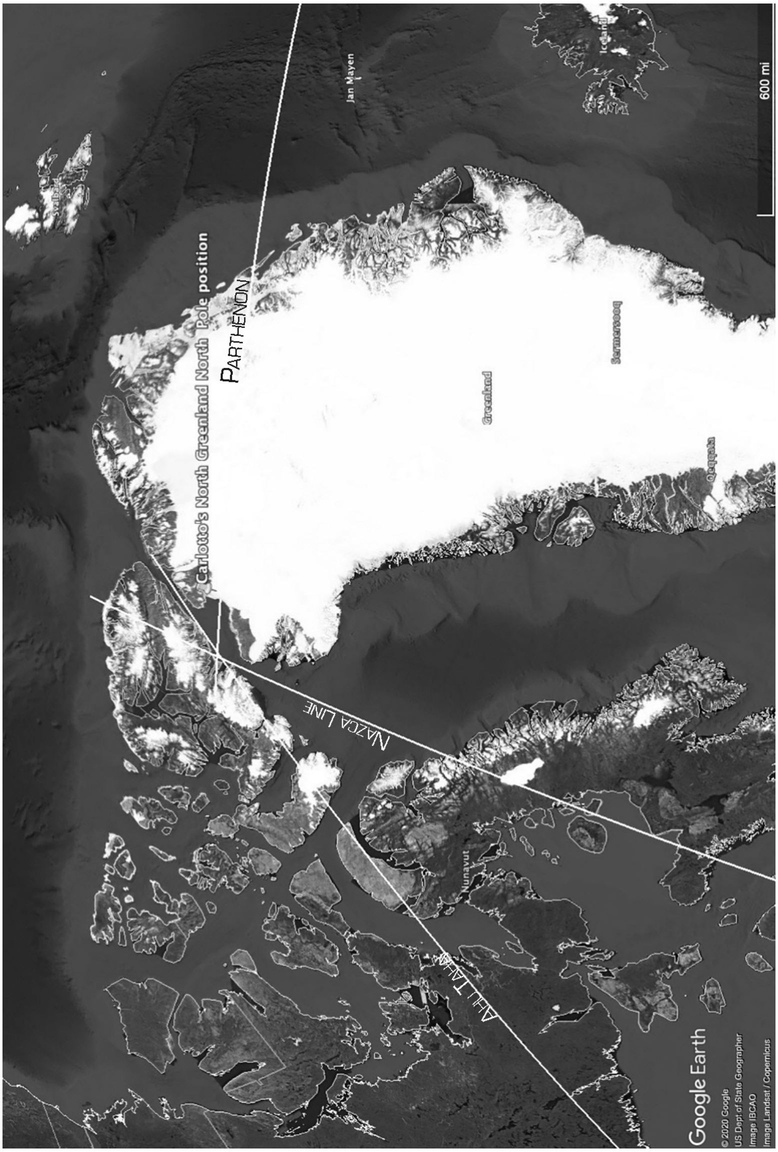


Figure 2. Plot of the three most accurate ancient sites to the North Greenland Pole. From left to right: *Ahu Tahai*, Nazca line, Parthenon.

The alignment of the famous Wailing or Western Wall in Jerusalem is also way off, and passes ~126 miles to the north. The Tower of Babel (Babylon) is one of the least accurate and misses by a whopping 240 miles to the south.

Inspired by Carlotto's stunning discovery that two of the Nazca lines point to former pole positions in the Bering Sea and Norway Sea, I began to investigate other Nazca lines, of which there are many. *I was amazed to find that one of them is closely aligned to the North Greenland pole position and may even be spot on with the Greek Parthenon and Easter Island!* (**See Figure 2**)

I was astonished again when I double checked the alignments and found that they vary by less than a mile. Assuming my plot is correct, this cannot be a coincidence. It appears that the actual pole position is not on Greenland itself, but in the Nares Strait between Greenland and Ellesmere Island. The spot is about thirteen miles from the coast of Ellesmere and 129 miles west southwest of Carlotto's estimated position.

I believe it is more useful to identify a pole position exactly, *if this can be done*, rather than settle for a compromise location. Finding the exact location, of course, is easier said than done. Plotting precise alignments can be frustrating work, even with the latest software. In some cases I ended up with a different alignment each time I plotted it. But if the pole position in the Nares Strait withstands scrutiny, it will be thanks to this Nazca line and a peculiar structure on Easter Island.

At this point, I went back and reread Thor Heyerdahl's books, which I had devoured as a boy. The Norwegian explorer was ahead of his time and produced a string of best sellers. *The Kon Tiki Expedition*, released in 1950, is a rip-roaring tale about how Heyerdahl and five Nordic companions crossed the Pacific in a home-made balsa wood raft. Wow! And his 1958 sequel *Aku Aku*, about the mysterious statues of Easter Island stirs up the same powerful juices of adventure and discovery. Heyerdahl was drawn to the Pacific by deep questions, which he pursued throughout his life. Who created the colossal statues on Easter Island?

The largest one weighs at least seventy-five tons and, though unfinished, would have stood as tall as a seven-story building. The stylized sculptures, known as *moai*, have always reminded me of the African masks that inspired Pablo Picasso. But why would anyone go to so much trouble on a tiny island at the ends of the earth? Easter Island is but a speck in the vastness of the Pacific, thousands of miles from anywhere.

Outpost of the Andes?

By now, another pot was boiling in the back of my head as I pondered a dozen different questions. Was there a connection between Easter Island and the high civilization that produced the incredible polygonal walls at Cusco? I felt there had to be a link. And what about the Nazca lines? Who created them? What was *their* purpose? I suspected they were extremely important. Nazca is located in southern Peru, not far from Cusco. As already noted, Carlotto traced one of the lines to Cusco. However, when I checked it out I found it more closely aligned with a central square in nearby Pisac. But why Pisac? What was its relationship to Cusco?

Heyerdahl developed his own ideas about the spread of human civilization. He believed the ancients were skilled seafarers who had dispersed culture far and wide via the world oceans. In this, he was on the same page with scholars like Charles Hapgood[189] and the great linguist Cyrus Gordon.[190] But Heyerdahl was not content simply to propound theories. He was no idle desk jockey. He was a hands-on investigator as well as an activist. He demonstrated in a series of well-publicized expeditions that it was entirely feasible to cross the oceans in a matter of weeks aboard a raft properly rigged for sailing. Heyerdahl and his companions proved it time and again on successive journeys.

In 1976, a French scientist named Michelle Lescot turned up the first hard evidence that Heyerdahl, Hapgood, and Gordon might be right. Lescot worked at the Natural History Museum in Paris, and she was examining the mummified remains of a famous Egyptian Pharaoh, Ramses II, when she found strands of tobacco in the mummy. When her discovery was announced, it went viral across Europe. It also rocked the field of Archeology, which had long denied any possibility of contact between ancient Egypt and the New World.[191] The standard view was that tobacco, a New World plant, was unknown in the Old World until the time of Christopher Columbus.

In 1992, Dr. Svetla Balabanova, a forensic toxicologist from Ulm, Germany, found additional evidence when she detected not just nicotine, but also cocaine while examining a different Egyptian mummy. Cocaine is native to South America and was thought to be unknown in ancient Egypt. A careful scientist, Balabanova double-checked her work by sending out samples to three other labs. When all three of them returned the same positive result, she and two of her colleagues published their work.[192]

But the same critics who refused to accept Lescot's findings in 1976, now insisted that Balabanova's mummies must have been recently contaminated. One Egyptologist at the Manchester Museum, Dr. Rosalie David, went so far as to travel to Munich to inspect Balabonova's work. There, David obtained tissue samples and sent them out to other labs. But the test results corroborated Balabanova! Later, Dr. David was quoted as saying: "it seems evident that they are probably genuine."[193]

As for Dr. Balabanova, she reacted to the critics by expanding her research. She tested many additional mummies from different museums around the world, and each time the results confirmed her earlier findings. Out of 134 ancient mummies from Sudan, for example, one third tested positive for *both* nicotine *and* cocaine. Today, the best available evidence supports the views of Heyerdahl, Hapgood, and Gordon. The ancients were global seafarers who engaged in commerce on a scale never thought possible until recently.

In the 1980s, Heyerdahl returned to Easter Island to continue the research he started many years before. Archaeological work, of course, had continued on the island over the intervening years. Excavators at *Ahu Nau Nau*, a megalithic platform on the north side of the island, had succeeded in carbon-dating human artifacts to 850 CE.[194] The date appeared to confirm the traditional beliefs of the island residents about their ancestry. The Easter Islanders trace their ancestral line back fifty-seven generations and claim they are the mixed stock of two separate waves of immigrants. These came from opposite directions. The first wave of the so-called "long ears" came from the east (South America) and, according to the islanders, were primarily responsible for the *moai* scattered around the island. Later, a second group arrived from the west (Polynesia).

Easter Island boasts hundreds of beautifully stylized *moai* statues, and they are of two types. Actually, both are similar in appearance but differ markedly in their placement. Many of the *moai* were individually placed and are found all over the island. However, at several locations, rows of standing *moai* were lined up on raised platforms known as *Ahus*. Mark Carlotto found that one of these platforms, the *Ahu Tahai*, on the island's western shore, is aligned with the North Greenland pole position. If he is correct, this places

This platform of four standing *moai* on the western shore of Easter Island, known as the *Ahu Tahai*, is aligned to the North Greenland north pole position.

Easter Island in a vastly more ancient context and also calls into question the traditional history told by the islanders.

Have they recounted the island's full history? Or merely the part they know?

The accurate alignment of the *Ahu Tahai* had to be the work of an advanced civilization. Such a conclusion is further supported by the presence of megalithic walls on Easter Island. Heyerdahl found these at three different locations and he concluded, correctly in my view, that they date to the earliest period of habitation.[195] Nor is Heyerdahl alone in this view. In 1982, a Chilean anthropologist, Laureani Ciccarelli, reached the same conclusion.[196]

In 1989, Heyerdahl published photos of two of these walls, at Vinapu and Anakena, and the photos show the same superb joinery I observed in Peru.[197] There is no mistake. Obviously, Easter Island was at one time an outpost of the same high Andean civilization that produced Machu Picchu, Ollantaytambo, Sachsawaman, and the Coricancha. Moreover, this is consistent with successive North Pole positions in the Bering Sea and in North Greenland, which establish the continuity of Andean civilization over tens of thousands of years.

Heyerdahl believed that the islanders were quarrying stone and producing *moai* right up until a few centuries before the first European ship arrived in 1722.[198] But Heyerdahl did not have access to the new earth-mapping software that has profoundly changed how archeology is done. So, he had no way of knowing about the probable deep antiquity of the island's megalithic walls. Some of Heyerdahl's own research, however, actually points to great antiquity. When his teams excavated a number of standing *moai* in 1956, they were surprised to find that the figures were not just sculpted heads. The heads had complete torsos. And they were enormous.

In some cases, the crews had to dig down twenty feet to reach the base. Surely these full-bodied *moai* had not been buried intentionally. Originally they had been placed on the surface, and came to be buried over spans of time by the slow deposition of wind-blown sand and dust and by the gradual displacement of soil down slope, a geological process known as solifluction. It is also possible that periodic tsunamis played a role, though Heyerdahl believed solifluction alone was responsible.[199] His colleagues discovered that nearby hillocks were actually artificial mounds of debris produced by the quarrying process. And he concluded, along with them, that rain probably had washed the debris downslope. This would certainly explain the burial of some of the *moai*. But what about the statues placed far from the quarries?

A thorough historian, Heyerdahl was familiar with the early accounts, including the journal of Captain Geiseler who headed up the 1882 German expedition.

Heyerdahl was able to extract some useful information from Geiseler's journal about one of the better known *moai*. The write-up was extremely detailed (in typically German fashion) and mentioned the *moai's* exact height above ground level. In 1956, when Heyerdahl's team inspected the very same *moai*, they found the ground level unchanged since 1882. There had been no further deposition around the figure. This suggests that burial was a slow process, and hints at the *moai's* likely extreme antiquity.

I began to study other Nazca lines. But I hardly knew where to begin. There are hundreds of them. At Nazca, the landscape of the Altiplano is literally crisscrossed helter-skelter with lines aimed in various directions. The two boldest lines are the two identified by Carlotto that point to the Bering Sea and Norway Sea pole positions. One of these is displayed on the ground so emphatically it is visible 90-100 miles above the earth, in other words, from space. Other Nazca lines are much fainter. Some are scarcely visible at all.

At this point, I made another discovery. One of the faintest Nazca lines is perfectly aligned to Carlotto's proposed North Pole position in Hudson's Bay. The line is so faint it's more of a trace than a line, almost a ghost impression. Yet it is there, nonetheless, and once again the alignment is spot on. I strongly believe that the most recent North Pole position was on Baffin Island, not in Hudson's Bay, and have presented compelling evidence for this. So, what could this latest marker signify? By now, this had my undivided attention.

As already noted, ancient sites are aligned to present or former cardinal positions with varying degrees of accuracy.

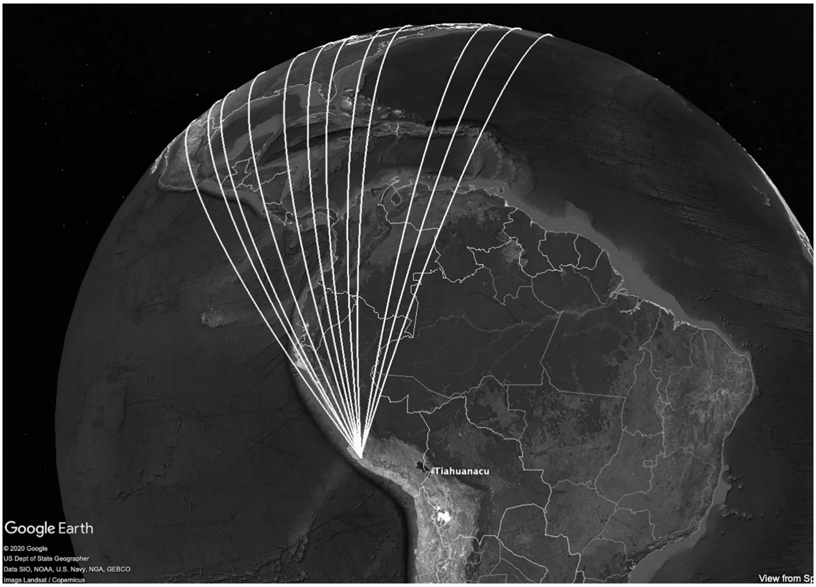


Figure 3. Plot of Nazca lines

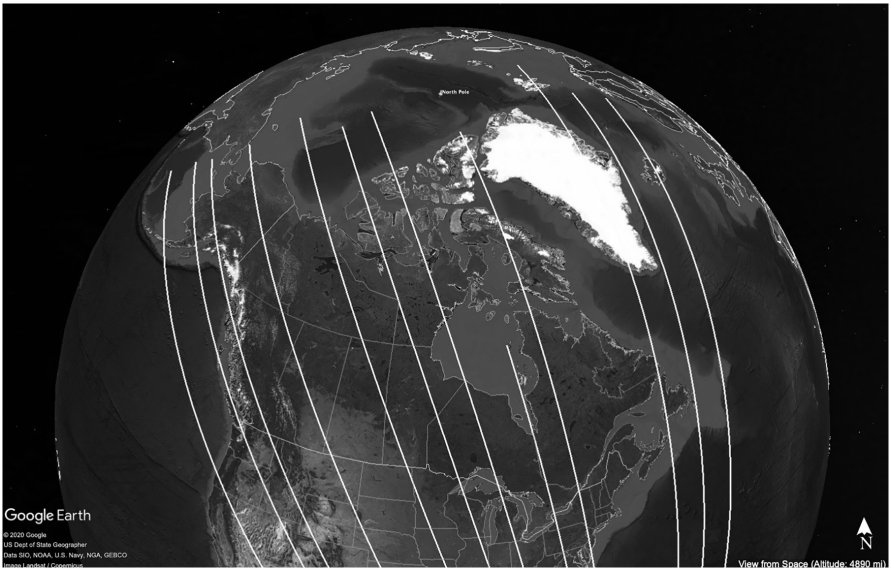


Figure 4. Continuation of the plotted Nazca lines.

Some sites are quite accurate, others less so. There are even sites, such as the Tower of Babel, that are crudely aligned. But the Nazca lines appear to be consistently precise. For the edification of the reader, I have included two Google-generated maps. (**See Figures 3 and 4**) They display twelve lines as projected from Nazca, Peru. The lines fan out from Nazca northward across the hemisphere toward the Arctic.

I have already shown that three of them are aligned to former pole positions. The line at far-left points to the Bering Sea pole position. The line at far-right points to the Norway Sea pole position. The line fourth from the right points to the North Greenland pole position (though it's actually located in the Nares Strait, between Greenland and Ellesmere Island.) I truncated the fifth line from the right because it clearly points to Carlotto's Hudson's Bay pole position. Even as I plotted the lines I found another match! The line second from the right apparently points to Charles Hapgood's proposed Greenland Sea pole position. I had not been aware of this match, which appears to confirm Hapgood's intuition. What are we to make of it, given that Carlotto's Norway Sea pole is a better fit with the European Ice Age?

And what about the six other Nazca lines?

Although it is too soon to draw any conclusions about their purpose, I strongly doubt that the lines are random. Creating lines on the surface of the earth that are perfectly aligned to a true North Pole position requires a high level of expertise, as well as a substantial expenditure of time and labor. It is an affront to reason to suppose that the other lines (hundreds of them) are random and without purpose.

So, perhaps the time has come to indulge in some honest speculation about the Nazca lines and who created them. Allow me to conjecture…

Based on everything I have learned, it would appear that a scientifically advanced civilization arose in the central Andes mountain range in the remote past, *long before* the rise of Sumer and Pharaonic Egypt. Moreover, this high civilization flourished intact over a period of time so long that the duration of all of the known civilizations in human history pale in comparison, even when rolled together. It appears that the high Andean civilization persisted from at least the height of the Eemian, 120,000 years BP, until the start of MIS-3, circa 50,000 years BP, and perhaps for much longer. That's a span of at least 70,000 years. Over this time period, the high Andean civilization not only survived successive Earth cataclysms, it actually recorded them. *Indeed, it appears that many of the straight Nazca lines constitute a record, continuous and detailed, of successive displacements of the earth's crust, all appropriately recorded…where else but on the surface of the earth itself?* Odd, yet, strangely fitting.

But what about the seven other lines in Figure 3 and 4 that have not yet been accounted for? Do they likewise point to former pole positions that have not yet been identified?

Are these lines a record of cataclysmic events dating back…even before the Eemian? Was the Hudson's Bay North Pole position current, say, at the time of penultimate glaciation, 190,000–130,000 years BP? According to Earth scientists, during this period, the North American ice cap extended south into Missouri and Kentucky. And what about Hapgood's proposed Greenland Sea pole position? Was it current at some other remote time?

As of now, five North Pole positions have been identified, spanning the last 120,000 years including the present position. If the seven additional lines, about which we know nothing also point to former pole positions (and if I am correct about this, there are probably others), it is quite possible that the high Andean civilization dates to 200,000 years BP. And who knows what additional information the hundreds of other Nazca lines hold about the natural history of our planet? Do they refer to past events about which we know nothing? After all, the scientific era is only 500 years old. We are at the crawling stage in terms of understanding our planetary home.

In the book's final chapters, I will turn the discussion to possible causes and mechanisms.

I will end this discussion with a sobering question: How can it be that we moderns have no knowledge of, nor any historical records pertaining to, the earth changes we have been discussing? I mean to say, apart from ancient legends and mythology: Why do we share no memory or recollection of our own deep past? Is it possible that our ancestors could fail to remember a cataclysmic 1,657-mile displacement of the earth's crust? No, I think not. The idea that humans could forget an event of such magnitude is absurd on its face. So, what is the explanation? Is there no record or memory because our forebears perished in the fire and brimstone of those events, leaving only a handful of traumatized stragglers reduced to a hardscrabble day-to-day struggle for survival?

This is the story Plato tells in his *Dialogues*. In the *Timaeus*, Plato's uncle Critias describes how, 200 years before, his distant relation Solon, a famous Greek statesman, visited Sais, Egypt, where an old priest informed him about events long forgotten by the Greeks. "Oh, Solon," the priest said, "you Greeks are but children, and there is not an old man among you." When Solon asked the priest what he meant by this, the priest went on to explain that the earth is hoary with age and has endured many cataclysms in the distant past, some caused by fire, and some by water, or other lesser means. On these occasions, catastrophes brought humanity to its knees. Proud cities, even whole civilizations, were wiped from the face of the earth, leaving behind only a remnant of unlettered men to start again, at the bottom, from zero.

Such was Plato's view of human history. It is one, I should mention, that most scientists dismiss as a fairy tale. But *if* Plato was not recounting legend but actual history, as I suspect he was, then our species suffers from collective amnesia about our deep past, just as the much-maligned catastrophist Immanuel Velikovsky argued in his books.[200] A practicing psychiatrist, Velikovsky was imminently qualified to express such views, yet he was ostracized in his later years and his reputation ultimately destroyed for espousing pseudoscientific ideas.

My quest for evidence in support of Charles Hapgood's theory of crustal displacement has opened up a number of fertile areas for continuing research. I would love nothing more than to dive straight into them, here. Unfortunately, that would take us beyond the scope of this book.

Chapter Twelve: The Paradox of the Mammoth Steppe

In June 1979, scientists from many different fields convened a historic nine-day conference in Burg Wartenstein, Austria. The purpose of the gathering was to address a problem, what the organizers called a paradox. The meeting was the end result of a long process of scientific research underway since the 1600s when occasional travelers from Siberia showed up in London and other western cities with gigantic tusks, bones, and/or teeth. The sojourners told wild tales about hairy elephants in the far north.[201]

It was not long before similarly large fossilized bones, tusks, teeth, and even skeletons began turning up closer to home, in caves and other deposits in Britain and across Europe. These remains were also thought to be elephants. That is, until George Cuvier proved otherwise. Cuvier had pioneered the new field of comparative anatomy and, in 1796, he showed conclusively that the gigantic bones belonged to an animal which, although related to modern elephants, was actually an extinct species previously unknown to science. Cuvier named it the woolly mammoth.

By the end of the 19th century, a compelling mass of physical evidence indicated that great numbers of these mammoths and other large vertebrates had once ranged across the northern hemisphere. The landscape in which they lived was believed to be generally treeless, wide open country, with a vegetation layer of grasses, forbs, and shrubs. The ecosystem in which the animals lived and flourished was thought to be a cold, dry, and windy place. R. Dale Guthrie, a presenter at the Burg Wartenstein conference, dubbed it the "mammoth steppe."[202]

The steppe country was an enormous biome. During the last 50,000 years (throughout MIS-3 and MIS-2) a land-bridge joined Britain with Europe, and a second land-bridge, i.e., Beringia, connected Siberia with Alaska. From Britain in the west, the mammoth range extended southward through Spain and Italy as far as Rome. From northern Europe, including Ukraine, it stretched unbroken across Asia to eastern Siberia and China. It also reached across the Bering land-bridge to what is now the western United States and central Mexico. Recently, while touring Mexico City, I marveled at the awesome sight of a more or less complete mammoth skeleton prominently displayed in the national museum there.

But the Pleistocene bestiary also included other large vertebrates: the woolly rhinoceros, a giant stag, three or four species of extinct horse, cave bears, a giant sloth, a saber-toothed cat, a camel, cave lions, the dire wolf, and other more familiar extant mammals like caribou, elk, musk oxen, antelope, and bison. The remains of every one of these species have been found in different parts of the mammoth steppe. But only the mammoth and bison inhabited all of it.

The Physical Evidence

The Pleistocene beds in the far north of Siberia turned out to be one of the richest deposits. In the words of two Russian scientists who attended the Burg Wartenstein conference:

> "Siberian deposits of late Pleistocene age contain a remarkable abundance of large mammal fossil remains. *Since large animals are extremely scarce in the recent mammal faunas of the tundra and forest-tundra, conditions during the late Pleistocene must have been quite different.*"[my emphasis][203]

The fossil deposits along the coast of Siberia between the Kolyma and Indigirka Rivers were especially rich. An ice cliff runs for many miles along this remote coast, and each year it serves up a fresh supply of bones and tusks. Abundant beds were also found in the New Siberian Islands, located 150 miles north of the Siberian coast, at a latitude of 75° N. Early explorers to the area reported that the very ground itself seemed to be made up of bones and tusks mixed together with sand, clay, and ice.[204] In 1926, a traveler, Bassett Digby mildly criticized these early accounts as exaggerated, even while admitting their essential correctness in the very next passage of his own manuscript.[205]

The first European visitors were at a loss to explain how these great boneyards of the far north came into existence. Some catastrophists, for example, Henry H. Howorth, attributed them to a Biblical scale deluge. Others, such as the German scientist-explorer, Alexander von Middendorff, argued that the large animals lived many miles to the south, and only after death had been carried to the Arctic beds by Siberia's north-flowing rivers. (**See Figure 1)** Charles Lyell was one of many scientists who supported Middendorff's "floater" hypothesis.[206]

However, today no serious investigator subscribes to these views. The deluge and transport hypotheses were overthrown by subsequent investigations. Although there is no present-day consensus about how the Siberian boneyards originated, nearly all researchers agree that the Siberian mammoths lived and died where their bones were (and are still) found. While the devilish details remain controversial, most scientists attribute the extinction of the mammoth to abrupt climate change. Of course, this only begs the deeper question: What caused the climate change?

The mass extinction of 70% of the megafauna at the close of the Pleistocene is all the more puzzling because, from an evolutionary standpoint, the mammoth and associated steppe fauna were highly successful species. Beginning in the Pliocene, they flourished together over perhaps two million years, a period that includes the entire Pleistocene.

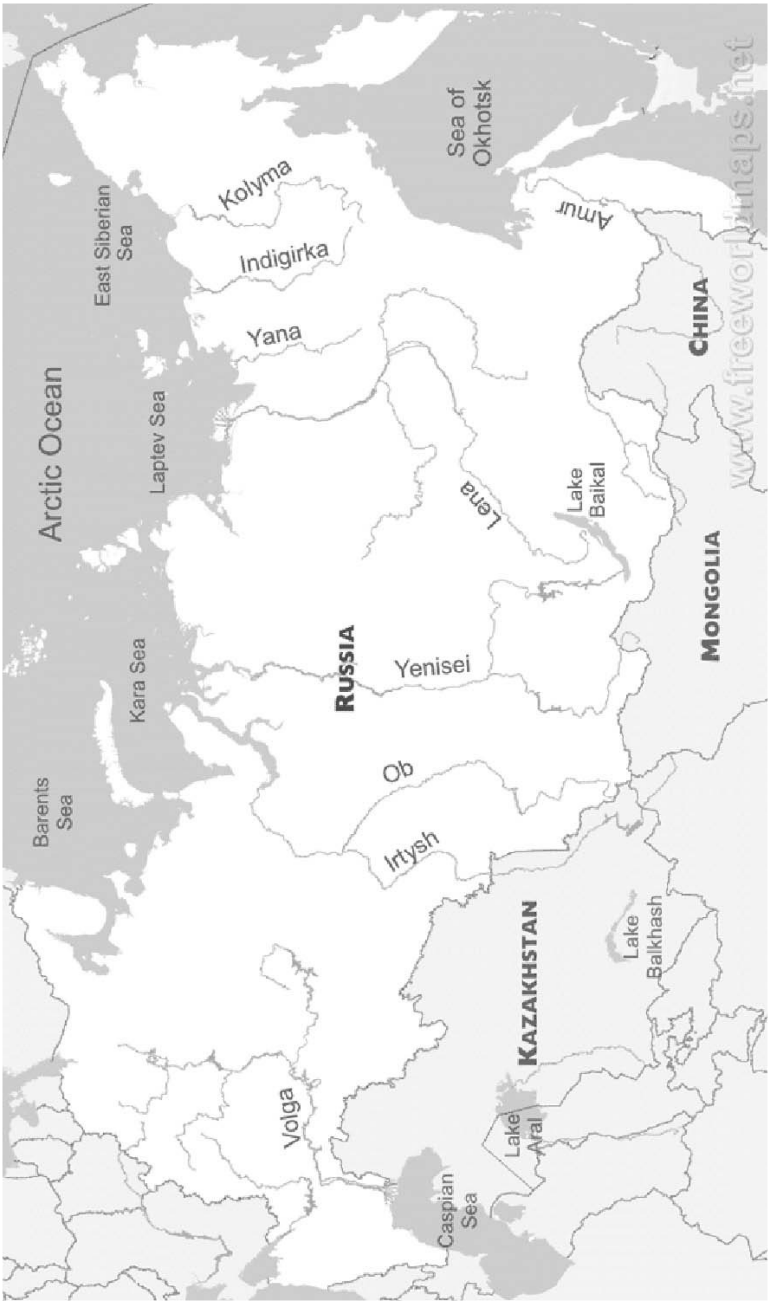


Figure 1. Map showing Siberia's north flowing rivers. (by permission of Free world maps.)

In central Alaska, a similar level of abundance came to light at the start of the 20th century during the fabled gold rush. In order to reach the precious metal, miners first had to remove a deep overburden of glacial muck, which they accomplished using high-volume water hoses, a method known as sluicing. It was in the course of removing these frozen "muck beds," which are up to ninety feet thick, that the miners encountered a very different kind of wealth. The archaeologist, Frank Hibben describes what they found in his 1946 book *The Lost Americans*:

> "In the tremendous gold pits in and around Fairbanks, Alaska, great quantities of fossil bones came to light. So many were discovered that a number of paleontologists were attracted to this region. In the Plains area [of Colorado and New Mexico] and in other locations in North America, they usually turn up in small quantities and in fragile condition…It was astounding, then, to discover in the gold mines of Alaska bones of extinct animals in unbelievable quantities and in sound condition…."[207]

Hibben continues:

> "The Alaskan muck is like a fine, dark gray sand. It is very moist, is eternally frozen, and apparently has been so ever since the Glacial Age….Even in summer the ground thaws only about three feet down from the surface…. Within this mass, frozen solid, lie the twisted parts of animals and trees intermingled with lenses of ice and layers of peat and mosses…. Here we do not have to reconstruct so much from parched and weather-worn clues and tidbits. In the historical icebox of the Alaskan muck, large segments of the story…lie rigid and cold, awaiting discovery."[208]

Hibben interviewed one old miner who told him that, as recently as the 1940s, the bone deposits stretched for miles along the Yukon River:

> "Throughout the Yukon River and its tributaries, the gnawing river currents had eaten into many a frozen bank of muck to reveal bones and tusks of these animals protruding at all levels. Whole gravel bars in the muddy river were formed of the jumbled fragments of animal remains. The picture was one of abundant animal life of a bygone era."[209]

Another rich deposit was found at Kotzebue on the Alaskan coast: ice cliffs that continue intermittently to Barrow, and beyond.[210]

The muck beds of Alaska and northern Siberia point to an astounding scale of life during the Pleistocene, and one wholly unexpected because of the northern location. Nothing in our world is comparable. True, the immense herds of bison that thundered across the American prairie before white settlement, and the former herds of the Serengeti in central Africa both come to mind. But neither example fits because comparing the subarctic with a tropical or a temperate ecosystem is biologically inappropriate. One might as well compare apples and oranges.

The Productivity Paradox

Yet, the numbers are so startling they invite comparison. The abundance of bones, tusks, and fossils in the far north tells us that mammoths surely numbered in the tens of millions—and possibly, like the bison, in the hundreds of millions. This takes us to the heart of the paradox because today most of the mammoth steppe is tundra (although now rapidly deteriorating), which is much less diverse in species than tropical and temperate ecosystems. Northern tundra is also much less productive. It was for this reason that several presenters at Burg Wartenstein argued that the Pleistocene mammoth steppe has no present-day analogue. Please remember, the historic conference happened in 1979, a decade or more before warming of the Arctic became too conspicuous to ignore.

There are three types of tundra: arctic, subarctic, and alpine. The most prolific of the three in producing forage is the subarctic variety. But even subarctic tundra is very limited from a productivity standpoint and can barely support even a modest population of herbivores. Today, only two large herbivores are able to live in the far north: musk oxen and caribou. Both species require large territories to subsist, and both are presently in serious trouble due to the melting permafrost. Throughout the Holocene, until very recent arctic warming altered the equation, the factors determining which species could survive on tundra were the cold soils (due to permafrost), the short growing season, and the cool summers.[211]

The paradox of the mammoth steppe is simply stated. The dietary needs of the Pleistocene megafauna far surpassed what the lands that once supported them are presently able to produce.

Yet, it appears that the same land was once highly productive. This is the key point, and it is supported by several lines of evidence. Experts agree that the most common species of mammoth (*Mammuthus primigenius*) was approximately the size of an African elephant, whose food requirements are well-known. Each day, an adult African elephant consumes between 200-600 pounds of forage.[212] Given this as a baseline, we may safely infer that a similar-sized mammoth ate roughly the same amount of forage. It is a lot of food, and it's why African elephants in the wild require a home range of several million acres of equatorial woodland-savannah.

African savannah is the most productive rangeland on Earth, beside which northern tundra cannot begin to compete. But the contrast is even more dramatic, because the most common variety of mammoth, *M. primigenius*, which stood ten or eleven feet tall at the shoulder, was actually one of the smaller forms. Three other mammoth species, although less common, were substantially larger. *Mammuthus trogontherii*, the largest, stood fifteen feet tall at the shoulder and was three or four times the size of *M. primigenius*! Its food requirements must have been prodigious. (**See Figure 2**)

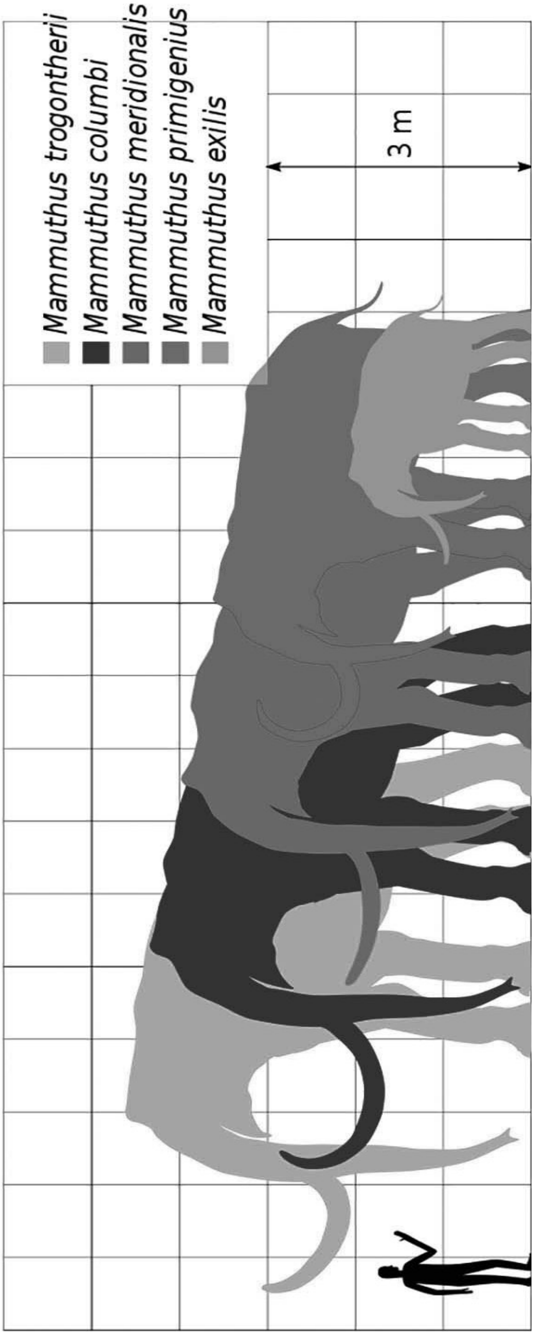


Figure 2. Graphic showing the different species of mammoth (Courtesy of Wikipedia)

Nor is there any evidence that mammoths were food stressed, or that they suffered from malnutrition. On the contrary, the best-preserved mammoth remains from Siberia indicate they were healthy and well fed when they died. Many individuals were in the prime of life. It is hard to escape the conclusion that the mammoth was a highly successful species and flourished across its enormous range.

The same can be said of the other megafaunal species that also inhabited the mammoth steppe. They are dubbed "megafauna" not simply because of their association with the mammoth, but because they too ran large in size. It seems that giantism was the rule during the Pleistocene. Many of the Pleistocene herbivores were scary big, including some of the forms that survived and are familiar to us today. The Pleistocene bison, for example, was more or less the same animal as the present-day bison of the American plains, the main difference being its larger size.

Although some taxonomists chose to classify the Pleistocene bison as a separate species, in 1975, Michael C. Wilson, a Canadian scientist, reported evidence of genetic remixing between the larger and smaller forms. If he is correct and interbreeding did occur, then both varieties were one and the same species of bison, despite minor differences.[213] The giant stag was another case. Despite its gargantuan size it was closely related to the modern elk (or wapiti).

There were some exceptions. The woolly rhino and several extinct species of Pleistocene horse ran a bit smaller than the rhinos and horses of our world.

Giantism also prevailed in the case of horns, tusks, and antlers. The amazing rack on the giant stag was much larger than any known deer or elk antlers in our world. As for the mammoth, the size of its tusks was almost beyond belief. While a tusk on an African male elephant weighs about fifty pounds, a typical mammoth tusk averaged 180-200 pounds—almost four times as much. The mammoth tusks were much longer and thicker. One remarkable pair reportedly weighed in at 432 pounds. Each tusk weighed 216 pounds.[214] This extraordinary set may have belonged to the mammoth's larger cousin, *Mammuthus trogontherii*.

The grand scale of tusks, antlers, and horns is a conspicuous hallmark of the Pleistocene. Biologists refer to these bony and ivory protuberances as "ornamentation." According to paleontologist R. Dale Guthrie, giantism of body size and ornamentation tell us several things. First, it is an indicator of a superabundant food supply, and secondly, it also tells us that competition for food was not a factor.[215] Giantism also implies that forage was of high quality, probably because mineral availability was optimal. And this in contrast with present-day conditions.

According to Guthrie, it is not uncommon today in the Arctic to find bones from a recent predator kill and, even more frequently, shed antlers from moose or caribou. And they usually show gnaw marks by mineral-starved rodents, squirrels, porcupines, and even by the same ungulates who grew the antlers. Sometimes, today one finds antlers and bones chewed down all the way to the nubbins.[216] Why? Because wild animals struggling to survive on a deficient diet will invariably seek out salt, or any other mineral source. By comparison, the Pleistocene bestiary was extremely well fed.

Trade in Ivory

The ivory trade is another powerful line of evidence. The trade began to develop in the mid-18th century. One of the best compilations of early accounts was by Henry Howorth who noted in 1887 that "the quantity of [mammoth] ivory which…found its way to the European markets from this source is almost incredible."[217] According to Howorth, in 1821 a single trader delivered 20,000 pounds of tusks from the New Siberian Islands. Another trader named Schtschukin reported that, between 1825-1831, at least 60,000 pounds of ivory was sold annually in Yakutsk. In two of those years the total reached 80,000 pounds. But the actual amount of ivory must have been greater, because the market in Yakutsk was only one of several venues. Perhaps for this reason, another trader put the annual grand total of the Siberian mid-19th century ivory market at 110,000 pounds. The same source insisted that all of the usual estimates under-reported the trade.[218]

The ivory trade continues as I write. The demand for Siberian ivory has never slackened in the Far East. Nor have supplies diminished despite relentless exploitation of the resource. In recent decades, the melting of Arctic permafrost, due to global warming, has exposed new fossil beds; as a result, the mining of ivory has intensified. My use of the term "mining" is appropriate, because many of the "tuskers," as they are called, have resorted to sluicing cliffs and riverbanks with hydraulic water pumps, just as the gold miners did in Alaska and California. The only difference is that ivory has replaced gold.

Today, a single high-quality mammoth tusk can sell for $30,000.[219] That is serious money for native people who have lost their traditional livelihoods (reindeer farming, cattle ranching, fishing, logging) due to the rapidly warming Arctic.[220] As permafrost melts, the ground gives way. Dry land is transformed into bogs, marshes, and lakes. Life in Siberia was always difficult, but never more so than today. As I write, the region's 5.4 million inhabitants are watching their world turn upside down. To survive, many Siberians have resorted to collecting mammoth bones for profit. Is such an economy sustainable?

By one estimate, the northern beds still hold some 500,000 tons of mammoth ivory.[221] Whatever the actual amount, the Siberian tundra continues to deteriorate. The trends are deeply troubling. But *that* is another story, one beyond the scope of this book.

My point: the undiminished supply of ivory from northern Siberia is another strong indicator that the landscape in which the mammoth lived was highly productive from a food standpoint. One can begin to appreciate why scientists felt the need to convene an unprecedented conference at Burg Wartenstein, in 1979, to compare notes and explore how and why the Pleistocene megafauna once flourished on lands, which, today, could not begin to support them.

Later, the scientists who organized the conference published a book of papers delivered at Burg Wartenstein. In its preface one of them writes:

> "The focus [of the conference and this

> book]…is on the paradox central to all studies of the unglaciated Arctic during the last Ice Age… vertebrate fossils indicate that from 45,000 to 11,000 years BP an environment existed considerably more diverse and productive than at present….*Whereas the botanical record supports a far more conservative appraisal of the region's ability to sustain any but the sparsest forms of plant and animal life.*"[my emphasis][222]

Charles E. Schweger, an anthropologist who attended Burg Wartenstein, summed it up quite succinctly: "How does one keep a mammoth alive and well under the seemingly impossible conditions of ice-age Beringia?"[223]

Indeed. How do we explain the super abundance of large vertebrates during the Pleistocene in a landscape that could not support them today?

Chapter Thirteen: Continental Vegetation Change

The Burg Wartenstein conference was an important scientific event. It is a memorable occasion when inquisitive individuals are able to come together to share data and debate one of the most fascinating issues in science. Most of the presenters at the conference were able to agree, more or less, about the nature of the problem, i.e., the productivity paradox. That they failed to resolve it should not surprise us. No solution was possible within the current science model, which assumes fixed and unchanging pole positions. But I will go further: The present model, *or any paradigm*, which inhibits intelligent people from thinking outside the box regrettably is a prison, hence, a part of the problem which is conceptual in Nature.

We can do better.

I say "most of the presenters" because there were a few dissenters at Burg Wartenstein. Pollen experts James Ritchie and Les Cwynar argued that the northern lands during the Pleistocene were very much like the tundra of today, essentially "a polar desert" which could never have supported a large and complex mammal community.[224] On this basis, they chose to ignore the compelling fossil evidence summarized in the preceding chapter. Viewed with

20/20 hindsight, however, their contrarian perspective was a valuable contribution because it helped to clarify the issues.

Ritchie and Cwynar had a point. Today, we know that much of the vegetation in the far north is unavailable as forage because many slow-growing Arctic plants defend themselves by producing toxic chemicals.[225] As a result, most Arctic plants are inedible to the two large herbivores that presently inhabit the region, musk oxen and caribou.[226] It is why both species utilize a very different pattern of grazing than, say, bison, who "mow the grass" as they move through a meadow. Musk oxen and caribou are much more selective, and they're technically browsers, not grazers.

They pick and choose what they eat, carefully avoiding toxic plants. And both must forage widely and are always on the move. The fact that grass-loving bison cannot survive in today's tundra surely means that a very different vegetation regime existed during the Pleistocene. Bison remains from the period have been found in every part of the mammoth steppe.

The productivity paradox explains why the early explorers were not wrong when they concluded that the mammoths lived far to the south. Investigators like Middendorff had the benefit of walking the ground, after all. They were able to study the "scene of the crime" and make an open-eyed assessment. I believe Middendorff understood at a glance what the scientists at Burg Wartenstein required more than a century of further study to conclude: The tundra could never have supported a population of hungry mammoths. It was obvious. The food supply was plainly inadequate. This was also the view of Middendorff's associate, Karl Ernst von Baer.[227]

Middendorff's conclusion that the mammoths lived in the much more productive temperate zone far to the south was perfectly rational, hardly a leap. Although he almost certainly knew nothing about crustal displacement, Middendorff was nonetheless on the path to a solution. The mammoth remains had indeed been transported from the south, however, not by Siberian rivers, but rather, on the "back" of the earth's shifting crust.

Nor were catastrophists like Howorth wrong either. Even if they failed to identify the cause, they were correct about the titanic scale of the event. How else would one describe a 23.8° slippage of the earth's crust? For that matter, it is quite possible, hardly a stretch, to imagine that the event involving the entire crust of the earth also set in motion enormous tsunamis across large parts of the earth. If such flooding occurred it was certainly of Biblical proportions, even if secondary to the main event. As I write, all of the facts available to me are consistent with this conclusion.

In the years after Burg Wartenstein, almost no progress was made resolving the productivity paradox, though there were a few failed attempts. Evidently influenced by Ritchie and Cwynar's thinking about the tundra, several scientists suggested that the mammoths had migrated seasonally between the more productive southern steppe and where their remains are presently found in the far north.[228] However, the migration hypothesis does not withstand closer scrutiny.

Although the mammoth, like the modern elephant, was probably nomadic, its anatomy, also like the elephant, was not designed for annual migrations of several thousand miles. As R. Dale Guthrie pointed out, "Mammoths had heavy graviportal, distally muscled legs, and they required much more energy to walk than other mammals...Nomadic ranging is not the same as a mass exodus in a long migration."[229] The opposite is true of smaller ungulates like caribou, which use only about 20% more energy to walk than to stand. The light-footed caribou is famous for long-distance travel. But the huge plodding mammoth could never have managed it.

The migration hypothesis also fails for another reason. Given that tundra is essentially a polar desert and produces little in the way of quality forage, why would the hungry mammoth expend so much time and effort to go there? The migration hypothesis makes no sense.

In 2001, R. Dale Guthrie proposed a solution of his own, and one that to my mind serves to illustrate just how badly stuck science has become. In his paper Guthrie attempts to reconstruct the paleoecology of northern Asia during the late Pleistocene. He argues that clear skies throughout the region are key to resolving the productivity paradox.[230]

According to Guthrie, the Himalayan mountains to the south and the massive North American ice sheet to the east together blocked the movement of moisture into northern Asia, producing an enormous stable zone of high pressure. As a result, the skies in Siberia were generally cloud free during the late Pleistocene, and this contrasts with the cloudy conditions that are so prevalent today in the far north. In the author's own words, "This [produced] enhanced evapotranspiration in summer (aridity) and radiation deficit to the black night sky in winter (cold)."

Guthrie calls his proposed solution "a new paradigm"; however, it is nothing but a rehash of the familiar aridity argument that I rejected as unpersuasive in earlier discussions. Guthrie has made numerous contributions to our understanding of the mammoth steppe, a phrase he himself coined. I have already cited his work several times. Unfortunately, fresh thinking is conspicuously absent from his 2001 paper, which, in my opinion, is symptomatic of a failed paradigm.

Fortunately, the solution to the paradox is quite simple, and was within reach even at Burg Wartenstein. The critical evidence was already known at the time and was even discussed at the conference. But recognizing its actual significance required a conceptual leap to a new science model, which those in attendance evidently were not prepared to make.

Scientists at Burg Wartenstein were well aware that, very late in the Pleistocene, a dramatic shift in vegetation occurred across the length and breadth of Beringia (eastern Siberia and Alaska).[231] This is based on converging lines of evidence from different fields, including pollen studies. The vegetation shift started about 13,800 years BP and continued well into the Holocene. It also appears to have coincided with the disappearance of the mammoth in Siberia. This cannot be a coincidence.

I believe the two phenomena are intimately related because both were caused by the same event. A cataclysmic 1,657-mile slippage of the earth's crust moved the North Pole from its previous position on Baffin Island to its present location in the Arctic. And the same event caused a reordering of vegetation zones across the entirety of Siberia and Beringia.

It is important to realize, however, that the mass extinction of the mammoth and other megafaunal species is a complex question. There have been multiple extinction events, each at different times. An earlier and separate mass extinction event wiped out the Australian megafauna approximately 41,000 years BP.[232] The cause has yet to be identified.

The mammoth extinction in the northern hemisphere occurred tens of thousands of years later, at the close of the Pleistocene, though the date and the cause remain controversial. Various hypotheses have been proposed, including the early Biblical deluge idea, predation by humans (i.e., Pleistocene overkill), and abrupt climate change. Each can account for some of the facts, but none is consistent with the entirety of evidence. Certainly abrupt climate change is implicated but, as noted, this only begs the deeper question: What caused the climate change?

I believe the primary driver was not solar insolation (Milankovitch) cycles, but rather a cataclysmic displacement of the earth's crust that set in motion a full range of climatic changes around the globe. The manner and degree of climate change in a given region would largely depend on the amount of latitudinal change. Any site on or near the MoMD would undergo the maximum latitudinal shift and would likely experience the greatest change in climate. Whereas a site far from the MoMD would experience much less, or even no latitudinal change, hence, little or no climate change.

One would expect to find a broad range of climatic changes between these two extremes depending on the region, and all due to the same cause. It follows that abrupt climate change was not global, but regional, and it depended on latitude. As they say in the real estate business: location, location, location.

Like the mammoth steppe generally, Beringia was a treeless landscape during the last glacial maximum (LGM). It was mostly open country, a mosaic of grasslands and other shrub and forb communities. Patches of forest existed on favorable sites within it, especially along rivers and streams, yet forest was a minor part of the overall steppe ecosystem. Today, by contrast, much of Siberia and Alaska are covered by boreal forest, primarily spruce, alder, and birch.

One of the most common plants found on the mammoth steppe in Beringia during the LGM was the genus *Artemisia* (sage, mugwort, wormwood, etc.). We cannot be certain of the individual species because, unfortunately, pollen studies of flowering plants cannot resolve differences at the species level. They are only able to distinguish genera.[233] *Artemisia* includes more than 200 kinds of plants, nearly all of which grow in the temperate zone. Only a few members are found in the Arctic or subarctic. Notably, *Artemisia* features some well-known medicinal absinthes, one of which, sweet wormwood (*Artemisia annua*), is commonly used in the treatment of malaria. This medicinal herb is grown commercially in southern China.

Today, several varieties of *Artemisia*, including sage brush, are common shrubs in the American West, where they tend to dominate entire landscapes. Late Pleistocene pollen samples from eastern Siberia and Alaska point to a similar dominance by *Artemisia* of Beringian landscapes. Steven B. Young, who helped organize Burg Wartenstein, presented research at the conference about the sudden vegetation shift that brought this dominance to an end. And his paper was included in the subsequent anthology.[234] According to Young, this vegetation change was sudden and occurred very late in the Pleistocene. He describes it as a "catastrophic" event. Indeed, Young employs the "c" word several times in his paper for emphasis, to leave no doubt about his meaning.

Even as the *Artemisia*-dominated plant communities were collapsing, birch (*Betula*) forest was simultaneously expanding its range across the same landscape. This, in turn, was followed during the Holocene by the slower colonization of the same lands by spruce forest (*Picea*) and alder (*Alnus*).[235] The catastrophic shift from open steppe country to forestland ran to completion in a few thousand years. The end result was the boreal forest (Russian equivalent: taiga) found across much of the north country today.

Artemisia was not eliminated entirely. The genus survived in Beringia on favorable sites, but in a much-diminished relict capacity. Here, favorable means "steep, well drained, and south-facing." According to botanists, *Artemisia* prefers warm and dry locations with a southern aspect.

Young put it this way:

> "…many if not most of the disjunct patterns of plant distribution in our area can be considered the result of extinctions of previously existing populations in intermediate areas. The disjunct populations are commonly relict populations… [which] can be considered as samples of a pre-existing vegetation."

Here, Young is suggesting that during the LGM, when *Artemisia* dominated, birch was itself a relict species *from a still earlier time,* before exploding once again and replacing *Artemisia* across the same landscape. Young continues:

> "This is precisely the situation one would expect if this type of vegetation had been confined to small relict areas, subjected to the loss of most of its original constituents by extinction, and had then been able to rapidly recolonize broad areas following a climatic change."[236]

Notice the implication. If Young is correct, the pattern of sweeping vegetation change across entire landscapes, from dominant to relict and back again to dominant, probably was repeated a number of times over the course of the Pleistocene, in concert with serial ice ages and warm interglacials.

Pollen studies in Alaska and Yukon indicate that an earlier vegetation shift of this same type and magnitude also occurred at roughly 30,000 years BP.[237] This earlier vegetation shift remains unexplained within the current science paradigm.

Although the pollen studies presented at Burg Wartenstein were limited to eastern Siberia and Alaska, more recently, similar studies for West Siberia have been published, and they strongly support Young's data. They indicate that the catastrophic vegetation shift documented by Young in Beringia in fact occurred over a much larger region, including nearly all of Siberia.

Two Russian scientists based in Tomsk, Tatyana A. Blyakharchuk and V.P. Amel'chenko, published this new research in 2012.[238] The scientists studied pollen grain samples collected from ninety-seven sites in West Siberia, an immense landscape bordered by the Ural Mountains in the west, the Altai mountains and China to the south, Lake Baikal to the east, and the Arctic in the north. It is a vast and diverse region, yet the authors found it appealing for study because the country tends to be uniformly flat. The absence of extreme topography over most of the area translates to a greater regularity of vegetation zones across the region.

The Russians concluded that the maximum range of *Artemisia* occurred in West Siberia during the LGM and continued until roughly 13,800 years BP, after which there was "a fundamental change in [the] landscapes of Western Siberia…."[239] The former continuous steppe landscape dominated by *Artemisia* rapidly disintegrated until, by 8,000 years BP, only small relict *Artemisia* communities remained. Of the fifty-eight species of *Artemisia* that still grow in the study area, nearly all are found in the southern portion of the region. Only two species from the genera are presently found at isolated locations in the far north (70 degrees N). All of the remaining *Artemisia* communities are relict populations.

And, just as in Beringia, the retreat of *Artemisia* in western Siberia was accompanied by the simultaneous northward spread of birch forest. This is well documented and non-controversial.

I have focused on *Artemisia* because it was dominant during the LGM, and because we have good data for this species. However, countless other plants, and probably whole floral communities, were surely also affected by crustal displacement, and likely responded in a similar manner. *Stipa* (needlegrass) is one such case. *Stipa* is an indicator species for steppe grasslands in central Alaska and Eurasia during the LGM. So, for this reason, no one was surprised when needlegrass recovered from an ancient ground squirrel nest in the Fairbanks area was dated to 18,230 years BP (plus/minus 410 years). Yet, needlegrass is no longer found in Alaska and presently grows far to the south.[240] Why?

In 1958, a Russian scientist reported a similar case. B.A. Tikhomirov, from the Komarov Botanical Institute of the Academy of Sciences, received permission to study the famous Berezovka mammoth discovered in 1901 near the Kolyma River, Siberia. Based on pollen analysis of its stomach contents, Tikhomirov concluded that the mammoth had been feeding primarily on grasses.[241] This overturned the earlier view that mammoths ate conifer needles and twigs. But most surprising was the fact that the types of grass in the gut presently grow south of where the carcass was recovered! Tikhomirov could think of no other explanation for this, and concluded that mammoths were like reindeer. The Berezovka mammoth had migrated north to the tundra after eating the grasses. However, migration is ruled out by the geographic distance involved and by the mammoth's twelve-hour gut-transit time.[242] The mammoth's grass dinner would have long since passed through his system, before arriving.

Fossil insect data tends to be scarce, but the data that *is* available supports the picture I have described. For example, although Holocene samples of fossil insects collected in Beringia include bark beetles that feed on conifers, these same beetle species are absent from late Pleistocene samples, pointing to a treeless landscape during the LGM. Also, late Pleistocene insect fossils gathered in eastern Siberia include several species of weevils no longer found in the region. Today, these weevils live far to the south in Mongolia.[243]

More recently, in 2005, four Russian scientists published a detailed report about fossil insects recovered from ice cliffs on the Laptev Sea coast. The site is near the mouth of the Lena River. (**See Figure 1**, **Chapter Twelve**) The team collected 5,900 specimens, and of these they were able to identify ninety-three different species.

Most of the insects are steppe or forest species presently found in southern Siberia, although some still live in isolated relict communities extending to the arctic.[244]

The results of a more recent DNA study of plant material from the Late Pleistocene are also consistent with large-scale vegetation shift. When an international team analyzed plant material from permafrost samples collected from 242 sites in Siberia, Alaska, and the Yukon, they found that "the post-LGM flora was different, with pronounced geographic differentiation."[245]

The new method of DNA analysis is an important adjunct to pollen studies because it can make an absolute identification down to species level from a microscopic sample, even from a few fragmented DNA molecules. In their paper, the team also reported another surprising result, one that calls into question the common view that the mammoth steppe was primarily a grassland. When the team analyzed eight different specimens recovered from the stomach contents of a woolly mammoth, a woolly rhinoceros, a bison, and a horse, they found a predominance of forbs, not grasses, in the gut. Forbs are more nutritious than grass forage, which could help to explain why the Pleistocene bestiary was so well endowed.

If the reader is not persuaded by this handful of cases, I suggest the only reason we do not have a great many more is quite simply because no one has looked. I suspect there are countless other cases out there awaiting discovery. Although each type of plant probably responds to crustal slippage in a somewhat different manner, we should nonetheless expect to find the same general pattern of shifting vegetation zones across entire landscapes and, indeed, hemispheres. As already noted (it bears repeating), the evidence for crustal displacement is all around us.

We need only train ourselves to recognize it.

Chapter Fourteen: The Ancient Vertex

Russians make a distinction between western and eastern Siberia, which they regard as separate regions. This is merely a convention and is attributable to Siberia's awe-inspiring immensity. Both regions are contiguous parts of the largest continental land mass on Earth. So, of course, the late Pleistocene vegetation changes in eastern and western Siberia were not separate events. They were simultaneous and doubtless had the same cause. A cataclysmic slippage of the earth's crust triggered a continent-wide re-set of vegetation zones across the entirety of Siberia and Alaska.

Because the implications are paradigm-busting, a brief review before we proceed might be helpful. Recall, in earlier chapters, aided by archaeological alignments, we identified four previous north pole positions during the last 120,000 years of Earth history. One of these, the Baffin Island pole, was current between roughly 50,000 years BP and the end of the Pleistocene. At this time, a 1,657-mile displacement event moved the pole to its present location in the Arctic Sea.

Discovery of the Baffin Island pole position (see Chapter Four) was crucial to this quest because it enabled the identification of the MoMD. Four points define this great circle: the two present pole positions (north and south) and the two former pole positions (north and south). I was also able to determine the distance of crustal slippage, i.e., 1,657 miles, unique to the event based on archaeological alignments and extralimital mollusk data, which I found, quite by chance, embedded in Charles Darwin's 1846 book about the geology of South America. In the 1820s and 1830s, capable mollusk enthusiasts working along the west coast of the southern continent meticulously compiled this data, which mollusk experts subsequently overlooked for the better part of two centuries. They are still doing so, as I write.

The MoMD is important for many reasons. In the first place it defines the line of maximum force, which in this case, by sheer chance, happened to follow the coast of Chile. This explains why the extralimital migration distance, i.e., 1,657 miles, exactly equaled the maximum displacement of the crust. As I write, the mechanism has yet to be identified and remains one of the most important unresolved issues in science. I will begin to discuss possible mechanisms in Chapter Eighteen.

The MoMD describes the great circle where the greatest movement of the crust occurred. So, we should also expect to find the greatest collateral effects along this meridian. In earlier chapters, I explored several different parts of the MoMD and presented multiple lines of evidence in support of Hapgood's theory. I will now examine another key segment of the MoMD: the portion that passes through Siberia. (**See Figures 1 and 2**)

Notice that the MoMD crosses the region just east of Lake Baikal, the oldest lake on the planet, and also the deepest by far. Universally recognized as a world heritage site, Baikal holds an estimated 20% of the planet's fresh water. The 375-mile-long lake also happens to lie on or very near the invisible boundary between western Siberia and eastern Siberia. In 1908, the Austrian geologist Eduard Suess showed remarkable prescience when he referred to Lake Baikal as "the ancient vertex of Eurasia…"[246]

I would very much like to know what Suess was thinking when he penned that. Because the cataclysmic event that moved the earth's crust at the end of the Pleistocene left

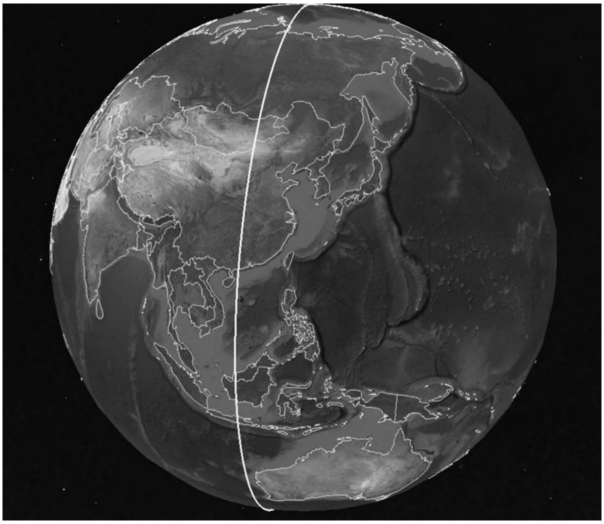


Figure 1. MoMD in relation to Asia

(Google Earth; US Dept of State Geographer; ©2020 Google; Data SI0, NOAA, U.S. Navy, NGA, GEBCO; Image Landsat/Copemicus; View from Space (Altitude: 11,012 mi))

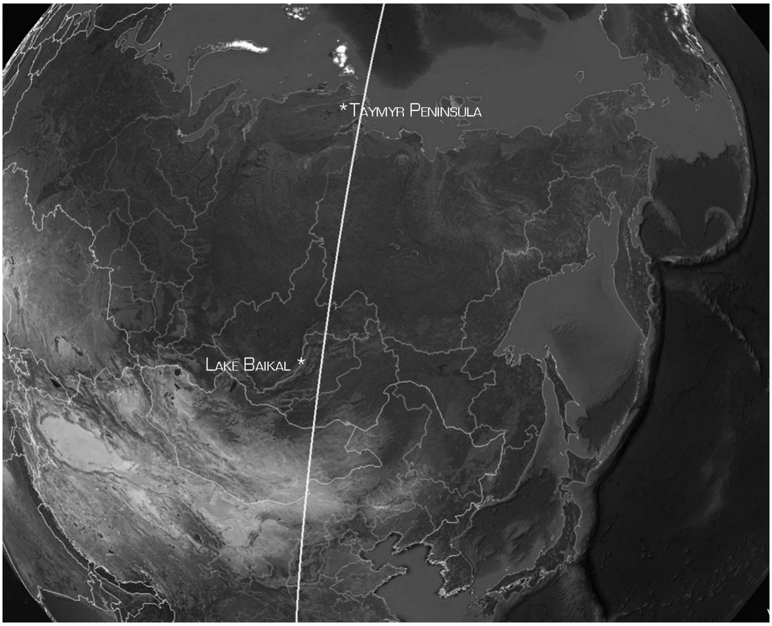


Figure 2. MoMD in relation to Siberia

(Google Earth; ©2020 Google; US Dept of State Geographer; Data SI0, NOAA, U.S. Navy, NGA, GEBCO; Image Landsat/Copemicus) a deep mark on the region. As North America was moving 1,657 miles to the south, Siberia was moving in the opposite direction, i.e., to the north, and by the same amount. And the path of maximum displacement fell within sixty-three miles of Lake Baikal.

Crucially, the MoMD also passes through the Taymyr Peninsula on the north coast of Siberia. Taymyr is unique in its own way and includes some of Russia's richest mammoth beds. But Taymyr was not always on the coast. Most of what is now the Taymyr Peninsula was landlocked during the LGM, hundreds of miles from the sea. When the crust of the earth moved, much of northern Siberia sank beneath the Arctic Ocean. No one knows exactly how much land was affected, but the total must have been very great. The continental shelf of Siberia is the world's largest, extending for hundreds of miles into the Arctic Ocean. According to Cambridge professor Peter Wadhams, who made fifty trips to the Arctic over the course of a long and distinguished career, the shelf totals some 811,000 square miles.[247]

To give some idea just how large this is, it's an area the size of California, Arizona, Nevada, Utah, Montana, Oregon, and Washington combined, plus Vermont, New Hampshire, and Delaware thrown in, with room to spare. Obviously, the mammoth steppe included a good deal more than the present landmass of Siberia. And Beringia, i.e., the former Bering Sea land-bridge, made up the extreme eastern part of this vast region.

The subsidence affected nearly all of the Siberian coast, from Murmansk in the west to Chukotka in the far east, a distance of more than 3,000 miles. Earth scientists attribute the flooding of northern Siberia to rising sea levels and the melting Laurentide ice cap. However, I suspect that the spheroid shape of the earth was also a factor. Although the geophysical processes responsible for the slippage of the earth's crust over the underlying mantle are not yet understood, it stands to reason that the earth's equatorial bulge and flattened poles are factors. And this may explain why land rises in some places and sinks in others.

An obvious example is the recent 2,000-foot rise of the Andes observed by Darwin, which we discussed in the early chapters. If this is correct, it partially resolves one of the most stubborn mysteries in geology. The subsidence of the northern Siberian landmass may be another case. And we should expect to find the greatest effects in the vicinity of the MoMD, for instance, in the Kara Sea, located just west of the MoMD, and in the Laptev Sea, just east of it.

The coastal waters along the Siberian shelf are quite shallow. According to Wadhams, 75% of the shelf is less than 130 feet deep.[248] Yet millions of mammoths once roamed over this now-submerged landscape. We know this because the physical remains of mammoths and/or bison have been found on islands in the Arctic Ocean hundreds of miles north of the Siberian coast. These Arctic outposts may also approximate the northern boundary of the mammoth steppe. For instance, bison remains were found on the island of Novaya Zemlya (75° N, 59° E), whose southernmost cape is about a hundred miles north of the Siberian coast. The presence of bison on Novaya Zemlya surely means that the island was once connected to the mainland.[249] (**See Figure 3**)

One of the most remarkable mammoth sites is Bennett Island (76° N, 149° E), located about 290 miles north of Siberia. The island is tiny, hardly more than a dot on the map. Yet, in 1903, an intrepid explorer, Baron Eduard von Toll, succeeded in visiting Bennett in a small open boat, where he reportedly found mammoth bones.

Years before, Toll had deeply impressed the science world with the first photos of the enormous ice cliffs and wedges along the Siberian coast. Regrettably, on his return journey from Bennett, Toll's entire party was trapped by sea ice during the November freeze up and never heard from again. The explorer's journal, however, did survive with a detailed write up.[250]

The voyage surely ranks as one of the most daring (or foolhardy) expeditions in the annals of world exploration. Yet the discovery of mammoth remains on Bennett was important because it proved that the Siberian continent, and the mammoth steppe, once extended at least eighty miles beyond the New Siberian Islands, which, as I have already noted, is itself an incredible mammoth repository. The superabundance of mammoth bones, teeth, and tusks on the New Siberian Islands surely means that the surrounding submerged lands were, at one time, prime mammoth habitat.

Bennett Island is only 923 miles from the North Pole and, for many years, held the distinction of being the world's most northerly mammoth site. However, that honor has now passed to the middle island in the Severnaya Zemlya archipelago (79° N, 96° E), located about one hundred miles north of the Taymyr Peninsula. (**See Figure 3**) No surprise that Severnaya Zemlya means "north lands" in Russian. The mammoth site on Severnaya Zemlya is only about 720 miles from the north pole.[251]

Surely these extreme locations are clues that something is very wrong with the present science model. Although most scientists agree that the mammoth evolved some adaptations to cold, most notably, a soft woolly undercoat, it would be a mistake to conclude on this basis that the mammoth was an Arctic animal. Not true. In North America, as already noted, the mammoth roamed as far south as central Mexico, and even farther south in China.

Wrangel Island is the fourth and last of these northern mammoth sites, located in the Chukotka Sea about ninety miles north of eastern Siberia (71° N, 179° W). In 1993, a Russian team led by S.L. Vartanyan announced that mammoth teeth from Wrangel had been carbon dated to 4,000 years BP.[252] The late date sent shock waves through the scientific community because this means that some mammoths survived the extinction event that wiped out the vast majority of the species at the end of the Pleistocene. A relict population evidently survived on Wrangel Island well into the Holocene. Moreover, follow-up studies have confirmed the date.[253] (**See Figure 3**)

Vartanyan also made another important discovery that would have greatly interested Darwin. When geneticists studied mammoth DNA recovered from Wrangel, they found a sudden reduction of genetic diversity and concluded that the relict group "was established by a single maternal lineage."[254] The narrowing of the gene pool,

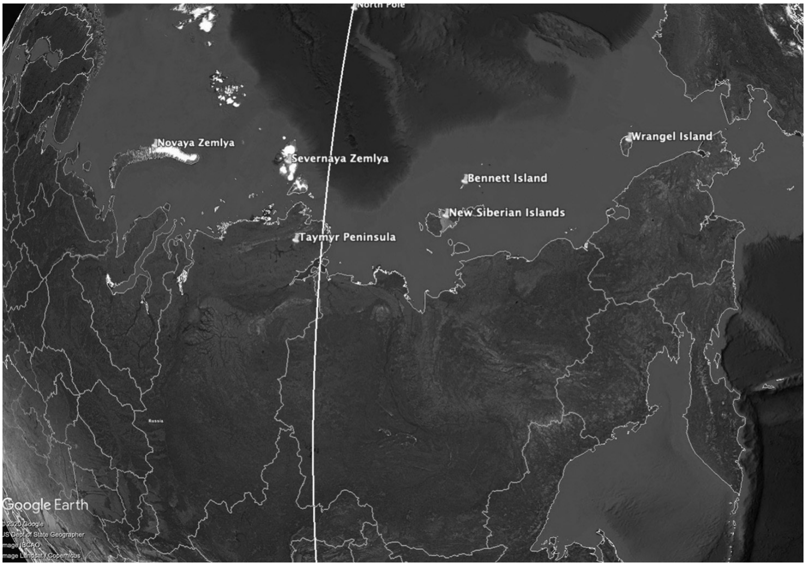


Figure 3. Mammoth and Bison fossil sites in north Siberia. From left to right: Novaya Zemlya, Severnaya Zemlya, New Siberian Islands, Bennett Island, and Wrangel Island

however, did not precipitate a swift downward spiral to extinction, as might be expected. Instead, the herd underwent a rapid evolution to a smaller dwarf form! Evidently the reduction in body size was an adaptive response to the diminished availability of food.

A second DNA study found that, subsequent to the herd's isolation, "genetic variation was maintained at a relatively stable level, and even increased slightly."[255] This raises interesting questions. Did a mutation spike, possibly caused by a storm of cosmic radiation, prompt a rapid evolution to a smaller form that was better suited to prevailing conditions? The tendency to dwarfism in response to environmental pressure is well documented. R.D. Guthrie reported a similar rapid down-sizing of the Alaskan horse,prior to its extinction. And the gigantic Pleistocene bison is also known to have declined in size, though in this case did not lead to extinction.[256]

Newly reported evidence suggests there may also have been a second relict population of mammoths in Estonia and northern Russia. In 2002, a team led by L. Lougas reported that two mammoth molars from a site in Estonia had been carbon-dated to 10,100 (plus/minus 100) years BP.[257]

A similar date has also been reported for mammoth bones from Cherepovets, north of Moscow.[258] These specimens came from a single mammoth unearthed in a peat bog in 1943. Recently, they were carbon-dated to 9,760 (plus/minus 40) years BP. The evidence from these two sites is thin, in contrast with Wrangel Island, which has produced a multitude of fossils. Nevertheless, it is possible that a small population of mammoths survived for another 1,000–2,000 years in the Baltics and on the north Russian plain before completing the downward trajectory to extinction.

Freeze Up?

In 2001, the Russian government acknowledged the political importance of Siberia's continental shelf by proclaiming ownership of 463,000 square miles of the Arctic Sea.[259] The shallow seabed now formally claimed by Russia extends ~350 miles north of the Siberian shore, well beyond the internationally recognized 200-mile limit. Evidently, the Russians intend to commercially tap the region's immense reserves of natural gas, estimated at 400 gigatons.[260]

How they plan to accomplish this is unclear, however, because the gas, i.e., methane, is in a frozen form known as clathrate. Attempts to extract it will likely further destabilize the deposits on the continental shelf that have been frozen since the Pleistocene, deposits which have *already* been destabilized by global warming. Gas development will make a bad situation worse and plainly is contra-indicated.

Planetary warming has been underway since the industrial revolution, and the sensitive Arctic is by far the most affected region. The Arctic is warming up about three times as fast as the rest of the planet. Since 2005, the formerly ice-bound Siberian coast has been essentially ice-free. This is a major problem because for thousands of years the sea ice chilled the Arctic Ocean and also served as a protective cap over the frozen seabed. In the absence of sea ice, the ocean is directly exposed to sunlight and absorbs more solar energy.

This warms up the ocean and destabilizes the frozen clathrate deposits on the seabed, which then leak methane into the water column. Although the ocean water tends to absorb the bubbling methane, because the sea on the continental shelf is shallow, the gas often reaches the atmosphere. Methane is a much more potent greenhouse gas than CO_2 over the short term.

Fortunately, we now have good data, thanks to new polar orbiting satellites equipped with sensors capable of detecting methane plumes and atmospheric methane. Should the methane leakage continue or accelerate, the possibility of a runaway greenhouse effect cannot be ruled out. There is also the potential for an explosive 50-gigaton methane "burp," which, should it occur, would likely cause a sudden warming of the planet by half a degree or more.[261]

The outcome probably depends on how much frozen methane is locked in the combined permafrost and seabed deposits and how fast it gets into the atmosphere. Wadhams has called the methane issue "a catastrophe in the making" and thinks it is the most immediate threat to human survival.[262] Once again, however, *that is another story,* beyond the scope of our discussion.

Unfortunately, Earth scientists engaged in non-commercial research have been slow to recognize the implications of the dozen or so deep-frozen mammoth carcasses that have been recovered, to date, from the Siberian far north. The process by which these few celebrated mammoths were preserved in Siberian muck more than 10,000 years ago has never been satisfactorily explained. In his book, *Frozen Fauna of the Mammoth Steppe,* paleontologist R. Dale Guthrie describes an exercise that taught him a great deal about freezing and decomposition. What he learned sheds new light on the frozen mammoths.[263]

One winter, Guthrie, who was then a professor at the University of Alaska at Fairbanks, heard that fifteen bison had died about a hundred miles south of town after drinking water contaminated with urea fertilizer. Guthrie saw an opportunity to learn something new, and he obtained permission from Alaska Fish & Game to recover one of the dead animals. Aided by a friend with a wrecking truck, he hoisted the largest dead animal of the group, a three-year-old bull, onto a pickup and brought the corpse home for study. By this time, the body of the bison had already been exposed to minus 30° F cold for several days, and Guthrie assumed it was frozen solid. He was about to learn otherwise.

There had been a light snowfall during the night and, the next morning, he noticed that the fresh snow on the body had melted. Evidently, the bison's inner organs were fermenting and generating heat. The same thing reoccurred three days later, after another snowfall. Eventually, Guthrie opened up the corpse and removed the still-steaming viscera. Two days later, the now-open bison had finally frozen.

If a dead bison can retain its inner body heat for many days due to putrefaction, despite intense winter cold, imagine the case of a dead mammoth that is at least five times larger. Obviously, a mammoth would retain its body heat for many weeks after death, perhaps even for months, as the inner organs and tissues slowly decomposed. Yet, by all accounts, the frozen mammoths recovered from Siberia were found to be in a remarkable state of preservation. Some of the marbled meat looked fresh enough to eat and, on occasion, was actually fed to dogs who suffered no ill effects. The standard explanation that the mammoths were preserved after falling into icy water or becoming mired in deep muck or snow cannot be taken seriously.

And there is another problem. Seeds and flowers recovered from the GI tract of a famous behemoth, the Berezovka mammoth, indicates the animal died in summer, in which case the body would have begun immediately to decompose.[264] Therefore, the preservation of a large part of the Berezovka mammoth remains unexplained—a mystery. And there are at least a dozen other similar cases. It would appear that the celebrated mammoths were flash frozen. If this is correct, it means that extraordinary events without precedent in recorded history occurred at the end of the Pleistocene.

I believe the unlucky mammoths were quick-frozen and interred in icy muck at the end of the Pleistocene when a displacement of the earth's crust moved the mammoth steppe from the temperate zone into the high Arctic. The abrupt hemispheric reordering of vegetation zones across Siberia at this time surely points to a global-scale event. It is no coincidence that the youngest carbon dates for the woolly mammoth in Siberia (apart from Wrangel Island and a few teeth/bones from the north Russian plain) are clustered in and around the Taymyr Peninsula.[265]

I was not surprised to learn this, because the line of maximum force (MoMD) passes through the area. (**See Figure 2)** I would argue that the most northerly mammoth specimens yet recovered, from Severnaya Zemlya, one of which was carbon-dated to 11,500 years BP, should also be included in this select group. (**See Figure 3**) The MoMD and the mammoth fossils are like a flashing neon sign that says: Look here for answers!

There are other compelling clues. Northern Siberia owns the world's deepest permafrost that, according to two different sources, is 5,000 feet deep.[266] That's nearly a mile. By contrast, the permafrost at Prudhoe Bay, Alaska, only goes down to 2,165 feet.[267] Earth scientists attached to the oil industry have exhaustively studied the Prudhoe Bay region, and they tell us it has the deepest permafrost found in Alaska, to date. Yet, the permafrost at Prudhoe Bay is less than half as deep as its counterpart in northern Siberia. Why?

Permafrost is also widespread across northern Canada and reaches its greatest depth on Axel Heiberg and Ellesmere Islands (80° N latitude). Both islands are located far to the north of Siberia and Prudhoe Bay, and so for this reason, one would expect to find deeper permafrost. Yet the permafrost on Axel Heiberg and Ellesmere Islands is only 1,640 feet deep.[268] Why is the permafrost in northern Canada so much shallower? *But perhaps I should rephrase the question: Why is the permafrost in Siberia so much deeper?*

The case is stranger still because most of Siberia, despite its proximity to the Arctic, was never glaciated during the LGM. I have argued, and the evidence suggests, that the European Ice Age was separate from the LGM and occurred earlier. Nor in any event was the European ice sheet responsible for the deep Siberian permafrost, because the cap barely reached the Taymyr Peninsula. Today, these important questions are unanswered. But we are free to speculate. I believe the cataclysm that quick-froze the woolly mammoths also produced the world's deepest permafrost.

Credit for the first scientific studies of the Siberian permafrost goes to a Prussian-Estonian zoologist, Karl Ernst von Baer, who was one of the most important scientists of the 19th century. A full professor of zoology by the age of thirty, Baer made contributions in a number of fields, including embryology, and is honorably mentioned by Darwin in *The Origin of Species*. But the professor was also an avid explorer. Baer visited Novaya Zemlya in 1837, and his numerous articles about the Arctic reached an international audience.[269] Subsequently, Baer organized the first field studies of the Siberian permafrost, and he was ably assisted in this endeavor by Alexander Theodor von Middendorff, already mentioned.

Baer's pioneering manuscript about permafrost, though never published, became a blueprint for continuing research. He also developed the first map of the Siberian permafrost, based on field work completed by Middendorff between 1842-1845. Unfortunately, the map gathered dust for many years and was only recently made public. (**See Figure 4**) I was astonished when I found the map posted on the Internet because the MoMD perfectly bisects Baer's region of deepest permafrost centered on the Taymyr Peninsula. This cannot be a coincidence. More than 11,000 years after the fact, the MoMD shows where the hammer fell on that fateful day.

I am well aware, of course, that skeptics will disagree. I am actually quite sympathetic to skeptics because I am a born doubter myself. No one should take Hapgood's theory on faith. I certainly do not, as the next section will show. His theory deserves to succeed or fail based on the evidence and continuing research. I have already proposed several ways to put Hapgood to the test. Fortunately, we are now in a strong position to do so and perhaps prove his theory, once and for all. It helps greatly that we have identified the former north pole position on Baffin Island, and that we also know the

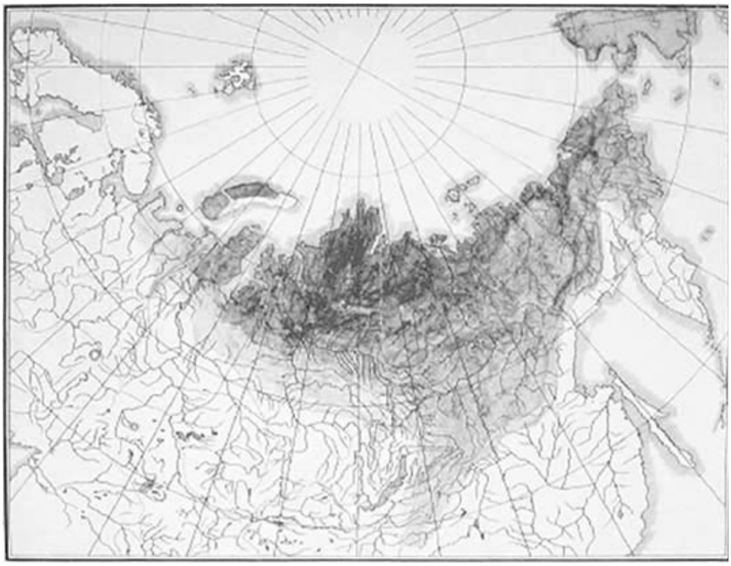


Figure 4. Baer's permafrost map of northern Siberia

(Reprinted with permission of Cambridge University Press)

maximum distance the crust moved, i.e., 1,657 miles. Armed with this information, we can easily plot changes in latitude for any given location, and make predictions about climate.

The "Noah Wood"

The boundaries of the present-day Asian steppe are well defined. (**See Figure 5**) This vast rangeland extends from Romania and the Ukraine in eastern Europe all the way across Asia to the Far East. The European portion of the steppe reaches south as far as the Danube River, the Black Sea, and the Caucasus mountains. In Asia the steppe is divisible into western and eastern portions separated by the Altai Mountains and other high ranges on the China-Russia border.

The western portion of the steppe lies roughly between 48° and 57° N and extends from Kazakstan north to Siberia, reaching its northernmost limit at about 57° N. The eastern portion (also known as the Mongolian steppe) is north of the Tibetan Plateau and bounded in the south by the Gobi Desert. In the far east, the southern terminus of a separate and smaller Manchurian portion of the steppe

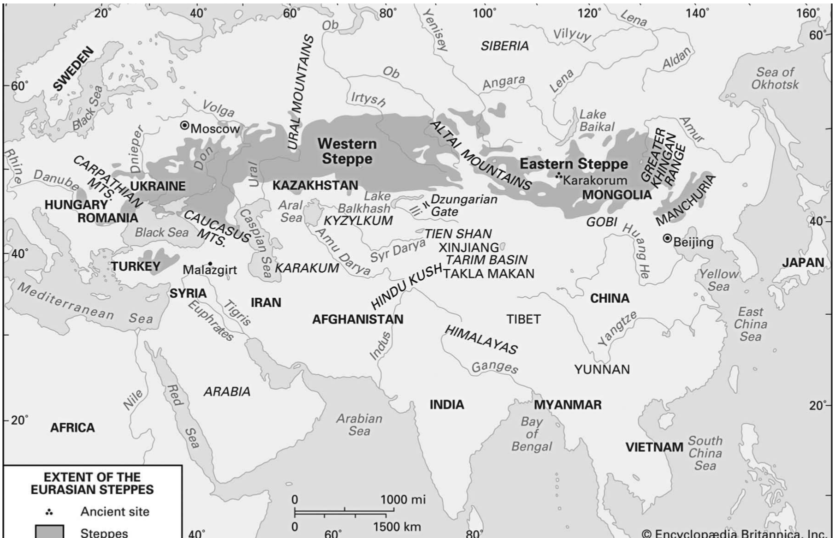


Figure 5. Present extent of Asian steppe grasslands

(Source: Encyclopedia Brittanica)

reaches to within about 200 miles of Beijing, at roughly 42° N. However, before the last crustal displacement, this easternmost portion of the steppe extended much farther south, and provided the world's most southerly mammoth habitat. This proves beyond the shadow of a doubt that the mammoth was a temperate species.

Grassland steppe is one of several vegetation zones existing in Asia today. While each vegetation zone is distinct, the zones do not have sharply defined boundaries but gradually transition from one to the next. Starting in the south, the succession goes as follows: desert, desert-steppe, steppe, steppe-forest, forest, forest-tundra, and tundra. Here, forest is equivalent to taiga. So, crucially, the Asian steppe is bounded by desert in the south and taiga in the north. And I believe it is fair to assume that identical or very similar vegetation zones also prevailed in the Pleistocene. I have seen no evidence to the contrary.

A simple exercise using Google Earth Pro shows the value of everything we have learned. Our most northerly mammoth site on Severnaya Zemlya (79° N) is a suitable test case because, as already noted, the site is probably quite near to the northern limit of the mammoth steppe during the late Pleistocene. (**See Figure 3, page 187**) Severnaya Zemlya is located close to the outer edge of the Siberian continental shelf. About one hundred miles northwest of the archipelago, the shelf drops away into deep water. It is possible that mammoths ranged north of Severnaya Zemlya, but not by much. The site is also conveniently close to the MoMD.

Plotting a line 1,657 miles due south of our site on Severnaya Zemlya brings us to a point on the map just west and slightly north of Lake Baikal, at a latitude just shy of 56° N, which is very close to the present northern limit of the Asian Steppe. If we reasonably assume that the mammoth steppe extended another hundred miles north of Severnaya Zemlya, and accordingly adjust our point northward to about 57 degrees N, we arrive at the present-day northern limit of the Asian steppe. This cannot be a coincidence. When Asia moved north 1,657 miles along the MoMD, all of the vegetation zones, including the steppe, shifted south by approximately the same amount.

I have laid the footing for a bold prediction, which I will now make.

Given that the Asian steppe is bounded by taiga in the north, should we not expect that the mammoth steppe during the Pleistocene was similarly bounded by forest to the north? Yes, certainly. *So, what happened to it?* Simple. When the crust moved north by 1,657 miles, the taiga disappeared beneath the Arctic Sea. Therefore, the old forest, or rather, the dregs, whatever remains of it, should still be there under the sea, awaiting discovery. We need only go and look for it.

Frankly, I am surprised that others have not reached this conclusion, because it is supported and even suggested by the early accounts of explorers to the region. A Swede, Mattias Hedenstrom and a Russian, Yakov Sannikov were the first to visit the New Siberian Islands in 1806, and they reported finding "the remains of enormous petrified forests. The trunks of the trees in these ruins of ancient forests were partly standing upright and partly lying horizontally buried in the frozen soil."[270] The remnants of the old forest were already well-known to the residents of Siberia who for centuries referred to it as "Noah wood."

In the 1840s, Middendorff succeeded in reaching the Arctic shore on his long Siberian trek, and his account includes a similar description. He writes that "the Noah wood is not distributed irregularly over the tundra, but lies in regular strand lines which descend in approximate parallelism, one behind the other, to the sea, each single strand line preserving for the whole of its course a fairly uniform height above the surface of the sea."[271]

There is actually a record in the form of rare old black-and-white photos of the extensive driftwood from these ancient forests along the Siberian coast.

According to Suess, the driftwood lines were found as much as fifty *versts* (thirty-three miles) from the present coast.[272] Evidently, these old, tree-lined beaches are the result of countless Arctic storms over the course of 11,000+ years that washed up the broken remains of the former taiga. If this is correct, it lends new meaning to the phrase "Noah wood." Pre-diluvial indeed! We are literally talking about a forest from another world age. Its location, i.e., north of the present-day tundra, tells the tale.

A summer expedition to the Arctic shelf should be able to locate the remains of the old submerged forest without too much difficulty, proving Hapgood's theory once and for all.

Chapter Fifteen:
Svalbard: a Proving Ground?

The Svalbard archipelago is important due to its location, and could soon become a test site for Hapgood's theory of crustal displacement. Svalbard (74°-81° N) is the warmest place on Earth at this high latitude due to the moderating North Atlantic current that brings warm water from the mid-Atlantic Ocean northward along the coast of Norway. The warm water from the south mixes with colder Arctic water in the vicinity of Svalbard.

In 1906, the geologist Eduard Suess cited early explorers to Spitsbergen (the largest island in the archipelago) who found raised beds of mollusks there along the coast. Seuss wrote:

> "A remarkable fact may be mentioned here. [The explorers] Nordenskiold and Drasche observed the shells of *Mytulis edulis* [common name: blue mussel] in great quantity a trifling height above the strand; they had preserved their color and ligament. *This species, according to existing accounts, does not appear to live at such high latitudes. The remains are evidently quite recent, and the suggestion offered by some investigators, that they flourished during the warmer climate of an interglacial period which*

affected the extreme north, does not suffice to explain them."[273] [my emphasis]

Mytilus Edulis is a shallow water bi-valve and is well-known in western Europe. The species is common in coastal waters from France all the way to the Russian subarctic, almost to Novaya Zemlya. In modern times, however, it was unknown in arctic Svalbard. Discovery of the anomalous *Mytilus Edulis* shell beds in Svalbard's Isfjorden and Sorgfjorden fiords was first reported in 1861.[274] (**See Figure 1**)

However, the first description of the extralimital phenomenon occurred many years earlier. Credit goes to Charles Darwin, who published a data table documenting the phenomenon in his 1846 book about the geology of South America. An equal share of credit must also go to the French naturalist Alcide d'Orbigny, who did some of the fieldwork and subsequently passed the data to Darwin. In retrospect, it is obvious that Darwin failed to understand the significance of what had come into his hands. Insofar as I am aware, W.O. Addicott was the first to use the term "extralimital"

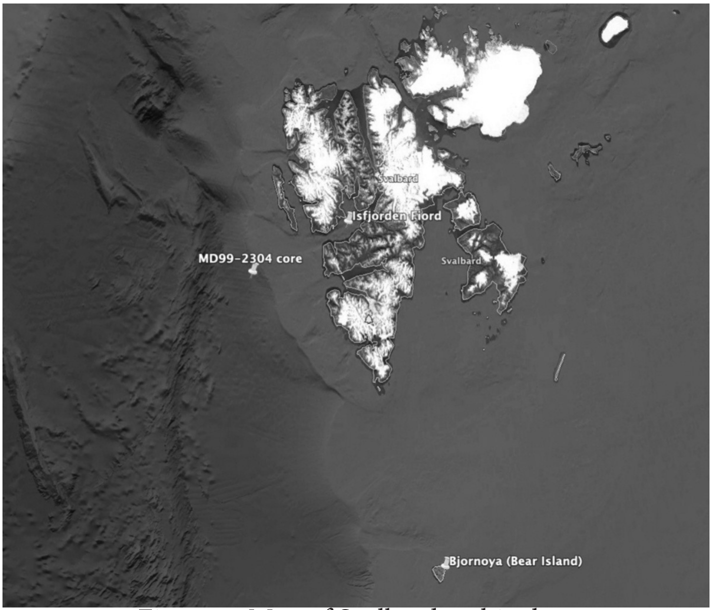


Figure 1. Map of Svalbard archipelago

(Google Earth; Image Landsat/Copemicus; ©2020 Google; Image U.S. Geological Survey; Image IBCAO) (in 1966) though he credits the paleontologist Ralph Arnold with the original description, in 1908, of the extralimital fauna from the Quaternary beds at Santa Cruz and Point Año Nuevo, California.[275] Addicott was apparently unaware of the mollusk data from South America reported by Darwin.

In 1955, R.W. Feyling-Hanssen described the early Holocene presence in Svalbard of nine warm water mollusk species, including *Mytulis edulis*, all of which were locally extinct when he wrote.[276]

Water temperature during summer is critical for mollusks because they spawn in the summer season. By one account, they are little affected by colder temperatures at other times of the year. However, I also found another view that repeated exposures to colder temperatures can be fatal. *Mytulis edulis* is found in the intertidal zone and is considered to be a reliable indicator of marine climate and old shorelines. Its presence in Svalbard, therefore, points to warmer temperatures.

Studies of Svalbard's recent glacial history also indicate that glaciers retreated or disappeared entirely during the early part of the Holocene. This is consistent with a warmer climate, contrasting sharply with the well-documented expansion of glaciers throughout Svalbard during the last 4,000–5,000 years, which continued until very recently.[277]

In 2018, Jan Mangerud and John Inge Svendsen published an excellent summary of all of this research.[278]

Based on the evidence, scientists concluded that Svalbard enjoyed a warmer climate (by about 2° C) in the early part of the Holocene than at present.[279] Why? The cause most often cited was a greater flux of warm Atlantic water into the region during the early Holocene. Scientists also give another likely reason: greater summer-season insolation at high latitudes, which refers to external climatic forcing as first described by Milankovitch. However, I am not convinced that either of these explanations is correct, and in a moment will propose an alternative.

Whether glaciers retreat or expand is determined by the balance between the accumulation of snow on the one hand versus the melting or calving of ice on the other. Two key factors govern this balance: summer temperature and the amount of precipitation. Whichever one dominates will tip the balance.

Because of the dramatic warming throughout the Arctic in recent decades, experts were not surprised in 1995, when J.M. Weslawski reported the reappearance of *Mytilus edulis* on Bjornoya (Bear Island), the most southerly island of the Svalbard archipelago.[280] Bjornoya is a very small island and is located about 142 miles south of Spitsbergen and 250 miles north of the Norwegian coast. (**See Figure 1**) As already noted, mollusks are able to ride ocean currents considerable distances during their larval stage. Evidently, the blue mussel hitched a ride on the northbound current to Bjornoya. Based on Weslawski's report, researcher Otto Salvigen predicted in 2002 that *Mytilus edulis* might once again show up in Svalbard proper.[281] And, sure enough, two years later, in 2004, it did just that.[282]

The exquisite temperature sensitivity of mollusks in general, and of *Mytilus edulis* in particular, suggests a powerful means to investigate abrupt climate change. And this includes climatic shifts at the end of the Pleistocene set in motion, I would argue, by cataclysmic Earth change events that radically rearranged continental landmasses with respect to the poles.

With the exception of a single *Mytilus edulis* shell recovered from a bed near Troms in northern Norway and carbon dated to 14,000 BP, there is no evidence the blue mussel inhabited sub-polar Norway or Russia before the Holocene. However, I believe this is a false impression. The lack of evidence in this case does not constitute evidence of absence.

A north pole position on Baffin Island (66° 06′ N, 68° 28′ W) during the last glacial maximum (LGM) would place Svalbard's centrally located Isfjorden fiord at about 65° N, which is 900 miles south of its present latitude (78° N). (**See Figure 2**) *This also means, of course, that the Svalbard archipelago enjoyed a substantially warmer climate during the LGM than at present. Crucially, it would also have been warmer than during the Holocene.* The

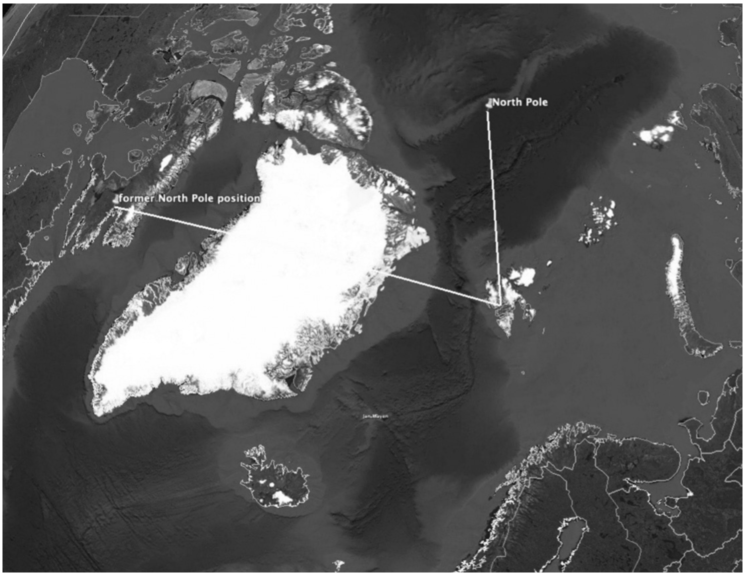


Figure 2. Comparative plot of measured distance from Svalbard to the current north pole, and to the former north pole on Baffin Island. The map shows that Svalbard was south of its current location during the LGM.

(Google Earth; Image IBCAO; Image Landsat/Copemicus; ©2020 Google; US Dept of State Geographer; View from Space (Altitude: 3344 mi))

climate was probably akin to that of present-day Norway just north of Trondheim (63.5° N).

Today, the coast of Norway runs north-south, more or less. However, at that time it ran east-west with respect to the pole. So, the entire coast of Norway then varied by no more than 2° of latitude, and all of Norway would have shared a moderate climate. Svalbard's resident population of mollusks probably included *Arctica islandica* and *Modiolus modiolus*, which prefer warmer water, and especially *Zirfaea crispata*, which is even more warm water dependent. Other warm water species may also have been present.

The Barents Sea basin would have enjoyed an even warmer climate during the LGM. Novaya Zemlya was then at the latitude of central Britain. The mollusks listed above, and probably other types that prefer even warmer water, would have flourished along the balmy coast of Novaya Zemlya and Murmansk.

If I am correct about this, where is the evidence? And why has it not come to light? The answer is simple.

Investigators have not found the evidence because they have not looked in the right place. Actually, I am a bit surprised no one has searched, because it is well-known that when the huge Laurentide ice sheet retreated and disappeared from North America at the end of the Pleistocene, world sea levels rose by 350-400 feet. As a result of which, the LGM faunal beds are presently underwater. Rising sea levels even affected some of the Holocene beds (in northwestern Spitsbergen and Bornoya), and this has hampered collection.[283]

An expedition should therefore be organized forthwith and dispatched as soon as possible to Svalbard and to sites along the Norway and Barents Sea coasts. A thorough survey will have to be made, beforehand, to identify the former coastline and the most likely faunal bed locations. A qualified and properly outfitted search team, using submersibles, should then be able to locate the beds and recover the evidence without too much time, expense, or trouble.

I predict the submerged beds will yield abundant evidence of long-term habitation by a mollusk fauna, which, although anomalous from the standpoint of the prevailing climate/Earth model, is entirely consistent with a north pole position on Baffin Island. That the residence was long-term appears certain because the Baffin Island pole position was constant from roughly 48,000–52,000 years BP until the end of the Pleistocene, a period of approximately 37,000 years. So, the beds are likely to be large and plentiful. Of course, the resident mollusks no doubt relocated numerous times during this long period in response to temperature changes during interstadials.

Why a warm phase during the early Holocene?

But I have yet to account for the warm phase at the start of the Holocene. The hard evidence for such a warming is based on a 23-meter ocean sediment core (MD99-2304) recovered by a French expedition, IMAGES V.[284] The core was taken about fifty-seven miles off the west coast of Svalbard. (**See Figure 1**) The drill site (77° 37.26′ N, 9° 56.90′ E) is located where the continental shelf of Svalbard meets the deep Atlantic waters. A team aboard the French ship

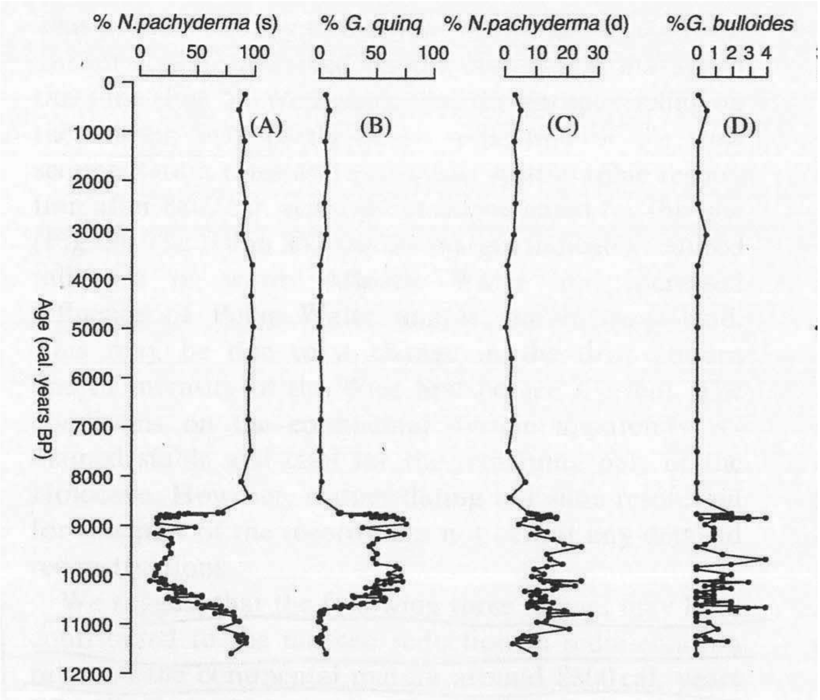


Figure 3. Chart of abundance of four plankton species versus water temperature, from sediment core MD99-2304.
Taken from Hald et al., 2004.
(Reprinted with permission of Morten Hald)

Marion Dufresne recovered the core in 1999 using a high-speed modified piston-coring "Calypso" drilling apparatus.

Later, when core samples were examined, scientists identified several species of plankton, which were then carbon dated.[285] The dominant plankton was a polar species, *Neogloboquadrina pachyderma* (s). (**See Figure 3**, cited from Hald et al., 2004) Notice, between 11,000 and 8,800 years BP, *N. pachyderma* (s) virtually disappeared and was replaced by two sub-polar species, *Globigerina quinqueloba* and N. *pachyderma* (d). This shift in the dominant species indicates that a change in water temperature occurred during this 2,200-year period: from cold to warm water.

Here, I must digress to explain why two of the above species share the same name, *N. pachyderma*. Foraminifera are tiny crustaceans that generally live on the ocean floor. However, long ago, some forams evolved into planktonic species, meaning that they developed the capacity to float and inhabit the water column. Some of these plankton species became widely distributed, even global, although each type evolved its own unique habitat requirements.

As with mollusks, water temperature is the single most important factor. This is where the plot thickens, because certain kinds of plankton, including *N. pachyderma*, evolved two different forms. One type developed a left-coiled calciferous shell and the other a right-coiled shell. The left or sinister form (hence, the "s" following the name) prefers cold water, while the right or dextral form (hence, the "d" following the name) lives in warm water.[286]

But why a warm episode at the start of the Holocene? If I am correct that a crustal displacement event at the end of the Pleistocene moved Svalbard 900 miles to the north, we should expect colder conditions during the Holocene—not warmer. Indeed, we should expect a sharp drop in water temperatures around Svalbard.

But what if the crustal displacement event triggered world-wide collateral effects like earthquakes and vulcanism? It stands to reason that a global event of this magnitude would probably trigger various kinds of secondary and tertiary effects. I believe this is exactly what happened: When the crust moved, long dormant underwater volcanoes became active again and produced a 2,200-year-long episode of oceanic warming around Svalbard. And this happened despite the latitudinal shift to a more northerly climate. After the vulcanism ran its course, the climate chilled. Water temperature decreased and glaciers began to grow in Svalbard.

The case for underwater vulcanism appears strong. A few years ago, scientists learned that submarine (underwater) volcanoes cause *El Nino* warming episodes in the Pacific.[287]

In fact, evidence has been mounting for years that volcanic activity is much more extensive under the oceans than was formerly believed. In the early 1990s, scientists at the University of California found a previously unknown cluster of volcanoes in the Pacific. Using sonar scanning devices to peer into the depths, the team was surprised to find 1,133 seamounts and volcanic cones in an area the size of New York state. Many of the volcanoes rose more than a mile above the ocean floor, and some were almost 7,000 feet tall, with peaks rising to within 2,500 to 5,000 feet of the ocean surface.

"We thought we would find a few dozen new volcanoes," researcher Ken McDonald from UC Santa Barbara explained during an interview. "Instead, we found over 1,000 that had never been mapped before."[288] And new cases keep coming to light. In 2017, scientists discovered ninety-one previously unknown volcanoes beneath the Antarctic ice sheets.[289] And, in 2019, scientists reported six new underwater volcanoes near the coast of Italy.[290] By one estimate, there are more than a million submarine volcanoes on Earth.[291]

Furthermore, Svalbard, like Iceland, has a long history of vulcanism dating back 130 million years.[292] So, it would be naive to suppose that the magmatic sources deep in the earth are no longer operative. It stands to reason that a crustal displacement event affecting the entire planet would set in motion powerful worldwide collateral effects. *It is even possible that some of them are still playing out, in our time, more than 11,000 years later!* Continuing research will decide the matter.

Finally, after reviewing a number of scientific papers about the status of northern Europe during the LGM, I must say I am surprised that so many scientists continue to embrace the view that the entire region (including Svalbard) was under ice during this time and only deglaciated between 13,000–10,000 BP. One encounters this view—which is actually an assumption—over and over again. I find it surprising because we now have compelling evidence, some of which I presented in Chapter Ten, that northern Europe deglaciated long before the start of the LGM, which actually refers to the North American glaciation. Indeed, the deglaciation of Europe probably ran to completion between 45,000–50,000 BP. Why has this not been sorted out?

The answer: Because old glaciations are next to impossible to date. This is yet another reason why we owe a deep debt of thanks to the late Andrew Currant and Roger Jacobi for their splendid work in the bone caves of Britain. Their synthesis, published in 2001, was the culmination of more than 170 years of research, and at last provided a sound means, i.e., isotopically dated fossils cut from stalagmites, to properly date the last European Ice Age.[293] But their accomplishment also has deeper implications. Because, as noted, the mammalian assemblages they identified correspond with former pole positions (four of them) over the last 120,000 years BP, encompassing the different ages of man.

Chapter Sixteen
Forbidden Archaeology

I have always felt that human origins is the most important subject. What could be more fascinating than our deep past and our beginnings? Is not "where we came from" and "how we got here" essential to our human identity? Yes, of course. So why, then, is the subject shrouded in mystery? Speaking for myself, I find it vaguely disturbing that we know more about the inner workings of the atom than about our own origins.

During my university days (it wasn't *that* long ago) we were taught that history started with ancient Egypt and Sumer, roughly 5,000 years BP. This was the official narrative. Modern man (Cro-Magnon) supposedly emerged about 40,000 years BP. And the big jump to agriculture and a settled lifestyle occurred around ~12,000 years BP. In 1935, the Australian archaeologist V. Gordon Childe coined a term for this transition, the "Neolithic revolution."[294] For some reason, the phrase stuck.

The cradle of civilization, where it all supposedly started, was the Fertile Crescent, located in the Mideast, basically the land from Palestine north to Syria and south to Iraq. Before humans crossed this critical threshold to farming, about 12,000 years ago, our ancestors were hunters and gatherers, as evidenced by an abundance of cave paintings, petroglyphs, and artifacts, including stone implements. This is the familiar story I have shredded in the preceding chapters. The actual history of our species is much more complex and vastly older. In the preceding chapters I have traced it back ~120,000 years.

But the framework still needs to be fleshed out. Unfortunately, as of today, we know next to nothing about most of this history. For this reason, in a very real sense, we are strangers to ourselves. The fact is weird because we humans take pride in knowing things. We like to figure things out. We also value record keeping, otherwise known as "history." So, why do our origins draw a complete blank? It's almost as if someone reached into our heads and erased every last memory byte.

The oldest written records that have come down to us are obscure, to say the least. I am referring to the Pyramid Texts, some Hermetic manuscripts, cuneiform tablets from several ancient libraries in Iraq and Syria, some early texts from ancient Persia, and finally, the Indian scriptures. None of these sources date to before the third millennium BCE, though presumably some of them are copies of older records that did not survive. To be honest, no one knows their true age.

Apart from the archaeological evidence I have presented (and about which I am confident more will come to light), our only other information from the remote past are a few prophetic lines from the Bible, some passages by Plato, and a large number of orally transmitted legends from indigenous peoples, which, I might add, we sophisticated moderns usually dismiss as superstitious nonsense or fairy tales.

Some speculate that a lost hall of records will be found beneath the Sphinx's right paw at Giza or elsewhere. But so far, it's just talk. Until and unless the aforesaid ancient library comes to light, we are as bereft as ever.

To be sure, there is also the Vatican library. It is a valuable resource though, unfortunately, one that remains wholly inaccessible. For this reason it is impossible to properly evaluate.

I believe cataclysmic Earth changes probably help to explain the paucity of evidence from our deep past. No records have come down to us because the ancestral civilizations were literally wiped from the face of the earth. If this is correct, any discussion for now must remain speculative. Nevertheless, I believe there is value in trying to imagine what our ancestors may have experienced in such times of great tragedy. So, for argument's sake, I am going to try to reconstruct from a few available clues what it might have been like to live through a displacement of the earth's crust.

Several passages in the New and Old Testament describe how the stars fell from the sky (e.g., Mark 13:25, Matthew 24:29, Revelation 6:13 and 12:4, Isaiah 34:4 and 14:12, Daniel 8:10). These lines possibly offer insight into what our forebears witnessed in the night sky during a displacement of the earth's crust—I mean those who were fortunate enough to survive the associated earthquakes, volcanic eruptions, and tsunamis. According to Scripture, instead of slowly tracking about the pole as they normally do, the entire canopy of stars fell in unison toward the horizon. If it happened this way, it was an illusion. The actual movement was not in the heavens above, but beneath our ancestors' feet, deep in the earth.

In the *Book of Enoch,* there is a similar description of a collapsing sky, which occurs during a dream or vision: "And behold, I saw many stars descend and cast themselves down from heaven…."[295]

The experience during the daytime would have been quite different, and it might have resembled the passage in Joshua 10:13 about how the sun stood still for an entire day. We cannot be certain, but this is a plausible interpretation.

The Toltecs in ancient Mexico had a similar story about how the sun stood still for a day.[296] It is interesting that the Aztecs, who inherited the Toltec traditions, believed that humanity had lived through four previous ages (or suns) before the present (or fifth) world age. Their historic framework appears to agree with the stratigraphic record from the bone caves of Britain: four climatic epochs (plus the present or fifth era, the Holocene), which I have correlated with successive pole positions.

The Hopis of the American Southwest have their own tradition about the ages of man. They believe we are now living in the fourth world age. The Hopis claim their progenitors migrated (or were guided) across the length and breadth of North America, traveling as far north as the Arctic and as far south as central Mexico.

The Hopis actually credit their ancestors with construction of the famous Serpent Mound in Ohio, about which I will have more to say in Chapter Nineteen.

One Hopi legend describes a possible crustal shift event which—they claim— ended the second world age. At the time, the human race had gone astray.

Humanity had lost its spiritual connection to Sotuknang (the Creator). In this respect, Hopi tradition resembles the beliefs of many other indigenous peoples. Typically, the end comes because humanity sinks into materialism and wickedness. God makes a decision to cleanse the earth. Sotuknang instructs the few remaining worthy humans to seek shelter with the Ant people in their underground kivas.

Then, Sotuknang commands the twins, Poqanghoya and Palongawhoya to leave their posts at the north and south ends of the world's axis, where they were stationed to keep the earth rotating properly. In the *Book of the Hopi*, Frank Waters describes what happened next:

> "The twins had hardly abandoned their stations when the world, with no one to control it, teetered off balance, spun around crazily, then rolled over twice. Mountains plunged into seas with a great splash, seas and lakes sloshed over the land; and as the world spun through cold and lifeless space, it froze into solid ice. This was the end of Tokpa, the second world."[297]

Things continue in this frozen state for many years. Meanwhile, the few humans who were spared remain happy and warm with the Ant people in their underground world. They also have plenty to eat. Eventually, Sotuknang commands Poqanghoya and Palongawhoya to return to their stations at the poles of the earth. Whereupon:

> "With a great shudder and a splintering of ice the planet began rotating again. When it was revolving smoothly about its axis and stately moving in its universal orbit, the ice began to melt and the world began to warm to life. Sotuknang set about creating the Third World: arranging earths and seas, planting mountains and plains with their proper coverings, and creating all forms of life. When the earth was ready for human occupancy, he came to the Ant kiva with the proper approach and said: 'Open the door. It is time for you to come out.'"
>
> Once again… Sotuknang instructs the people:
>
> "I have saved you so you can be planted again on this new Third World. But you must always remember the two things I am saying to you now. First, respect me and one another. And second, sing in harmony from the tops of the hills. When I do not hear you singing praises to your Creator, I will know you have gone back to evil again."[298]

When I read this, I was reminded of the Hindu story of the Gopis, who spend all of their time singing and dancing for joy at the miracle of existence.

Evidence for Extreme Antiquity

Today, orthodox scientists and archaeologists shrink from deep history and human origins. According to the official story, native people first crossed the Bering land bridge into North America only about 10,000–12,000 years BP. This cannot be correct, however, because as I have shown, archaeological alignments point to a far more ancient history. And there is *additional* evidence, which I will now discuss. Some of it came to light in the 1920s, thanks to a pioneering mineralogist named William Niven, who was sponsored, at times, by the American Museum of Natural History. His story, however, actually began in the 1890s, while Niven was in the employ of a Mexican corporation in the state of Guerrero, near Acapulco.

Niven's interest was piqued when indigenous people showed him terra-cotta figurines that they said came from the famous pyramids at Teotihuacan. Niven was skeptical, of course, as anyone will appreciate who has visited exotic lands and encountered street urchins and hucksters. Ultimately, Niven bribed the Indians to learn the truth. The actual source turned out to be a region of pit quarries between Texcoco and Haluepantla, northwest of Mexico City. The numerous pits had supplied sand and clay for builders in the capital city for hundreds of years.[299]

When Niven explored the region, located in the northwest corner of the Valley of Mexico, he found that the pits extended over about 200 square miles. But the shocker came when he began to excavate and made "the great find of my many years' work in Mexican archeology."[300]

He discovered a prehistoric city buried thirty feet beneath the plain, covered by a two-foot thick layer of volcanic ash and two deep and distinct layers of sand, gravel, and mud. When Niven excavated other nearby pits, he found the same vast ruined city. The pavements or layers pointed to a series of cataclysms at intervals of thousands of years, and from the considerable depth, Niven estimated the ruined city might date to 50,000 years BP. But the archaeological establishment would have none of it. They dismissed Niven's conclusions and shunned his work. The explorer might have been forgotten altogether but for an engineer named James Churchward who featured Niven's discoveries in a series of popular books.

More recent discoveries in central Mexico are consistent with what Niven found. One key site is the Valsequillo (bal-say-KEY-yo) reservoir near Puebla, Mexico, located in a high valley bounded to the north by the well-known volcanoes Popocatepetl and Iztaccihuatl. The area was already known to paleontologists, because for more than a century the eroded hills around the reservoir had yielded fossils of many extinct species from the Pleistocene, including the mammoth, mastodon, bison, horse, camel, dire wolf, and saber-tooth tiger.

But the seminal discovery occurred in 1935, when a local collector, Juan Armenta Camacho, found a human-made flint spearhead embedded in a mammoth bone. Inspired by the momentous find, Armenta thereafter spent much of his free time combing the area. His labors were rewarded. Over the next thirty years, Juan recovered more than a hundred partial skeletons of mammoths and mastodons; often the bones showed signs of butchering. Obviously, tool-making humans had hunted in the area. Eventually, these discoveries became known internationally (beyond the orbit of the conservative Mexican archaeological establishment). In the 1960s, a team led by a young Harvard anthropologist, Cynthia Irwin-Williams, arrived to investigate.[301]

During the first field season, the team identified four promising sites around the reservoir, and selected one of them, Hueyatlaco (way-at-LAY-co), for intensive study. The site soon produced some forty stone tools that were obviously man made, and many associated bones. However, the bones had mineralized, which made dating them a challenge. There was not enough carbon present to use the Carbon-14 method, so the geologists on the team resorted to the uranium method that yielded a date of 250,000 years BP. This accorded well with the stratigraphy of the site and the depth at which the artifacts were found.

But the date was contentious. The team leader, Irwin-Williams, was an anthropologist, not a geologist, and she refused to accept that the bones could be a quarter million years old. If the date was correct, this meant sophisticated stone tools were in use at Valsequillo long before analogous tools were thought to have been developed in Europe and Asia. In the view of Irwin-Williams, this was impossible. The geologic date also placed humans in North America *240,000 years before their supposed arrival over the Bering land bridge*. Science had produced anomalous evidence. It was messy. Who was right?

Initially, the geologists on the team tended to agree with Irwin-Williams and were skeptical of their own work. However, as the years passed and they continued to study the area, their thinking gradually changed. In 1973, the geologists employed a different method (zircon fission-track dating) which returned dates no less ancient, i.e., between 170,000–260,000 years BP.[302] The dates came back with two sigma numbers, indicating a 95% probability they were correct to within the calculated margin of error. Slowly, the scientists began to appreciate the implications of their own research. From a geologic standpoint, the deposits around the reservoir were *old*. Moreover, the three other sites in the area yielded dates even older than Hueyatlaco.

The controversy turned bitter. The archaeological establishment ostracized the heretics. Massive excavations were made by a rival team, within yards of the Hueyatlaco dig site. Local authorities confiscated the artifacts recovered by Juan Armenta, the man who had started it all. Juan himself was banned from doing any further fieldwork, ever. Virginia Steen-McIntyre, one of the geologists, had her submissions to scientific journals returned or disappeared. She lost her job as a government scientist and her position as an adjunct professor.[303] The case shows what can happen when science turns up evidence that does not fit the standard model. Messy, indeed.

Hueyatlaco is not a unique case. Similar dating controversies have occurred elsewhere in the Americas. Probably the most compelling example is Toca da Esperanca (the Cave of Hope) in the province of Bahia, Brazil, discovered by the archaeologist Maria Beltrao in 1982. Actually, it is not one but a series of caves that feature prehistoric wall paintings. In 1986-1987, excavations yielded stone implements and associated mammalian fossils from the lowest of four stratigraphic beds. Three different laboratories tested the bones from this layer using the uranium method and returned dates ranging between 204,000–295,000 years BP.[304] Once again, mainstream archaeologists refused to accept the results. Such antiquity was impossible. Unthinkable. Simply out of the question.

The controversies I have summarized were never satisfactorily resolved. The disputes (and others like them) simmer on today, despite the passage of years and the regrettable passing of many of the principals. It is a sad state of affairs when a scientist does not live to see his or her research validated or, at least, resolved one way or another. Limbo must be a cruel fate for a scientist.

This is yet another reason why the new framework I am proposing in this book is important. In one fell swoop, the correlation of the isotopically dated mammalian assemblages from Britain (and their associated climates) with five former pole positions, pushes the timeline for human civilization back from 5,000–6,000 years BP to 120,000 years BP. Given that human civilizations were flourishing along the coast of Peru and in Yucatan 75,000 years BP, and in the high Andes even earlier, at ~120,000 years BP, it stands to reason that hunting and gathering societies may have existed in Mexico and Brazil 200,000–300,000 years BP.

The new extended timeline is part of a paradigm shift to a radically new Earth-climate model. It is no exaggeration to call it a breakthrough. And most of the credit, I will say it again, goes to the late Andrew Currant and Roger Jacobi for their synthesis of 170+ years of stratigraphic work in the bone caves of Britain. Their research changed the world, or, at any rate, our understanding of it. Kudos to them and their colleagues.

Chapter Seventeen
A Geodetic Marker

Throughout this book, for the sake of simplicity, I have limited my discussion of Earth change events to changes in the true pole position. It is important to realize, however, that Earth changes can affect other physical parameters of our planet, including its orbit, rate of rotation (or spin), and even the tilt of its axis (currently 23.5°). Because none of these are fixed in stone. All are potentially subject to change given the application of enough directed force. A change in Earth's orbit, for example, would alter the length of the year, in other words, the time it takes for the earth to complete a full revolution around the sun. A change in the earth's speed of rotation would alter the length of the day. For instance, if the speed of rotation slowed down, the day would increase in length. Finally, a change in the tilt of the earth's axis would affect the seasons. Less tilt will cause a reduction of seasonal changes. More tilt will make them more pronounced.

An Existential Crisis

For these reasons, it should be apparent that the last cataclysmic shift of the earth's crust impacted our ancestors long after the event itself. The slippage of the crust was only the start of the crisis. Survivors who lacked a readily available food supply probably faced starvation within a matter of weeks or months. But survivors also faced challenges over the longer term, and this was true even if the other Earth parameters did not change.

In the preceding chapters I have shown that the most recent crustal displacement of 1,657 miles altered the latitude of nearly every locale on Earth, some more, some less. Many locations ended up nearer to the equator. But an equal number of places moved closer to the pole. One can imagine the shock of survivors who suddenly found themselves in a colder climate, i.e., at a higher latitude. They faced an immediate existential crisis governed by the most fundamental law of Nature: adapt or die. Circumstances compelled them to modify their lifestyle, especially agricultural practices, and quickly.

The only other option was to attempt a perilous relocation to a warmer climate. Either way, the bottom line for agriculturalists was brutally simple. *If you do not learn to plant your seeds at the proper time, your next crop will fail, and you will starve*. The proof that at least some of our forebears met the challenge is the simple fact we are here: I am discussing the matter and you are reading about it.

The triumph of our ancestors over dire events beyond their control is an important lesson for us moderns. And one that calls for a re-evaluation of a number of the world's megalithic sites, which, in my opinion, we have not adequately understood. No one has explained why they were actually constructed and the purpose they originally served. At the top of the list: Stonehenge.

Stonehenge

The megalithic stone circle on the Salisbury plain is one of the most iconic sites on Earth (51.17° N, 1.82° W). (**See Figure 1**) But do we really understand why it was created? I think not. Of course, everyone and his uncle has a theory. Over the centuries, visitors to Stonehenge have proposed many different explanations, ranging from funereal rites and wild druidic orgies to sacrificial bloodlettings and healing rituals. In my opinion, however, one of the most authoritative studies was published in 1965 by astronomer Gerald Hawkins.[305] The Boston University professor was the first to use a modern computer. Hawkins identified

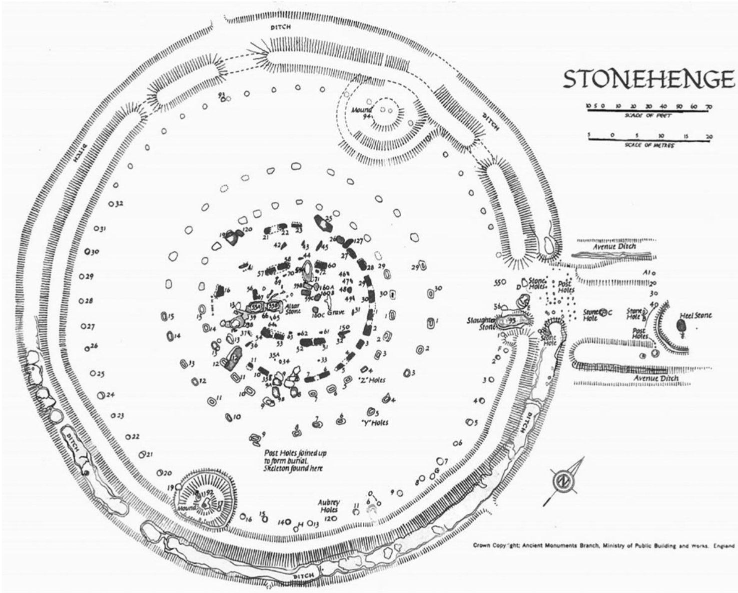


Figure 1. Stonehenge
(Crown Copyright: Ancient Monuments Branch,
Ministry of Public Building and Works, England)

eleven viewing points at the site, then prepared punch cards encoded with all of the relevant data. Finally, he fed the cards into an IBM 7094. His instructions were simple: Plot lines through 120 pairs of charted points, and determine azimuths and declinations for the lines.

The computer did the rest, in less than a minute.

The results were decisive. The mathematically rigorous workup affirmed Hawkins' intuition that the site had been an astronomical observatory. It also affirmed what Dr. William Stukely pointed out in 1740, when he wrote that "the principal line of the whole work [points to] the northeast, where abouts the sun rises, when the days are longest…" According to Hawkins, Stukely's observation that the site was organized around the summer solstice "is of crucial importance to understanding the nature of Stonehenge."[306]

The computer analysis also vindicated the ancient historian, Diodorus of Sicily. In the first century BCE, Diodorus had described "Apollo's temple in the land of the Hyperboreans," by which he meant Britain.[307] Apollo was the Greek sun god.

Hawkins' computer analysis turned up no evidence of alignments to the stars or planets. The site had been designed to track the sun and the moon. Its main axis was organized around the summer solstice marked by the heel stone. From the solstice points the equinoxes were easily derived. But the solstices had to be located first. They were easier because the sun slows and indeed appears to pause for a few days at its extreme terminus points in the northern and southern skies. By contrast, the sun moves quickly through the equinox points, which for this reason were probably derived by geometrically halving the portion of the circle bounded by the summer and winter solstice points, using long ropes. At Stonehenge, two stone markers (stone position 94 and stone hole C) still serve as a pointer to the spring equinox.[308]

The independent astronomer James McCanney has produced a helpful pamphlet that explains, step by step, how to replicate Stonehenge starting from scratch, should the need ever arise.[309]

I also find it curious that the *Book of Enoch* includes an obscure account describing how the prophet was taken up by the archangel Uriel (or an extraterrestrial?) and shown a method to understand the sun's movements and mark the calendar.[310]

The Stonehenge we visit today probably bears little resemblance to the original. Doubtless, the site evolved greatly over time. The prominent bluestone trilithons at its core and the surrounding 30-ton limestone sarsens represent the final phases of construction, not the earliest. The original posts erected on site, probably in the outer Aubrey circle, were wooden timbers, not stone dolmens. The great stones were only brought in, much later. Charcoal found at Stonehenge has been dated to nearly 10,000 years BP, and I suspect this date will be pushed farther back as additional discoveries of even older wood are made.[311]

During the LGM, the north pole was located on Baffin Island. The Salisbury plain was then situated 228 miles south of its present latitude of 51° N. When the earth's crust shifted at the end of the Pleistocene, the pole moved to its present position in the Arctic. Britain simultaneously moved north.

The people of Britain suddenly found themselves living in a slightly cooler climate.

This posed a threat to agriculture. The Brits responded by constructing an observatory to monitor the sun and moon and reconstitute the calendar. Elsewhere on Earth, humans did much the same. Similar stone circles have been found in many other places around the planet. The residents of Britain were actually fortunate because the climatic change in their land was slight compared with, say, Siberia, which took the full force of the crustal displacement. As noted, there is abundant evidence that humans were living in Siberia 40,000 years BP. But they probably did not survive the cataclysm at the end of the Pleistocene. Unfortunately, they were in the path of destruction.

The same can be said of the central and southern Andes. One of the megalithic walls at Machu Picchu shows major earthquake damage that may have occurred at this time. (**See Figure 2**) A geologist who inspected the damaged wall informed tour guide Brien Foerster that a 9.0 quake or

Figure 2. Earthquake damage at Machu Picchu

larger was probably responsible. The geologist concluded that the force had come from the east, which is consistent with the MoMD.

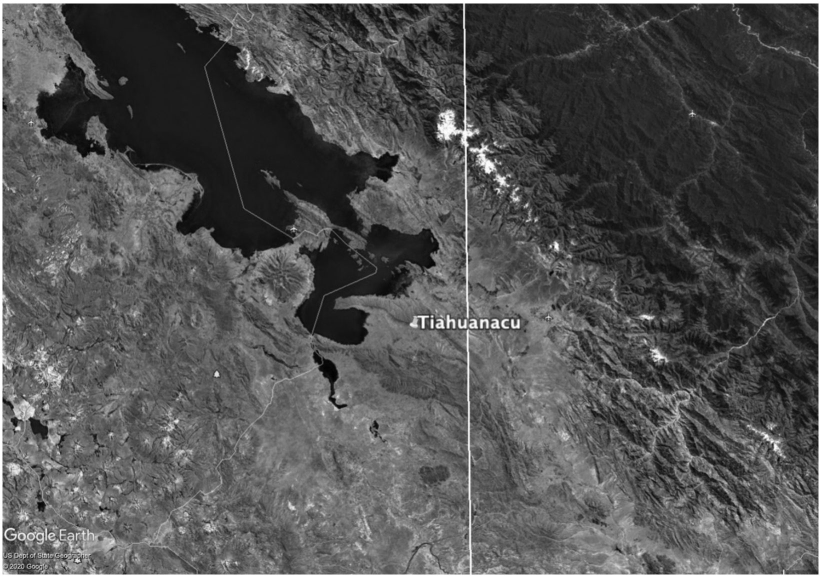


Figure 3. MoMD in relation to Tiahuanacu, Bolivia and Lake Titicaca

(Google Earth; US Dept of State Geographer; ©2020 Google; Image Landsat/Copemicus)

Figure 4. Shattered foundation wall at Puma Punku, Tiahuanacu

The damage was much greater at Tiahuanacu, which lies just thirteen and a half miles from the MoMD. (**See Figure 3**) Indeed, the sudden event that destroyed the city is still very much in evidence. A deep overburden of red dirt blankets the area, except where archaeologists recently removed it to expose the original foundations. One smashed wall of the Puma Punku pyramid shows the direction of force. The blocks were pushed inward. (**See Figure 4**) All of this suggests that a major volcanic eruption in the Andes forty miles away sent a wall of ice and mud cascading down into Lake Titicaca and over the surrounding plain.

The high Andean civilization had survived previous Earth changes for more than 100,000 years, based on the alignments of several Nazca lines with former pole positions. However, it suffered terrible damage at the time of the most recent event. Although most of the polygonal walls in Peru remain intact, the desolate ruin at Tiahuanacu and the fallow terracing system throughout the region give silent testimony to the Andean apocalypse.

The Great Pyramid

The public's interest in the Great Pyramid is so great that the subject has spawned an entire literature. Egyptology has become a cottage industry. Yet, despite the hundreds of books and millions of words in print, the big questions are few: Who? When? How? And above all, why?

Today, it is clear that whoever built the Great Pyramid knew the dimensions of the earth to a level of accuracy not achieved in historic times until the modern age. For centuries it was thought that Greeks made these discoveries.

In my student days, I was taught that Greece was the cradle of Western philosophy. Recently, however, there has been a shift. Priority has passed to ancient Egypt. Current thinking is that Pythagoras, Eratosthenes, and Hipparchus learned their geometry and science from Heliopolitan priests. However, the alignment of the Temple of the Winged Lion (at Petra) with the Bering Sea pole, and the alignment of the Parthenon with the North Greenland pole, raise new questions.

These alignments mean that the cultures ancestral to the Nabataeans and Greeks are far more ancient than anyone has imagined. At least three reconstructions of the Parthenon are known to have occurred in historic times, and surely there were others. Given the Parthenon's alignment to the former North Greenland pole, the original must date to at least 80,000–85,000 BP.[312] And this suggests that the Greeks and Egyptians both share a debt to an earlier common source.

Incidentally, the Parthenon alignment also supports the work of English architect Francis Cranmer Penrose, who first identified the Entasis at the site.[313] In 1846-1847, Penrose accurately measured the Parthenon and showed that "errors" in the curvature of its steps and entablature were deliberate. Entasis refers to the slight (1.6 inch) swelling in the center of the columns, evidently incorporated by the builders for aesthetic reasons. Penrose concluded that the Parthenon was planned and executed to a high standard of mathematical skill.[314] This is certainly an apt description, given the original alignment to the North Greenland pole, which was preserved in all subsequent renovations.

Orthodox Egyptologists, of course, reject this view of extreme antiquity. Their standard narrative compresses the high period of Egyptian history into about six centuries, culminating in the fourth and fifth dynasties. This is often referred to as the pyramid age (2500 BCE), during which Egypt attained a level of artistic perfection and pyramid construction never equaled in history. And we are supposed to believe the Egyptians accomplished all of this using only copper tools! Which is plainly impossible. One cannot cut and shape granite blocks with copper, nor with bronze, nor even with iron.

Egyptologists also believe that the Great Pyramid was a tomb constructed by the pharaoh Khufu for his personal use. And the same is supposedly true of the other pyramids. Yet, so far, no dead pharaoh has ever been found in a pyramid. Given the absence of evidence, is it reasonable to cling to the cenotaph hypothesis? No, I think not, especially since the Great Pyramid's design and physical dimensions point in a different direction.

One researcher, Harvard trained Livio Catullo Stecchini (1913-1979), concluded after a twenty-year study that the Great Pyramid is a kind of map of the northern hemisphere of the earth.[315] Each of the four sides represents one quarter of the hemispheric surface. The apex represents the north pole and the perimeter the circumference. The height of the Great Pyramid (481.2 feet) therefore relates to its perimeter (3,023.6 feet) as the radius of the earth relates to its circumference (at the equator). It's one of the few math equations I actually remember from school. The following junior high school calculation shows that the ancient Egyptians understood the constant π.

c (perimeter) = 2πr (where r is the height)
3,023.6 feet = 2 x 3.14159 x 481.2 feet

In the late 19th century, Sir Flinders Petrie, one of the founders of modern archeology, spent months on site measuring the Pyramid's inner chambers and outer dimensions. Petrie showed that π is also expressed in the King's Chamber, *along with the Pythagorean theorem*. Although piles of sand and rubble made it impossible to measure the pyramid's base, Petrie nonetheless accomplished a triangulation using a theodolite.

His conclusion: The Great Pyramid is more accurately aligned to the cardinal points than any other structure on Earth built before the twentieth century.[316]

It was not until the 1920s that workers finally cleared away the debris from around the base of the pyramid, exposing its corners. At that time, an engineer named J.H. Cole completed the first accurate survey of the site. Cole found that the length of the pyramid's base equals one eighth of a minute of latitude. This was an extraordinary discovery, because it means that the ancient Egyptians knew the circumference of the earth and actually expressed this in the pyramid! (Twice the perimeter of the Great Pyramid exactly equals one minute of latitude, i.e., 6,068 feet.)[317]

Based on his survey, Cole concluded that the builders were also aware of the equatorial bulge and the flattening of the poles. Neither of these were supposedly known before the time of Isaac Newton. In his *Principia*, Newton asserted that the centripetal force of the spinning Earth should produce a slight bulge at the equator. The fact was confirmed in Newton's lifetime after scientific expeditions were dispatched to the Arctic and the equatorial zone to take measurements.[318]

Stecchini also showed that the cubit, the ancient unit of measurement used in the construction of the pyramid and throughout the ancient world, was actually based on an ancient foot also in common use. Stecchini concluded that the tiny differences between the English foot, the Greek foot, the Persian foot, the Egyptian foot, and so on, were due to the fact they had been computed astronomically. The tiny variance in each foot was based on latitude![319]

Stecchini even found evidence that the Egyptians understood the basic principles of modern calculus, which was only developed in the mid-17th century (by Newton and Leibniz, working independently).[320]

According to Jewish and Arab legends, the Great Pyramid dates to the pre-diluvian age. In one Arab account, a king constructs the pyramid after a prophetic dream warns him that "the world will be turned upside down, and the stars will fall from the sky."[321] Here, again, we have the familiar image of the falling stars.

In the Jewish version, the Sethians encode into the pyramid all of their wisdom and knowledge about the celestial bodies, knowledge and wisdom that survives the Great Flood.[322] However, by now, it should be evident that the Arab and Jewish legends have conflated two very different cataclysmic events. Obviously, the Great Pyramid was constructed *after* the last crustal displacement event, and was intended as a geodetic marker in time and place. This answers what is arguably the deepest question, the "*Why?*"

Now for the "*When?*"

Throughout this book I have cautiously refrained from assigning a specific date to the latest crustal displacement event. We know it occurred at the end of the Pleistocene. But I deemed the evidence insufficient to identify the date with certainty. However, I will confess that I have been tempted, because 11,500 BP keeps turning up in the literature. 11,500 BP is also attractive because Plato gave this date for the destruction of Atlantis, based on Egyptian records.[323] I strongly suspect that researchers will, very soon, succeed in nailing down the event.

Chapter Eighteen
Gravitational Waves and Comets

In his first book, *Earth's Shifting Crust* (1958), Charles Hapgood proposed a mechanism to explain past displacements of the earth's crust. Hapgood argued that the slow but relentless buildup of ice in the polar regions might ultimately reach a tipping point, causing the earth's outer crust to separate from the deeper layer beneath it (usually referred to as the mantle) and slide toward the equator, driven by the centrifugal force of inertia. He thought the displacement was gradual and occurred over a period of perhaps 1,500 years. However, when Hapgood and a colleague crunched the numbers, they concluded that the polar ice would never become massive enough to destabilize the crust.

Hapgood was compelled to abandon his polar ice model. Thereafter, although he continued searching, he never identified a plausible mechanism. But this did not dampen his conviction that crustal displacement is a genuine phenomenon, because the evidence for it continued to mount. In 1970, Hapgood updated the discussion with cogent new arguments in a follow-on book, *Path of the Pole*. Based on the geomagnetic evidence alone, Hapgood estimated that several hundred displacements of the earth's crust had possibly occurred since the Precambrian.[324]

Based on the evidence I have presented in *this* book, however, Hapgood's figure appears to be a serious underestimate. A frequency of four different pole positions every 120,000 years would add up to a total of thirty-three pole changes over a million years, and well over 1,780 since the Precambrian. My estimate, of course, is speculative because we have no way of determining the long-term frequency of such events, either in the past or future. The future lies beyond our reach. As for the past, the problem, as noted, is that recent events tend to erase the older evidentiary record.

The good news is that advances in science now make it possible to revisit the mechanism issue again, however, this time, from a different perspective. Whereas Hapgood searched for a cause within the earth, I begin by assuming that no force exists within our planet powerful enough to displace the earth's crust.

As I delved into the issue, I dialogued with two scientists, both familiar with Hapgood's work. One is Dr. Bill Deagle, an MD who also holds a PhD in Bacterial Oceanography and Genetics from Dalhousie University. The other is Professor James McCanney, originator of the Plasma Discharge Comet Model, which I will discuss in detail.[325] Deagle and McCanney both agree that crustal displacements are set in motion by gravitational forces external to Earth. However, they disagree about the specifics. I will start with gravitational waves, an exotic special case of gravity, which Deagle favors as the cause. First, however, some background is essential.

Gravitational Waves

Isaac Newton described gravity as an attractive force that propagates instantaneously across the universe. But Einstein explained it very differently: as a disturbance in the curvature of space-time that propagates outward from a source at the speed of light.

The physicist, Jules Henri Poincare postulated the existence of gravitational waves in 1905, and Albert Einstein subsequently predicted them in his theory of General Relativity. The first indirect evidence for gravitational waves followed the discovery in 1974 of the first binary-pulsar by physicists Russell Alan Hulse and Joseph Hooton Taylor Jr. at the University of Massachusetts, Amherst.[326]

A pulsar is a rapidly rotating and highly magnetized neutron star. This particular pulsar was found to be rotating on its axis at the impressive rate of seventeen times per second (some pulsars rotate at much higher rates), emitting a radio signal with each rotation. As Hulse and Taylor studied the pulsar, they noticed a regular variation in the pulses. They interpreted this to mean that the pulsar is in a binary orbit with a second neutron star. Observations of the pulsar emissions over a decade showed that the mutual orbit of the two neutron stars is slowly decaying.

In other words, the two neutron stars are inspiraling and will eventually collide. Measurements of the orbital decay matched the loss of energy and angular momentum predicted by General Relativity. In 1993, Hulse and Taylor were awarded the Nobel Prize in physics for discovering the first binary pulsar (which bears their name), and for producing the first indirect evidence of gravitational waves.

Both acceleration and spherical asymmetry are required to produce gravitational waves. The known sources include binary stars, colliding black holes, and supernovae. For example, if an exploding supernova just happened to spew energy and mass symmetrically in all directions, it would not produce gravitational waves. But this is very unlikely. Likewise, two neutron stars of equivalent mass in a perfectly stable orbit would not produce gravitational waves. But again, this is unlikely. Binary neutron stars almost always have different masses.

Gravitational waves are commonplace in the universe. They pass through Earth and our bodies constantly. But the sources are so distant that the waves are minuscule, at or below the threshold of detection. Einstein himself doubted if scientists would ever succeed in building instruments sensitive enough to record them. Although Hulse and Taylor only produced *indirect* evidence, their work motivated others to join the elusive search for gravitational waves.

The development of the first lasers in the 1960s proved critical to the detection effort. The other key piece of equipment is the interferometer, invented in the 1880s by Albert A. Michelson, and featured in a famous 1887 experiment. The Michelson-Morley experiment was an attempt to detect the hypothetical medium, or ether, by which light waves are transmitted. Michelson's interferometer used a light source and a special mirror to split the light beam in two. The two light beams then traveled out to the ends of long arms and were reflected back by small mirrors. The beams were recombined, producing an interference pattern that was visible in an eyepiece. For stability, the interferometer was mounted on a massive block of sandstone and suspended in a pool of liquid mercury.

During the test, the slab and apparatus was slowly rotated 360°. Michelson and Morley postulated that movement of the ether relative to the movement of Earth would affect the speed of light at two points around the 360° range; this would be visible in the eyepiece as a change in the interference pattern. However, no change was detected. The experiment was repeated many times with the same result. Physicists thereafter ruled out the existence of an ether.[327] The 1887 test is often cited as the most famous failed physics experiment ever, because it led to the formulation of Einstein's theory of Special Relativity.

In the 1970s, scientists married the laser with the interferometer in the search for gravitational waves. The early prototypes were not sensitive enough to detect gravitational waves, but development continued over many years. Several international projects came into existence, including a joint MIT-Caltech team (LIGO) in the United States, two European projects (GEO600 and VIRGO), and a Japanese effort (KAGRA). The research teams often worked together, sharing expertise, data, and rotating staff.

One of the important design improvements was the replacement of the eyepiece with a sophisticated photodetector. Another was to greatly increase the length of the interferometer arms. The longest, at present, are the two -and-a-half-mile-long arms of the LIGO (laser interferometer gravitational wave observatory) in the US, which operates two identical facilities, one at Hanford in Washington State,

Figure 1. LIGO station, Livingston, LA, USA.
Each of the two arms is 2.5 miles long.

and another at Livingston, Louisiana. (**See Figure 1**) Multiple observatories are necessary to screen out false positives. The interferometer arms are set at right angles to one another. A passing gravitational wave will have the effect of slightly stretching one arm and shortening the other.

Scientists can also tailor the length of the arms to the gravitational source being studied.[328]

The first time ever detection of a gravitational wave occurred on September 14, 2015, even before LIGO was fully on line. The facility was still in "engineering mode."[329] Marco Drago, a postdoc at the Max Planck Institute in Germany, made the discovery. The Max Planck Institute has a contract with LIGO to help analyze its data. That morning, Drago opened an email from LIGO with links from each station. A moment later he was staring at two identical signals from deep space.

The timestamps indicated the waveforms were separated by seven milliseconds. A flurry of excited emails and phone calls followed, as Drago and other LIGO scientists sought to rule out any chance of a false or dummy signal. Several months later, on February 11, 2016, after many additional checks, the discovery of gravitational waves was officially announced at an international press conference. It was the third confirmation of three major predictions by Einstein.

LIGO identified the source of the gravitational wave as a collision of two enormous black holes more than a billion years ago. One was the equivalent of thirty-six solar masses, the other twenty-nine solar masses. Although the signal had traveled 1.3 billion light years and was faint for this reason, its original energy output had been enormous, estimated at three times the mass of our sun converted to energy. The signal lasted only a few thousandths of a second. It was generated during the final inspiral of the decaying orbit, at the very last instant, before the black holes merged. At that point, the signal ceased.[330]

Although gravitational waves have not yet been detected from supernovae explosions, scientists say this is only a matter of time.[331] Dr. Deagle explained to me that he believes this type of gravitational wave was responsible for the past displacements of the earth's crust discussed in the preceding pages. Recent work by geologists has shown that Earth's interior contains copious amounts of water.[332] The mantle may hold more water than all of the oceans on the surface of our planet combined. The water-rich minerals are mainly located between two geologic discontinuities, at depths of 410 km (255 miles) and 660 km (410 miles), respectively. This part of the mantle is known as the "Transition zone."

According to Deagle, the gravitational waves generated by a nearby supernova cause a phase shift as they pass through the earth's mantle, freeing up nascent water bound up in minerals like Ringwoodite. Deagle postulates that gravitational waves jostle loose the chemically bound "H" and "OH" ions, reconstituting water that then acts as a lubricant, allowing the upper portion of the mantle and crust to slip over the deeper rock. Deagle thinks the displacement occurs over a period of months.[333] However, I was unable to find any supporting evidence for Deagle's proposed mechanism, so I will not comment further about it.

The Role of Comets

The other physicist, Professor James McCanney, was also a part of the conversation, but he did not agree that exotic gravitational waves generated by a supernova explosion could alter the mineral structure in the mantle. McCanney thinks such a wave, even from a nearby supernova, would be much too weak. Nor in his view could a gravitational wave cause a sideways or lateral movement of the mantle and crust. McCanney favors a different gravitational mechanism: a close encounter with a planetary-size comet.

First, consider the case of the moon, which has only one-sixth the surface gravity of Earth, yet it still generates twenty-foot-high ocean waves that follow the moon around the earth "like a pet on a leash." This lunar tidal wave moves around the earth at 1,000 miles/hour, on a daily basis, and even causes the surface of Earth to rise and fall about an inch. Now, compare this to an earth-sized comet passing, say, within a fourth of the distance from the earth to the moon and moving at 50,000 miles/hour.

The gravitational field of such a body would be twenty times greater than that of the moon and would have 10,000 times as much energy. It would set in motion 1,000-foot high tsunamis in our oceans and 250-foot surface waves in Earth's crust. There would also be differential effects—and this is important—because the tidal forces would be much greater at the surface of Earth than deeper down in the mantle and core. This is simply because of the greater distance of Earth's core from the comet.

As stated by Newton, the strength of gravity is determined by an inverse square distance relationship. The net effect would be to rip the earth apart. According to McCanney, this might cause the outer crust and mantle to separate from the deeper mantle and slip over it.[334] All of this would happen in about twelve hours, which is the transit time for the comet to pass by Earth.

When I read McCanney's email describing all of the above, something clicked in my head. It sounded familiar, and I went to my library to investigate. My memory was correct. On December 12, 1694, the astronomer Edmund Halley pitched a similar idea to the Royal Society: A comet caused the Great Flood.

Halley argued that the earth was "made out of the ruins of an old world," as evidenced by seashells found on mountain tops and the fossils that even then were being recovered from mines and construction pits. He proposed that the comet possibly altered the poles, the length of a day and year, even the axis of the earth. It is unclear whether Halley favored an impact or an encounter.

Yet, his 1694 lecture is pertinent to our discussion because in it he mentioned that "the North-west [sic] of America, about Hudson's Bay, had once been more northerly, or nearer the Pole than now they are."[335]

Halley's biblical time scale was compressed. All of this supposedly happened only a few thousand years ago, which explains his other comment about "immense quantities of ice yet unthawed in those parts, which chill the air to that degree." Halley was a product of his times and, like most scientists of the day, accepted Scripture as a literal record of natural history. The job of the scientist was to clarify the correspondence between the two. The impossibility of this led to the 18th Century Enlightenment and the irreversible rupture of science with doctrinal Christianity.

Soon after Halley proposed his comet thesis, Isaac Newton's protege, the mathematician William Whiston, did likewise. In 1696, Whiston presented a newly published book to the Royal Society in which he attributed the Biblical Deluge to a comet. As the comet swept by, the oceans massed on the side of Earth nearest the comet, to a height of seven or eight miles. And the water-rich tail of the comet produced a rain lasting forty days and forty nights.

According to Whiston, the comet made two passes by Earth. The first passage took nine hours, and the second twelve hours.[336] I mention all of this to inform the reader that well-known astronomers have associated comets with cataclysmic Earth changes since the earliest days of the scientific tradition.

Whiston, Newton, and Halley were colleagues who engaged in lively discussions among themselves about many issues, including comets. In 1684, for example, Halley visited Newton at Cambridge to discuss a comet he had recently been studying. Halley's jaw must have dropped when Newton informed him he had worked out the laws that governed the comet's motion.

Vastly impressed, Halley encouraged Newton to organize and publish all of this material, and later, even helped with the editing. The *Principia* was indeed published in 1687, with funds provided by Halley.[337] Some scholars cite Halley's encouragement and support of Newton as his most important contribution to science. The two men evidently kept in touch because the record shows they were still corresponding in 1724, just three years before Newton's death.[338]

Newton was also close to Whiston, a former pupil, and helped to advance his career. In 1696, Newton received a royal appointment as Warden of the Mint, an office located in the Tower of London. That spring, Newton moved to London to take up his new position, while retaining his chair at Cambridge. However, the duties of two positions, and the press of travel back and forth, evidently was burdensome, because in 1701, Newton asked Whiston to lecture in his stead at Cambridge. And later, when Newton stepped down at Cambridge, he had Whiston installed in his chair as Lucasian professor of mathematics. In their 1982 book *The Cosmic Serpent*, astronomers Victor Clube and Bill Napier argue that Whiston fell out of favor with Newton because his comet thesis clashed with Newton's clockwork universe.[339]

Comets were indeed a problem for Newton because they often follow seemingly lawless orbits. The issue seems to have preoccupied Newton because, during his lifetime, he brought out several expanded editions of the *Principia*, each one further revising his treatment of cometary orbits. "This discussion," Newton reportedly said, "is the most difficult in the whole book."[340] The matter of unruly orbits is accounted for by McCanney's Plasma Discharge Comet Model, as I will show in the next chapter.

But I must disagree with Clube and Napier, because although it is true that Newton later ostracized Whiston, the rupture (after 1710) did not result from a scientific dispute.

Whiston's book, after all, had been released in 1696, *five years before* Newton arranged for Whiston to lecture in his place. If he disapproved of Whiston's comet thesis, would Newton have planted Whiston in his own teaching post at Cambridge? Surely not. Whiston's book, *A New Theory of the Earth*, was thoroughly Newtonian in tone, was actually dedicated to Newton, and even interpreted Scripture along the lines preferred by Newton. The best-selling book went through five editions, though its popularity did not survive the Enlightenment.[341]

The record suggests that in private Newton largely shared Halley and Whiston's thinking about comets. It is even likely that Newton was the source of some of their ideas, including the apocalyptic belief that a comet would one day bring about the end of the world. Whiston discussed this in his book. After an exhaustive review of the historical record, Sarah Genuth, a resident scholar at the Smithsonian, concluded that "Newton was in close touch with both men, and it is sometimes hard to distinguish with whom ideas originated."[342] Not long before his death, Newton opened up to a nephew, John Conduitt, and explained that the world had undergone dramatic reformations in the past and would do so again in the future. In the last days, a comet would probably fall into the sun, fueling the solar furnace, and the resulting firestorm would consume the earth. When Conduitt asked his uncle why he had not published nor spoken in public of such things, Newton famously replied: "Because I do not deal in conjectures."[343]

Newton's break with Whiston had more to do with the latter's public espousal of Gnostic ideas in a time of religious conservatism.[344] Newton actually shared Whiston's religious leanings. Both men opposed the doctrine of the Trinity, believing it to be a corruption of the original pure teachings of Jesus. However, this was in private. In public, Newton maintained an orthodox persona and cautiously avoided religious controversy. Notwithstanding his own personal fame and influence, Newton evidently was haunted by the ghost of Giordano Bruno, burned at the stake, a century before. And Galileo's public humiliation by Rome in 1633 was still recent history.[345] At the start of the 18th century, the Church remained a powerful force, even in Protestant England. The final rupture of science and doctrinal Christianity lay in the future.

The notion that a comet caused the Great Flood was widely shared in the day. Newton, however, downplayed the threat that unruly comets posed to his clockwork universe by emphasizing their positive role in replenishing Earth's water supply. Newton actually promoted the idea that comets are dispensers of divine providence. Many years later, in 1759, when the 1682 comet returned on schedule as Halley predicted, the event was heralded as a decisive victory for Newtonian physics. The comet was re-named in Halley's honor. Its regular orbit appeared to be a ringing affirmation of the divine clockwork. But the devil was lurking in the details. At the start of the 18th century, Newton and Halley had no way of estimating the mass of a comet nucleus and, so, were unaware that its regular orbit was due to its small size. Many small comets have more or less regular orbits.

Planetary size comets are another matter entirely. Their orbits change unpredictably. Nor is their seemingly lawless behavior explainable, solely in terms of the gravitational pull of Jupiter and the other planets.

McCanney's comet model can account for this. But is there physical evidence for it? Yes.

The evidence lies beneath our feet in Ohio and inscribed on a sandstone bluff in Utah. If this sounds improbable, read on….

Chapter Nineteen: From an Ancient Petroglyph to the Frontier of Science

Serpent Mound in southern Ohio is larger than life, its scale such that visitors are typically unaware of what lies beneath their feet. From the tip of its spiraling tail, the undulating figure sprawls for nearly a quarter mile to the head, whose gaping jaws appear poised to swallow a huge orb. (**See Figure 1**)

From an aesthetic perspective, the design is nearly perfect. And, like the glyphs at Nazca, Peru, the layout is oriented to the sky above. It is apparent that the site has to do with the heavens. The earthen mound's physical dimensions are impressive: From head to tail it averages about four feet high and twenty-two feet wide. Its construction required the relocation and placement of at least 117,040 cubic feet of earthen material, an ambitious project for a stone-age society. What justified this enormous expenditure of human labor?

But perhaps the deeper mystery is, why? For what purpose was it built? Why go to so much trouble?

There are many opinions. One of the earliest investigators pointed out in the 1840s that the karst plateau upon which the mound is situated resembles a giant reptile, which presumably explains the choice of the site. Another expert reported that the snake's head is aligned to the

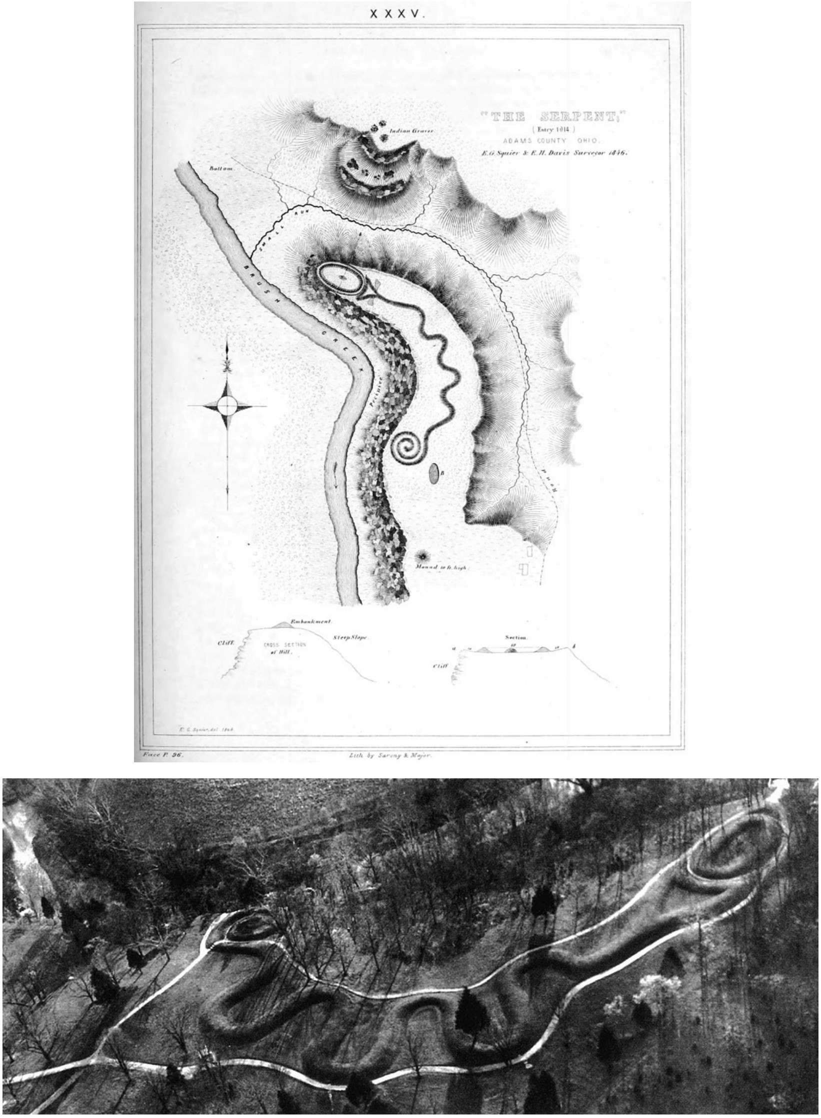


Figure 1. Serpent Mound, Ohio

summer solstice, though what this signifies we can only guess. Yet another view holds that the earthen shape was meant to depict a solar eclipse. One armchair expert pointed out that the mound resembles a rattlesnake. Others think the orb represents an egg, or an eye. Opinions have been as varied as the "experts."

To obtain the answer it is necessary to decode the symbol of the serpent, which, as we know from analytical psychology, can have many different meanings. But context is always the key. The symbol of the snake represents energy. This can be spiritual energy, or life energy, or the darker chthonic forces of the unconscious.

The serpent can even symbolize malevolent energies. Because snakes shed their skins, the serpent can also refer to transformation. The problem with the Ohio site is the absence of contextual evidence. Therefore, we must look elsewhere. I believe the clue to serpent mound is a petroglyph known as the Head of Sinbad. (**See Figure 2**) It is located on a sandstone bluff near Green River, Utah. The site is on federal land, very near Interstate 70 and is accessible to the public.

The petroglyph includes two vaguely shamanic figures, the larger of which is dressed in a robe-like garment. He is gesturing with his arms spread wide and is bug-eyed, as if he just witnessed something that blew his mind. The other smaller individual standing at the left is also gesturing wildly as he watches.

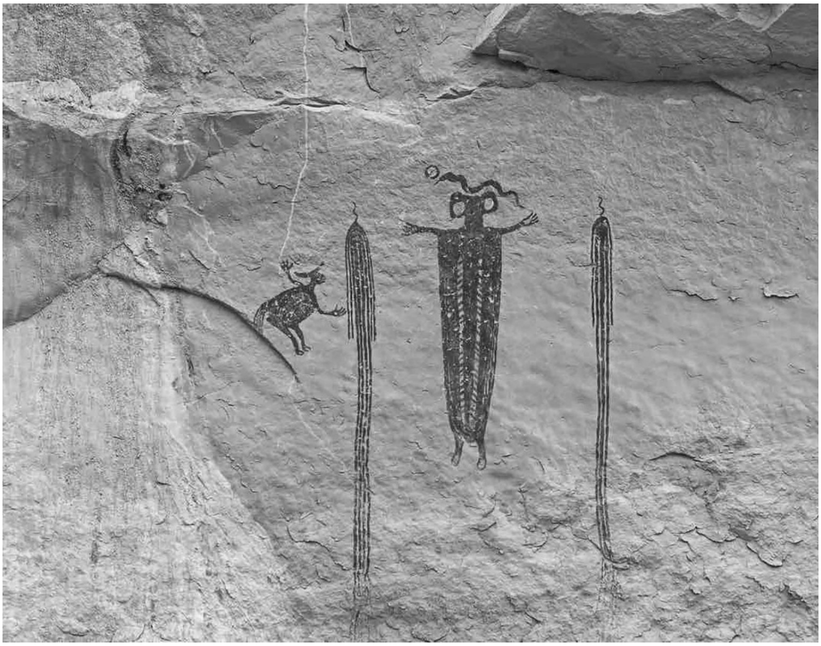


Figure 2. Head of Sinbad petroglyph, Green River, Utah

Above the hooded figure is an undulating snake with an orb at its head: an immediately recognizable likeness of serpent mound. But two additional elements are also present: side-by-side glyphs of what can only be comets. And these glyphs, I submit, provide the context missing in Ohio. It is not a stretch to conclude that the mound builders in Ohio employed the same language of symbolism as the Native American artist or shaman who created the Green River petroglyph.

Sometime in the distant past, native peoples across a broad swathe of North America witnessed an extraordinary event in the sky, more likely a sequence of events, involving multiple planetary-size comets and something more, what exactly we cannot say for certain. But I suspect that it involved a celestial display of electromagnetic energy, and on a colossal scale.

Notice the curled spikes at the tip of each comet, a crucial detail indicating that the early Americans witnessed a phenomenon that was unknown to science until very recently. The sunward or cometary spike was first documented in a stunning 1957 photograph of Comet Arend-Roland, which must be seen to be believed. (**See Figure 3**) However, priority of discovery must go to the artist or shaman who, long ago, recorded the phenomenon at Green River in the form of a petroglyph.

Sunward spikes are so named because they always point from the comet nucleus toward the sun. None of the great astronomers of the last 500 years, including Copernicus, Kepler, Galileo, Tycho, Halley, Newton, Herschel, and Hubble were fortunate enough to observe this extraordinary phenomenon. They had no inkling that such a thing existed.

Although similar spikes have been photographed many times since 1957, mainstream science has never adequately explained the phenomenon. Not that scientists have not attempted to do so. Indeed, they have. In December 1986, shortly after the much-anticipated return of Halley's Comet, a team associated with the European Space Agency (ESA) published grainy photos of a sunward spike on the head of Halley's Comet.

Figure 3.
Comet Arend-Roland (1957)

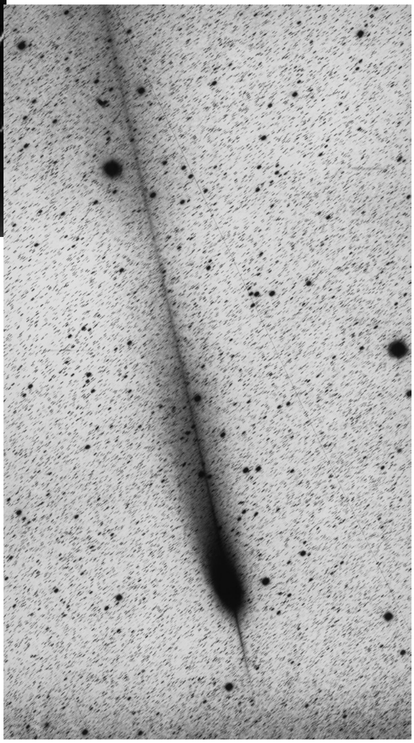


Figure 4. Comet Hale-Bopp
(reverse image)

In its report, the team announced that the 435,000 mile-long spike was "obviously composed of dust…" ejected from the comet nucleus.[346] But their phraseology, in particular the word "obviously" tells us more about the scientific bias of the researchers than the phenomenon itself. Elsewhere in their paper, the ESA team acknowledged that detection of the spike had been "entirely unexpected." If this is true, then on what basis should their conclusion that the spike was made of dust be regarded as obvious? If it was unexpected, how could it be obvious? The team conceded it failed to consider possible electrodynamic forces, an admission that shows the limited scope of its investigation.

Filming sunward spikes requires modern technology: sophisticated telescopes and cameras. As noted, grainy photos of the spike on Halley's Comet were captured in 1986. But Halley's is a small comet. In 1996, excellent photos were recorded of the sunward spike on the much larger Comet Hale-Bopp during its passage. (**See Figure 4**) But no one reported seeing Hale-Bopp's sunward spike with the naked eye. Nor have unaided sightings been reported since modern astronomers re-discovered the phenomenon.

The fact that Native Americans, who lacked modern technology, observed them means that the comets sighted at Green River were extremely large, i.e., planet-size. It's also likely they were close to Earth. One planetary-sized comet, let alone two, would have been more than capable of wreaking havoc with our planet.

Does this explain why Native Americans created serpent mound and the Green River petroglyph? Were they survivors of a cataclysm involving the close encounter of Earth with a large comet? Although we cannot be certain, one thing seems clear. A major celestial event involving comets left an impression on early Americans so deep that they felt compelled to create a lasting record. They went to a lot of trouble constructing the serpent mound. Was this an exercise in self-therapy, as native people struggled to come to terms with something far beyond their ken?

Were they motivated also by the understandable human need to warn their great-grandchildren and subsequent generations about the awesome power of the cosmos? If I am correct about this, we owe these early Americans a sincere debt of thanks.

It is not possible to date the Green River petroglyph, but this hardly diminishes its historical value. The cliff drawing obviously long predates the scientific era, perhaps by ten thousand years or even more. Its depiction of multiple planet-size comets is a cautionary tale for us moderns. Although no comet of this size has passed through the inner solar system during the scientific era, the last 500 years is but a blip in the natural history of our planet. The petroglyph is a sober reminder that recorded history is much too short of a time frame to serve as a baseline for what is possible. The Green River petroglyph tells us that Earth has encountered large celestial objects in the past. And it is entirely possible that they caused major disturbances to our planet, possibly including displacements of the earth's crust.

Needless to say, this is not the message one gets reading articles or books by NASA scientists, who always downplay the dangers. Visit a NASA website and you will read that comets are "cosmic snowballs of frozen gases, rock and dust that orbit the sun."[347] In the very next line, NASA mentions that comets are "the size of a small town," in other words, rather small and harmless.

Enroll in a college-level astronomy course (or sit in on lectures for free, as I did) and you will be instructed in this arcane knowledge. You will learn that comets are loosely held conglomerates of primordial rock and ice left over from the creation of the solar system 4.5 billion years ago. The astronomer Johannes Kepler first proposed the ice model, and the French philosopher and mathematician Pierre Simon de Laplace revived it in 1813.

But Harvard astronomer Fred Whipple gets credit for the modern formulation. Whipple proposed the dirty snowball comet model in a series of papers published between 1950-1955. According to Whipple, solar radiation melts the volatile ice in the comet nucleus, and the water vapor is swept away on the solar wind. This accounts for the spectacular tails that have dazzled the human imagination down through history. Everyone agrees that in all of Nature there is nothing to compare with one of these visitors to the inner solar system.

The Dirty Snowball Comet Model: Anomaly After Anomaly

Problems with Whipple's ice model first arose in the 1960s when studies of Comet Ikeya-Seki (1965 VIII) showed that the dust in its tail was polarized. The scientists who did the studies concluded that the dust was behaving like a semiconductor.

Here was strong evidence of the presence of an electrical field, which made no sense from the standpoint of Whipple's gravity-driven model. The significance was not lost on Whipple himself, who mentioned the anomaly, many years later, in a summary paper on the current state of cometary science.[348] Though Whipple couldn't explain the data, in 1989 he still viewed it as worthy of note. The case shows that Fred Whipple, to his credit, did not necessarily dismiss data simply because it disagreed with his theory.

Whipple understood that cometary science was still in its infancy. During a round table discussion at a 1976 comet conference held at the Goddard Space Flight Center, Whipple enthusiastically endorsed a proposal to collect and catalogue historical accounts of comets for further study. As he commented:

> "We don't know what a normal comet is. The fact is, we have not proceeded to the point in comet studies of having any taxonomic study of comets. We do not have classifications of comets, in any real sense."

At the time, astronomers were struggling to understand comets (they still are) and the reason was (and is) due to the strange behavior of these visitors from space. Time and again, comets have shown themselves to be notoriously inconstant and maddeningly unpredictable. As Michael J. Mumma of NASA's Goddard Space Flight Center once put it: "Comets are quite fickle…They are like cats. They both have tails and do what they want."[349]

The anticipated arrival of Comet Kohoutek in 1973 presented another case. Widely expected to put on a sensational display, Kohoutek was even dubbed the comet of the century. But it failed to live up to its billing. Kohoutek fizzled, though from a scientific standpoint it was a success. Kohoutek was the most studied comet in history, a distinction it held until the much-anticipated return in 1986 of Halley's Comet, the most famous comet of all.

Indeed, for a week in March 1986, Halley's Comet held court on the world stage as the focus of every working astronomer on Earth. An international flotilla of five space probes was on hand as it approached, to better study it. But Halley's Comet made news even *before* the rendezvous by announcing itself from an incredible distance. When it was first spotted in October 1982, Halley's was then between the orbits of Saturn and Uranus.

As noted, Halley's Comet is average-sized, which means that its nucleus is rather small. It is roughly oblong in shape: ten miles long and about five miles wide. But how could an object of this size be visible from a distance of 14 AU, that is, from fourteen times the distance of the earth from the sun? The comet burst into visibility from so far away that even proponents of the snowball model began to have second thoughts. According to the snowball model, solar radiation sublimes the frozen solids in the cometary nucleus, causing them to outgas. The vapors (mainly water) make up the coma, which also includes significant amounts of dust. All of this material shrouds the nucleus in a vast envelope hundreds of thousands, even millions, of miles across.

The coma is optically opaque, making direct observation of the nucleus impossible in most cases. Even transit studies of comets moving across the solar disk have failed to show the dark silhouette of the nucleus. For this reason, it is difficult to determine the size of a comet's nucleus, although in general it is proportional to the diameter of the coma. The fact that the same gas and dust that hides the nucleus from optical study also tends to shield it from solar radiation should have raised serious doubts about the ice model's efficacy, for how then is the frozen material sublimed?

The tail is the other distinctive feature, which supposedly forms as the vapors and dust are swept away on the solar wind. In the case of Halley's, however, the observed facts were so strange that some skeptics questioned whether there was sufficient solar radiation at 14 AU to vaporize the frozen solids in the nucleus. If solar radiation was responsible, then why didn't it *also* volatilize the icy surface of Jupiter's moon Europa, which was much closer to the sun than Halley's? Europa should have been outgassing like a comet! And if not, then why did Halley's brighten at such a great distance? The approach of Halley's lived up to Mumma's feline homily.

Nor could anyone explain, later, why Halley's was 200 times more luminous on its outgoing leg at the same distance from the sun than during its approach. The anomaly was stranger still because this was *exactly opposite* the behavior of Comet Kohoutek, which was 100 times fainter *on its outgoing leg* than at the same distance during its approach.[350]

The opposite behavior of the two comets was inexplicable and maddening.

The eminent astronomer and mathematician Sir Fred Hoyle described Halley's uneven display as "a sequence of explosions."[351] In 1993, several years after Halley's had passed perihelion and was exiting the inner solar system, Hoyle gave voice to the consternation of many concerning its erratic behavior:

> "What a comet is *not* is a dirty snowball, the supposedly respectable theory contradicted by every aspect of the approach to earth in 1986 of Comet Halley, and by events since then. No dirty snowball at a temperature of minus 200 degrees [Kelvin] ever exploded as Comet Halley did. Nothing in the behavior of Comet Halley has been like that of any normal object of which we are familiar."[352]

Hoyle went on to cite other strange features, for example, the "cooked organic material" on its surface, that he described as looking like "black tar, not a dirty snowball."[353] Fred Whipple agreed. He described the nucleus of Halley's Comet as "black as roughed soot…blacker than almost all natural substances."[354]

Hoyle's assessment was based on the data gathered by the Giotto space probe that passed within 372 miles of Halley's nucleus. According to a subsequent paper summarizing the mission, Halley's Comet had "a very low albedo of 2-4%, comparable to the darkest bodies in the solar system."[355]

And there was another issue: the incredibly small size of the dust particles in Halley's coma, as measured by the dust impact detectors and mass spectrometers on board the Giotto and Vega space probes. The data showed that "particles below 10 to the minus 14 grams were much more abundant than anticipated…"[356] Why the ubiquitous presence of smoke-sized and sub-micron size particles? No one could say, including Fred Whipple who, again, to his credit, instead of simply dismissing the data saw fit to mention it in his 1989 summary paper.[357] The more one studied the data, the more it seemed that something was wrong with the dirty snowball concept.

On May 1, 1996, NASA's Ulysses spacecraft documented another striking anomaly when it discovered a previously unexpected feature of comets. Ulysses detected the ephemeral tail of Comet Hyakutake at a point in space more than 342 million miles from its nucleus.[358] The data showed, in other words, that the length of Hyakutake's tail was 3.8 times the distance of the earth from the sun. The number was so large it astonished everyone. The discovery was accidental. Ulysses had been placed in an unusual orbit, outside the plane of the solar system, to better study the solar wind.[359]

Scientists had never guessed that ephemeral comet tails could be so long. The extraordinary length of the tail meant that as Comet Hyakutake moved around the sun toward its minimum point, or perihelion, its tail arced across a vast portion of the solar system. But what cohesive force held the ephemeral tail together in the vacuum of space? According to the snowball model, comet tails are composed of gas and dust, blown away from the nucleus by the solar wind. But if this were so, how could Hyakutake's tail maintain its integrity? Why didn't the same solar wind, which was pushing it away from the nucleus, disperse it? And there was another problem. The nucleus of Comet Hyakutake is small, less than two miles in diameter.[360] How could a nucleus this small produce a tail so long?

A team led by astrophysicist Carey M. Lisse considered this. The team studied Comet Hyakutake from three different observatories (using infrared, optical, and radio telescopes) and concluded that to produce a tail of this length the comet nucleus would have to be outgassing water over nearly 100% of its surface. This was shocking, to say the least, because in general the median percentage of surface outgassing for comets is only about 1%. (Halley's Comet was considered high at a mere 10-15%.) The surface temperature of Hyakutake's nucleus was equally bizarre: 320° Kelvin (116° F), *which is much too warm for water to exist as ice*.

Moreover, its surface albedo, which is a measure of light reflectivity, was 40%, low enough to classify as a black body.[361] This meant that only 40% of the light reaching the surface of the nucleus was being reflected back into space. An icy surface would have an albedo of 80-100%. In short, the observed facts were completely out of step with a snowball. How was all of this to be explained?

And there was another anomaly. If, as proponents of the ice model contend, solar radiation sublimates water and dust from the comet nucleus, and if the solar wind pushes the gases and dust away, then why does the coma (the nebular cloud around the nucleus) noticeably contract in the vicinity of the sun as the comet moves toward perihelion? This is not wild fantasy. An abundance of photographic evidence gathered over many years of studying comets shows that the coma markedly contracts near the sun.

The phenomenon is observable and can be confirmed by anyone with a good-quality telescope. Given that the neighborhood of the sun is the most extreme environment in the solar system, should we not expect outgassing to greatly *increase* near the sun? Indeed! In which case the coma and tail ought to visibly expand. Only they don't. The observed behavior is the opposite of what one might expect.

But perhaps the strangest anomaly of all was the discovery in March 1996 that Comet Hyakutake was producing X-rays.[362] The news stunned the scientific world because naturally occurring X-rays are associated with extreme temperatures: in the range of millions of degrees Kelvin. Yet here they were coming from a ball of ice. NASA scientist Michael J. Mumma summed up the feeling of shock in the astronomical community: "We had no clear expectation that comets shine in X-rays. Now we have our work cut out for us explaining these data."[363]

The discovery was the work of the German ROSAT satellite, an orbiting X-ray telescope that had been in operation since 1990.[364] Earth-based X-ray telescopes are not feasible because, fortunately for us, Earth's atmosphere very effectively absorbs X-radiation. To study space objects in the X-ray portion of the electromagnetic spectrum, scientists must go above the atmosphere and "see" through the "eyes" of a specially designed X-ray space telescope.

The X-rays from Hyakutake were not coming from the comet's nucleus. The area of emission was so far in advance of the comet that the nucleus of Hyakutake did not even show up in the ROSAT image. The discovery was not a glitch. The following year, X-rays were also detected coming from the short-period Comet Encke. And in subsequent years, many more comets were found to produce X-rays. The region of emission was always between the nucleus and the sun: a zone more-or-less crescent-shaped and 6,000-19,000 miles from the head of the comet. A smaller area of maximum emission was identified at 12,500-15,000 miles. In each case, researchers found the same X-ray footprint, though it varied in size and intensity from comet to comet.

The production of X-rays was anything but constant, far from it. The level of emission varied greatly, even from hour to hour, and, notably, was synchronized with fluctuations in the solar wind, hence, with solar activity.

Scientists noticed that whenever the sun released large flares or coronal mass ejections (CMEs) in the general direction of the comet, shortly after, there would be a surge of cometary X-rays. This linkage with the sun prompted new investigations of the solar wind to better understand its composition and its interaction with comets.

In July 2000, after four years of conspicuous silence on the issue, NASA finally unveiled an official solution to the X-ray conundrum. While conceding that X-rays are produced under extreme conditions, the agency announced that positively charged ions from the sun were responsible. According to NASA, the ions are produced in the solar corona and are then carried by the solar wind to the comet where they collide with neutral elements in the coma, pick up electrons, and release high-energy photons (X-rays). In essence, NASA was arguing that multiple-charged ions carried on the solar wind were an extension of the extreme conditions of the corona itself.

Credit for the "charge exchange" mechanism, as it is known, went to T.E. Cravens who argued that the sun's energy is thus "frozen in" during the long transit of these positive ions on the solar wind, due to the relative paucity of collisions in vacuous space. In the words of Cravens: "the energy required to power this [X-ray] emission originates in the hot solar corona, and is temporarily stored as potential energy in highly stripped solar wind ions until this energy is released by these charge transfer collisions."[365]

Far from resolving the issue, the mechanism preferred by NASA only raised new questions. Not all scientists agreed that charge-exchange was the primary mechanism responsible for cometary X-rays. Positively charged ions, after all, make up only about 1% of the solar wind. Some believed that the space agency was fumbling badly with a mystery it did not understand. Professor James McCanney was one of these critics. Indeed, McCanney was probably *the only scientist not surprised* that comets were producing X-rays. He had actually predicted them, many years before, when he published his three-part Plasma Discharge Comet Model (1980-1981). For years, McCanney had been urging NASA to look for cometary X-rays, and he even told them *where* to look.

Chapter Twenty: The Solar Capacitor

The Plasma Discharge Comet Model is built upon ideas first articulated by the astronomer William Herschel (1738-1822), who is probably best known as the discoverer of Uranus, the seventh planet from the sun. Herschel lived at the time of the American Revolution and was King George III's royal astronomer. Herschel believed that star formation resulted from the collapse of interstellar clouds or nebulae. He proposed that comets also could attract nebular material as they moved through the reaches of space. By a process of consolidation, comets added bulk, grew larger, and matured into planets.[366]

Herschel also believed that our sun had a solid core, and that the source of its luminosity was high in the solar atmosphere. Although he lived two centuries ago, Herschel's understanding of the sun was more advanced than the model currently in use by NASA scientists, who think nuclear fusion occurs deep in the sun's interior. But if this were true, the sun's outer surface would be relatively uniform, which is anything but the case. Observation shows that the outer portion of the sun, known as the corona, is a place of unimaginable violence, characterized by immense solar flares, complex magnetic storms, and coronal mass ejections.

Hydrogen is by far the most abundant element in the sun and constitutes 90% of its atoms and 70% of its mass. However, due to the extreme conditions in the corona, a hydrogen atom (consisting of one proton and one electron) cannot exist in its normal state. The electron is stripped away from the nucleus and the result is a plasma of free electrons and protons, the so-called fourth state of matter. Although the two particles have the same (though opposite) charge, the mass of a proton is 1836 times greater than the mass of an electron, which is negligible. The heavier protons tend to concentrate lower down in the solar corona, while the much lighter free electrons collect on the outer surface.[367]

This separation of charge is fundamental to the workings of the sun, the solar system as a whole, and the behavior of comets. Although charge separation starts in the solar corona, it does not end there. Separation of charge is pervasive throughout the solar system. This should not surprise us, since the sun dominates the entire system. And electrons, because of their greater mobility (relative to protons), tend to be the principal carrier of charge throughout. It logically follows that the solar system is a non-uniform electric field.[368]

I should add that NASA scientists regard this as heresy because they believe space is charge neutral. However, the sun's behavior and its interaction with comets tells us otherwise.

The nuclear fusion in the corona accelerates protons and positive ions up through the much lighter outermost envelop of free electrons and out into space. This solar wind sweeps dust and gas out of the inner solar system and pushes it far out beyond the orbit of Jupiter. The result is a positively charged nebular cloud surrounding the solar system, with the negatively charged sun at the center. Recent discoveries have confirmed the presence of this nebular cloud.[369] It appears to be a standard feature of solar systems throughout the galaxy. Apparently, all stars possess a nebular cloud.

Professor McCanney's important insight is that the system I have just described behaves like an electric capacitor. McCanney uses the analogy of a backyard bug-killer to describe how it works. The analogy is easy to visualize. When a mosquito enters the space between the bug killer's two charged plates (one positive, one negative) it discharges the field. Electricity jumps from one side and zaps the mosquito. Similarly, when an object from interstellar space enters the solar system from any direction, it begins to discharge the solar capacitor. A stream of electrons from the negatively charged sun flows to the comet nucleus, which also becomes negatively charged.

Meanwhile, positive ions including protons, dust, and gases are attracted to the comet from the rear, and these make up the comet tail. If McCanney is right, the working of a comet is opposite the general impression. Reality is not as it appears. Comets do not outgas water, dust, and other volatiles. Water is often found in the coma, but it does not originate in the comet nucleus. Comets are not made of ice. As Herschel foresaw, they are like asteroids. The coma is a chemical laboratory where water is reconstituted from free hydrogen (protons) and oxygen ions pulled in from the rear.

Many kinds of complex reactions occur in the coma. However, in general, positively charged ions are drawn in from the rear, add electrons, and become electrically neutral. Small comets tend to lose these neutrals back into space. The comet sloughs-off neutral material about as fast as positive ions are drawn in. But comets can come in all sizes, and moon-size or larger comets behave very differently. These monsters have sufficient mass to gravitationally hold the dust and gas in the coma. Large comets actually gain mass through the accretion of this material onto the nucleus. This explains why their orbits are erratic and why they tend to slow down, due to the conservation of momentum. McCanney's original comet paper includes equations that define the behavior of the comet tail and the strange way the coma contracts as the comet approaches the sun.[370]

Electromagnetism explains the polarized dust in the tail of Comet Ikeya-Seki (1965), and the brightening of Halley's Comet (1986) at an extreme distance from the sun. Halley's coma "turned on" like a fluorescent light bulb once the electrical connection was established between the sun and the comet nucleus. An electrical connection also explains Comet Hyakutake's incredible tail length, which is otherwise inexplicable. Certainly, the alleged outgassing of water from the comet nucleus cannot begin to account for it.

The ubiquitous presence in comets of sub-micron (smoke-size) particles is also powerful evidence that comets are electrically charged. Particle size always determines whether gravitation or the electromagnetic force will predominate in a given situation. Electromagnetism is a much stronger force, but it is also limited because an electrical charge is always a surface phenomenon. Gravitation, by contrast, has no such limitation. Electrical forces easily dominate the sub-micron realm, while gravity rules the world of baseball-size objects and larger. Pea-size particles fall in between and are affected by both.

The non-uniform nature of the field explains why one comet can be brighter during its approach to the sun while another comet is brighter as it speeds away. Likewise, the variable intensity of X-ray production on the sunward side of the comet nucleus depends on the changing conditions in the solar corona, which affects the stream of electrons from the sun. X-ray production is variable because the electron stream from the sun is variable.

The mechanism responsible for cometary X-rays is well understood, and in physics is known as *bremsstrahlung*, a German word that means "braking radiation." It is easy to visualize. Imagine a fast-flowing stream. Now, picture what happens when the flowing water encounters a large boulder in the current. The water is blocked and momentarily slows down. In a similar fashion, the electron current from the sun decelerates as it approaches a comet nucleus which itself is moving toward the sun at a high velocity. As the electrons slow down they release energy in the form of X-rays, due to the conservation law.

Bremsstrahlung produces X-rays across a broad spectrum. By contrast, the charge exchange mechanism proposed by T.E. Cravens, a NASA scientist, is much more limited, producing X-rays only at the individual spectral lines associated with each type of ion.[371] For this reason, charge exchange can account for but a tiny portion, at most, of the total X-ray production. In an email, McCanney informed me that when NASA scientists conducted lab experiments to better understand the charge exchange process, they discovered that free electrons are necessary for their mechanism to work. But NASA never explained the source of these electrons.[372] Given that the region of cometary X-ray production is very specific, on the sunward side and far out in advance of the comet nucleus, all of this is consistent with a current of electrons from the sun to the head of the comet.

Criticism and Response

McCanney has faced critics on many occasions. On March 30, 2005, for example, during a nationally broadcasted radio debate, David Morrison, a senior scientist at NASA's Astrobiology Institute, took issue with McCanney's claim that space is electrically active.[373] Morrison pointed out that in recent decades NASA and other nations have launched numerous probes into space without ever detecting an electrical field. McCanney countered that none of the craft were properly designed to detect a charged field in a space environment that has no electrical ground.

McCanney also pointed out that spacecraft are influenced by the surrounding electrical field of space. In such a field, electrons in the probe's metallic body/skin will freely migrate to one end of the craft, which will then function like a dipole, skewing the telemetry. McCanney added that NASA could overcome the problem by modifying the design of its spacecraft. While the scientific search for truth is not a popularity contest, it is worth mentioning that a poll taken after the live debate found that a majority of listeners thought McCanney won it.

Years ago, when I first began to study McCanney's comet model, I exchanged emails with a NASA astronomer, Michael A'Hearn, who disagrees with McCanney's assertion that the material in comet tails moves toward the nucleus.

A'Hearn informed me that researchers "have measured Doppler shifts in the ion tail [of comets] and it is clear that the ions are moving away [from the nucleus]."[374] I reviewed several of these spectroscopic studies, and A'Hearn is correct. The various authors report that light from the comet tail is red-shifted, i.e., shifted to the red end of the electromagnetic spectrum. And on this basis they conclude that the ions are moving away from the nucleus.[375] This is the standard interpretation of red-shifted light, and it is why many astronomers also believe the universe is expanding.

But McCanney disputes this interpretation of the data. He proposes a very different explanation for red-shifted light, one so fundamental that it involves a reexamination of light itself. It is well-known in physics that light photons have wavelike properties but can also behave like particles. High energy photons, e.g., Gamma rays, are especially particle-like. At the other end of the spectrum, lower energy infrared and radio photons tend to be more wavelike. Ultra-low frequency photons are the most wavelike photons of all.

It is also well-known in physics that under certain conditions a Gamma ray will divide, transforming itself into two equal but opposite particles: an electron and a positron that have opposite charge and spin characteristics. McCanney argues that because charge is always conserved, the positron and electron must have existed within the Gamma ray photon *even before the division*. He is saying, in other words, that charge is an inherent property of light.

McCanney argues that the inherent property of charge refutes the standard interpretation of the red-shift. Because the inherent dual charge will be expressed whenever a photon passes through a star's electrical field, or that of a comet. If McCanney is correct, it is not the mass of a star (or a comet) that bends light but the star's intense electrical field, which, he says, causes the photon's inherent positive and negative charges to separate slightly. The photon behaves like a dipole in the field. The negatively charged star attracts the positive end of the dipole. The photon moves slightly toward the star. As it does, it loses energy and its wavelength shifts to the red. The photon bends around the star. And the bending is powerful evidence of an electrical field, *not an expanding universe*. Neither stars nor comet tails are moving away from us.

This is not a new idea. In 1921, a German physicist named Walther von Nernst proposed that light loses energy because of many star encounters during its long passage through the cosmos.[376] More recently, other scientists have articulated slightly different versions of what has become known as the "tired light" hypothesis. But McCanney is the first to propose a mechanism, what he calls the "induced dipole effect." McCanney claims to have demonstrated the principle in the laboratory. And he has encouraged NASA scientists to conduct similar experiments, which, he says, will prove his comet model.

Indeed, McCanney thinks it is proven already. He told me that Russian scientists verified his comet model in 1994 when Comet Shoemaker-Levy 9 crashed into Jupiter.[377] For decades, Shoemaker-Levy had been orbiting the Jovian giant. However, its orbit was decaying steadily and, in 1992, the nucleus broke apart. Two years later, twenty-one comet fragments returned, strung out in space like a string of pearls. And as they plunged into Jupiter's atmosphere, the fragments caused a series of spectacular fireballs.

Each impact was greater than the combined megatonnage of all of the nuclear arsenals on Earth. The display happened on the back side of Jupiter, so it was not directly observable from Earth. But the evidence of the impacts was unmistakable, i.e., enormous dark blotches in the Jovian atmosphere as the back side came round into view. Russian scientists informed McCanney that sulfur showed up in the tails of the latter fragments, shortly before impact. Yet, no sulfur was detected in Shoemaker-Levy's nucleus and coma, so the source had to be Jupiter itself.

Evidently, the first impacts disturbed enormous amounts of material and lifted it up thousands of miles above the Jovian atmosphere. As the later fragments passed through this displaced material the tails picked up sulfur ions, thus confirming McCanney's model. Although I have not been able to verify the report by Russian scientists, there is no disputing that the Hubble Space Telescope detected sulfur above the Jovian atmosphere, after the impacts.[378]

As already noted, McCanney predicted cometary

X-rays as early as 1980-1981.[379] And on multiple occasions thereafter, he encouraged NASA to look for them. For example, in 1985, NASA was preparing to rendezvous with Comet Giacobini-Zinner, which was then approaching the sun. At the time, the International Sun/Earth Explorer 3 (ISEE-3) probe had recently completed its original mission of studying the solar wind and was being re-tasked by NASA to intercept the Comet Giacobini-Zinner.

The probe was equipped with an X-ray detector, and McCanney urged senior scientists at NASA to use it during the flyby. McCanney also recommended a trajectory across the sunward bow of Giacobini-Zinner to focus the X-ray detector on the head of the comet. Instead of following his advice, however, NASA shut down the X-ray detector to conserve the probe's battery and, after a series of complicated maneuvers, sent the satellite across *the rear* of the comet. NASA even re-christened the probe for the new mission with a name befitting its comet model: the International Cometary Explorer, or ICE for short.

NASA detected no X-rays during the passage, probably because it did not look.

In 1986, McCanney presented a comet paper at a San Francisco meeting of the American Geophysical Union.[380] During the lecture, he again encouraged the NASA scientists who were in attendance to look for X-rays during future encounters with comets. *He even told them where to look: on the sunward side of the nucleus*.

McCanney's prediction was finally born out in 1996 when, as noted, X-rays were detected on the sunward side of Comet Hyakutake. The fact that McCanney predicted the phenomenon, many years before, did not deter NASA scientists from taking credit for the discovery![381] NASA's 1997 paper describing the first detection of cometary X-rays fails to credit McCanney and never even mentions his name. This was not a mistake or an oversight. It was deliberate mendacity, and actually brought *discredit* upon NASA.

In science, it's standard practice to credit the individual who makes a discovery. This is not simply a courtesy. Recognition establishes priority and shows mutual respect, which are the basis for a collegial atmosphere conducive to sharing data and ideas. All of which are essential for good science. So, it is no exaggeration to state that scientific progress depends on attribution and recognition. Why then did NASA consign McCanney to scientific oblivion? It is an interesting question. After researching the matter, I concluded the reason is because McCanney's Plasma Discharge Comet Model scares NASA to death. The model provides a plausible mechanism to explain the capture of a large comet by the sun. But this is anathema to NASA because it revives the specter of Velikovsky.

A word to the reader: I am well aware this discussion has taken us deep into the woods. I must beg your indulgence. If the issues were not of the utmost importance, I would not have ventured thus. All will be clear momentarily.

The Velikovsky Controversy

Immanuel Velikovsky was a Russian-born psychoanalyst whose 1950 book *Worlds in Collision,* touched off "a literary earthquake." In the book Velikovsky argued that science has failed to account for the electromagnetic nature of the solar system. Another prominent theme was that major cataclysms have ravaged Earth, even within historical times. Velikovsky believed that during the second millennium BCE, a large comet, which he identified as the planet Venus, rampaged through the inner solar system. During this 500-year period, Venus had several gravitational encounters with Earth and Mars, after which it gradually settled into an orbit around the sun and became the familiar sister planet to Earth.

Velikovsky cited an abundance of literary material drawn from ancient religious writings, old texts, diverse legends, and various world mythologies. None of this amounted to empirical evidence. But Velikovsky was an able writer and a meticulous scholar. Notably, he also drew heavily from the Old Testament in an attempt to synchronize the Venus-Earth encounters with events described in Scripture, especially the famous Exodus of the Hebrews. The Biblical tie-ins help to explain his book's enormous appeal.

In subsequent books, *Ages in Chaos* (1952), *Earth in Upheaval* (1955), and *Mankind in Amnesia* (1982), Velikovsky dealt with other aspects of the same theme. In the 1952 book, *Ages in Chaos*, he challenged standard archeology and biblical scholarship by arguing for a major revision of the accepted chronology of the second millennium BCE. Velikovsky believed that a close gravitational encounter with Venus had altered Earth's orbit, which lengthened the year by five days, thereby accounting for the historical chaos of the second millennium BCE. He sought to re-date the Exodus at roughly 1700 BCE rather than around 1250 BCE (the standard view), a revision of nearly five centuries.

In *Earth in Upheaval*, Velikovsky marshaled a wealth of evidence from paleontology and the earth sciences in support of catastrophism. His last book, *Mankind in Amnesia* (1982), published posthumously, was a psychological study. Velikovsky was a trained psychoanalyst, and he argued that the human race still suffered from a serious case of amnesia regarding its actual past due to the traumatic events endured by humanity.

But *Worlds in Collision* was the seminal book. It was so controversial that even before its release an influential and vocal segment of the science community attempted to suppress it. Led by Harlow Shapley, then director of the Harvard Observatory, a number of prominent astronomers, including Carl Sagan and Shapley's protege, Fred Whipple, launched a media campaign to discredit Velikovsky. Shapley threatened to cancel Harvard University's book contracts with Velikovsky's publisher, the MacMillan company, which was financially dependent on sales of college text books. Even as *Worlds in Collision* topped the bestseller charts, MacMillan caved in to the pressure. The company halted publication and even burned all remaining stocks of the book. The publishing rights were transferred to Doubleday, which was less vulnerable because it catered to the popular paperback market. Doubleday soon re-released *Worlds in Collision*.

Volumes have been written about the Velikovsky controversy, which raged for a quarter century. But a showdown eventually occurred at the 1974 meeting of the

American Association for the Advancement of Science (AAAS), at which Carl Sagan delivered a blistering keynote address and sought to portray Velikovsky as a pseudoscientist. Other speakers also denounced Velikovsky. Some of the criticisms were valid.

Velikovsky was a doctor and a psychiatrist and had no formal training in astronomy or astrophysics. Even so, the meeting failed to adequately address a number of questions raised by Velikovsky, probably because the science of the day was not advanced enough to provide definitive answers. Sagan erred, for example, when he cited the abundance of impact craters on Venus as evidence for the planet's extreme antiquity.[382]

Sagan thought Venus was pockmarked with impact craters like the moon or Mercury. However, in 1994 we learned otherwise. That year, the Magellan probe surveyed the entire surface of Venus and found it to be 100% volcanic, with few, if any, impact craters.[383] This is precisely what one would expect of a young planet. Venus clearly does not date to the origin of the solar system. Which, of course, means that Sagan and NASA were wrong.

The Magellan mission came too late to save Velikovsky's reputation, which was destroyed at the 1974 AAAS meeting. Thereafter, his very name became stigmatic, synonymous with pseudoscience, the kiss of death in scientific and academic circles. But Velikovsky was not the only loser. The campaign against him had a chilling effect on the search for truth, a chill that continues to this day. The irony is that better scientific data (as in the case of the Venusian craters) suggests that Velikovsky might well have been correct—not on all of the issues (what visionary is?) but on the question of Venus.

Today, NASA appears irreversibly committed to a theory it should have retired after the 1986 rendezvous with Halley's Comet. Fred Whipple's snowball comet model actually predates the space age, and it is the present-day equivalent of the medieval Earth-centric solar system with its clunky cogs and Ptolemaic wheels within wheels. NASA scientists seem incapable of acknowledging the reality, because that would be to admit that Sagan and NASA were mistaken and a pseudoscientist, i.e., Velikovsky, was right all along. Evidently, this is more humble pie than the big egos at NASA are prepared to swallow.

As a result, science is stuck.

Does it matter? Yes! Because our species will not survive unless we embrace an accurate model of our solar system, and quickly. Moreover, the interaction between the sun and comets is the key to properly understanding the system. Even now, NASA could redeem itself by taking a lesson from Isaac Newton, who humbly acknowledged in his *Principia* that, in spite of introducing the laws of motion (a work of genius), "I have not yet learned the cause of gravity…"

In the next passage, Newton went further. He wrote:

> "He who investigates the laws and effects of electric forces with the same success and certainty will greatly promote philosophy [i.e., natural science], even if perhaps he does not know the cause of these forces."[384]

The good news is that humanity has arrived at the historic moment hinted at in the above passage. Newton was plainly looking beyond the science of his day to a more inclusive theoretical framework, one that incorporates electromagnetism.

The Vertical Field

In 1997, the SOHO satellite, which studies the sun, discovered, by chance, that the planet Venus possesses an ephemeral tail that reaches nearly to Earth.[385] NASA scientists had known about the tail since the late 1970s. However, until the discovery by SOHO, they had no idea it was 28 million miles long, 600 times longer than anyone at NASA had guessed. SOHO passed through the tail in July 1997, when the satellite was roughly in line with Venus and the sun. SOHO is a joint venture of the European Space Agency (ESA) and NASA.

Marcia Neugebauer, a scientist at the Jet Propulsion Laboratory in Pasadena, California, expressed surprise. "I didn't expect to find it," she told *New Scientist*.[386] According to the article, "standard physics says that [the] narrow plasma streams [in comet tails] are unstable and should dissipate fast. No one can yet explain how they hold together over tens of millions of kilometers."[387]

But Professor McCanney was not surprised by the tail on Venus nor by its length. His comet model predicts that planets will also have tails. In plasma physics the well-understood "pinch effect" explains how electrical filaments in comet (or planet) tails twist together and maintain their integrity over great distances. The same pinch effect accounts for Comet Hyakutake's incredible tail length that, as noted, stretched across a vast portion of the solar system.

Other planets also have tails. For example, in 1992, the Ulysses satellite detected Jupiter's tail while crossing in the wake of its orbit.[388]

But planets are also comet-like in another key respect. McCanney's comet model predicts that planets *also* discharge the solar capacitor. This means that a stream of electrons constantly flows from the sun to each of the planets. The discharge is less than with comets because the orbits of planets are more circular. Nonetheless, this would account for the abundant electricity known to exist in Earth's ionosphere.

And it would explain the estimated nine million lightning strikes on Earth each day.[389]

Do I need to mention that nine million lightning strikes per day is more than enough electricity to power a global civilization?

For many years, it was believed that static charging in thunderheads was responsible for the electricity in lightning storms. It was thought the mechanism was simple friction. In other words, small droplets of water in clouds rub together and generate the electricity we observe as lightning. Anyone who has reached for a doorknob after shuffling across a carpet in his or her socks will understand the principle. However, very recently, scientists were shocked (!) to discover that their proposed mechanism of static charging fails by orders of magnitude to account for the incredible amount of energy in a single bolt of lightning.[390]

Moreover, in the 1990s, several previously unknown types of electrical phenomena were detected high in Earth's atmosphere, tens of thousands of feet above thunderstorms: the so-called red sprites, elves, halos, blue jets, and so on. The story of these discoveries is extremely interesting, and I regret that I do not have space to cover it. I refer the curious to Joseph Dwyer's 2013 summary paper.[391] Here, I only need to mention why these discoveries are so important: because they confirm the existence of an electrical field between the ionosphere and the surface of our planet, what McCanney refers to as the "vertical field."[392]

In 2001, C.B. Moore, an atmospheric scientist based in New Mexico, made the unexpected discovery that lightning produces X-rays.[393] Follow-up research by Joseph Dwyer, a physicist at the Florida Institute of Technology, confirmed the discovery and also showed that the cause is *bremssstahlung*, the very same mechanism responsible for cometary X-rays! As lightning moves toward the earth it encounters greater resistance, due to the increasing density of Earth's atmosphere near the ground. The lightning slows down and gives up energy in the form of X-rays. Researchers have also detected Gamma rays that are forty times more powerful than X-rays.[394]

These recent developments have turned the field of atmospheric science upside down. In a 2005 interview that was remarkable for its candor, lightning investigator, Joseph Dwyer told *New Scientist*: "Nobody understands what's going on here. You have a lot of people guessing, but we are really clueless. After a couple of hundred years [a reference to Ben Franklin's famous 1752 kite experiment] it's actually quite embarrassing."[395] In a separate article in *Scientific American*, Dwyer again described the problems, then added: "These difficulties have led many researchers in the field, including me, to wonder if we have missed something important."[396]

But it was not always so.

At the dawn of the twentieth century, an inventor-scientist named Nikola Tesla was keenly aware of the vertical field I have just described, and even then was preparing to tap it on behalf of humanity. In the 1880s, Tesla had harnessed the power of Niagara Falls with turbines of his own design, which brought electricity (and mass electric lighting) for the first time to cities across the eastern United States. Thanks to these achievements, by 1900 Tesla was recognized as the greatest inventor the world had ever known. His patents on alternating current (AC) and other inventions had made him a multi-millionaire. But Tesla was not content to rest on his laurels. He had a bigger dream. About this time, Tesla acquired a property at Wardenclyffe, Long Island and began to construct a heavy-duty 187-foot high wooden tower. (**See Figure 1**)

While the details are sketchy, enough is known to draw some conclusions. Tesla installed an array of transmitters (appropriately termed Tesla coils) atop the tower, all pointed skyward. Tesla's contract with the Westinghouse Electric Company had a clause allowing him to draw large amounts of electricity from the grid during off-peak hours. Professor McCanney thinks Tesla used this power to transmit high voltage impulses from his tower straight up into the sky, for the purpose of breaking down the dielectric property of the atmosphere: to create an electrical conduit or pathway to the ionosphere. Once the connection was established, Tesla could then draw down as much free electricity as he pleased.

Yet, even as Tesla was on the threshold of realizing the dream, disaster struck. As the story goes, when Tesla's financier James Pierpont Morgan learned that electricity would soon be too cheap to meter, he withdrew his support. Morgan thereafter used his considerable influence in the world of finance to prevent Tesla from securing banking credit elsewhere. It was the beginning of the end for Tesla, who had sunk his entire fortune into the venture but still needed additional funding. Eventually, Tesla faced foreclosure and lost control of his project. The Wardenclyffe tower was demolished in 1917, an ignominious end to what may have been the most important scientific innovation since Prometheus gave fire to mankind. In subsequent years, Tesla

Figure 1. Tesla's tower at Wardenclyffe

faded from public view. The genius who gave us radio, radar, AC, the electric motor, WIFI, and so much more, ended his days a pauper.

Few Americans are aware of this important history and how close we came to realizing the Utopian dream of abundant clean energy. So, it is instructive to consider for a moment what our world might look like today if Nikola Tesla had been allowed to complete his work. No question, inexhaustible electricity from the ionosphere would have made our world unrecognizable. The availability everywhere of abundant clean energy would have brought about a more peaceful world by eliminating the most serious causes of political instability and conflict.

Instead of the present downward spiral, the present world would be enjoying a rising tide of unmatched economic prosperity, with the biggest advances among the poorest nations. The progress would have been genuine, in other words, sustainable, because it would have been achieved without the kinds of pollution and environmental despoliation that always accompany the production and burning of coal, gas, oil, not to mention nuclear. A significant reduction of the gap between rich and poor would have been achieved in the context of generally improving environmental quality.

Instead of oil derricks, visitors to the Middle East would today find a proliferation of Tesla towers, and the same pattern throughout the tropics. Nations would be experiencing a more peaceful world than at any time in recorded history. The problem of terrorism, while not absent entirely, would have subsided. People who are successfully engaged in realizing their dream of a better life seldom resort to violence. Many societal problems would still remain, of course, but it would be a different set of issues and on a lesser scale than what we face today.

Throughout this book, I have raised more questions than I have answered. It was never my intention to leave my reader out in the cold. Yet, on reflection, I find there is no satisfactory way to bring this journey of discovery to a happy conclusion. As I write in 2020, in the midst of a global pandemic, human options appear to be shrinking rather than expanding. Meanwhile, an unforgiving future rapidly closes in upon us. Everywhere I look, I see irresolution and complacency. The exigencies of the present age have stranded us on the horns of an existential dilemma, with no easy solution and no exit in sight.

Chapter Twenty-one: Past as Prologue?

Will the crust of the earth move again? Yes, of course. It is not a question of whether, but of when. As I have shown, the earth's crust has moved four times during the last 120,000 years. That is an average of one pole change every 30,000 years. Given that the present position of the north pole in the Arctic Sea has been current for only about 11,500 years, there is no reason to expect another event any time soon. And I have seen no evidence that another such event is imminent. Nevertheless, the 120,000-year period since the Eemian is too short to draw any final conclusions. And because crustal displacement events appear to be neither cyclical nor regular, but random, it is possible that another such event could occur at almost any time. We simply do not know.

The Hopis believe this is the case. I will never forget Art Bell's 1998 interview with two Hopi elders on his *Coast to Coast* late-night talk radio show. The elders introduced themselves and explained that they came on air to inform Americans about the Hopi prophecies, in response to the extraordinary passage of Comet Hale-Bopp in 1996-1997. Their message was that the present world age is coming to an end.

The Hopis apparently recognized Hale-Bopp based on oral traditions dating back thousands of years. They had seen it before, long ago, and interpret its re-appearance as the herald of major Earth changes coming in the near future. All nine of the Hopi prophecies reportedly were fulfilled during the twentieth century, so the Hopis were not surprised by the comet's appearance. Apparently, they had been expecting it.

The Hopis refer to Comet Hale-Bopp as the "twin Kachina" because it is white and blue. And they say it presages the coming of a second comet, a red one, the "purifier," whose appearance will signal the start of the chastisement or purification of Earth.

Evidently, comets can come in sequence, or in pairs, even as an entourage, as suggested by the Green River petroglyph.

The interview occurred in 1998, twenty-two years ago, and the second comet has yet to appear. Were the elders mistaken? Is Hopi prophecy wrong?

Or, did the orbits of the two large comets change enough that they are no longer traveling together? If so, McCanney's model might explain why, and in that case the arrival of the second comet has been delayed.

Only time will tell…

APPENDIX

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PERGAMON

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A formal mammalian biostratigraphy for the Late Pleistocene of Britain

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Abstract

A series of distinctive mammalian assemblages spanning much of the British Late Pleistocene is defined on the basis of type localities and a formal biozonation proposed. The Joint Mitnor Cave mammal assemblage-zone includes the famous ''Hippopotamus fauna'' of the early part of the Last Interglacial complex (Oxygen Isotope Substage 5e). This is succeeded by the Bacon Hole mammal assemblage-zone in which hippopotamus is no longer present and species like mammoth, roe deer and northern vole re-enter the British region. This assemblage-zone appears to represent the later substages of OIS 5. A faunal grouping dominated by bison and reindeer is named the Banwell Bone Cave mammal assemblage-zone and is believed to correlate closely with the Early Devensian (OIS 4). The Pin Hole mammal assemblage-zone includes the familiar mammoth-steppe faunas of the Middle Devensian (OIS 3) dominated by horse, woolly rhinoceros and mammoth. The Lateglacial Interstadial is characterized by the Gough's Cave mammal assemblage-zone in which horse, red deer and humans are well represented (part of OIS 2). No definitive evidence for human activity can be found for a period spanning the Last Interglacial complex (OIS 5) and the Early Devensian (OIS 4). Human populations return to Britain with the Pin Hole mammal assemblage-zone fauna during the Middle Devensian (OIS 3) and reappear after the Dimlington Stadial during the Late Devensian (OIS 2) but in a different faunal association. 2001 Published by Elsevier Science Ltd.

1. **Introduction**

Mammalian fossils are conspicuous, common and widespread in many Late Pleistocene deposits in the island of Great Britain. In this paper, we consider the mammalian record for this period and propose a formal biostratigraphy based on repeated patterns of faunal associations, stratigraphic superposition and absolute dating evidence. Our work has involved site investigations, a very thorough re-examination of museum collections around the country and critical appraisal of the extensive literature relating to Late Pleistocene mammal finds within this region. We believe that the biozonation put forward here will have widespread utility and will serve to formalize and extend a provisional framework proposed in an earlier paper (Currant and Jacobi, 1997). We have made one significant change to the original proposal which we believe strengthens this scheme, the substitution of Pin Hole, Creswell Crags, Derbyshire as the type locality for our Middle Devensian (OIS 3) assemblage in place of Coygan Cave, Laugharne, Dyfed, which has been destroyed by quarrying. Two new mammal assemblage-zones which were not considered in our previous treatment are added to the formal model, summarized below with approximate OIS correlations in order to locate the coverage of this zonation.

Gough's Cave mammal assemblage-zone	Late OIS 2
Dimlington Stadial interzone	Early OIS 2
Pin Hole mammal assemblage-zone	OIS 3
Banwell Bone Cave mammal assemblage-zone	OIS 4
Bacon Hole mammal assemblage-zone	Late OIS 5
Joint Mitnor Cave mammal assemblage-zone	Early OIS 5

We have tried, as far as possible, to use the well established principles of biostratigraphy as they are more generally applied to the rest of the fossiliferous geological succession, but the highly fragmented nature of the Quaternary terrestrial record stretches some of the nicer points of standard practice to their practical limits. The actual sequences represented are often of very short duration, making evidence for the direct stratigraphic relationship between some of our proposed assemblage-zones quite hard to establish. The links we have used are sometimes based on inferences derived from lithostratigraphy and absolute dating, and although the purist may not approve of this methodology, no progress in this difficult field would be possible without some degree of pragmatic compromise. We feel that it is more important to the user that this model is robust and useable rather than appearing to be intellectually elegant in its construction. At the end of the day, we believe that we have come up with a testable biostratigraphic model. Indeed, we have tested it ourselves at site after site and on collection after collection. Absolute dating programmes have been instigated specifically to check parts of this framework and so far it has held together very well. We believe very strongly that the type locality concept is essential to this kind of terrestrial sequence biostratigraphy, particularly with such a fragmented record, and it is hoped that the type localities selected here will be used as the basis for future improvements in the resolution of this model. The discussion begins with the oldest unit in our proposed scheme.

2. The Joint Mitnor Cave mammal assemblage-zone

A vertebrate assemblage in which hippopotamus is the most distinctive element has long been attributed to the Last Interglacial period (King, 1955; Sutcliffe, 1959) and is here believed to be restricted to Substage 5e of the marine oxygen isotope record. Uranium series age determinations on stalagmite enclosing hippopotamus bone from Victoria Cave, North Yorkshire have dated the occurrence of this fauna to at or before 12076ka (Gascoyne et al., 1981). Joint Mitnor Cave, Buckfastleigh, Devon , NGR SX 744665, (Sutcliffe, 1960) has been chosen as the defining locality for this widespread faunal assemblage (Currant and Jacobi, 1997) to which we here assign the name Joint Mitnor Cave mammal assemblage-zone (Table 1). At this stage, Britain is believed to have been isolated from continental Europe (Keen, 1995).

Table 1
The mammal fauna from Joint Mitnor Cave, Buckfastleigh, Devon

Sorex araneus Linnaeus, 1758	Eurasian common shrew
Lepus timidus Linnaeus, 1758	Mountain hare
Clethrionomys glareolus (Schreber, 1780)	Bank vole
Arvicola terrestris cantiana (Hinton, 1910)	Water vole
Microtus agrestis (Linnaeus, 1761)	Field vole
Apodemus sylvaticus (Linnaeus, 1758)	Wood mouse
Canis lupus Linnaeus, 1758	Wolf
Vulpes vulpes Linnaeus, 1758	Red fox
Ursus arctos Linnaeus, 1758	Brown bear
Meles meles (Linnaeus, 1758)	Badger
Crocuta crocuta (Erxleben, 1777)	Spotted hyaena
Felis silvestris Schreber, 1777	Wild cat
Panthera leo (Linnaeus, 1758)	Lion
Palaeoloxodon antiquus (Falconer, 1857)	Straight-tusked elephant
Stephanorhinus hemitoechus (Falconer, 1859)	Narrow-nosed rhinoceros
Sus scrofa Linnaeus, 1758	Wild boar
Hippopotamus amphibius Linnaeus, 1758	Hippopotamus
Cervus elaphus Linnaeus, 1758	Red deer
Dama dama (Linnaeus, 1758)	Fallow deer
Megaloceros giganteus (Blumenbach, 1799)	Giant deer
Bison priscus Bojanus, 1827	Bison

The aurochs *Bos primigenius* Bojanus, 1827, is not known from Joint Mitnor Cave, but has been recorded from other vertebrate assemblages of this age, notably that from Barrington, Cambridgeshire (Gibbard and Stuart, 1975).

Apart from remains of hippopotamus, which are often very abundant at open sites, occurrence of fallow deer, giant deer and, where collected, a small mammal fauna dominated by bank vole, water vole, field vole and wood mouse serves to characterize this assemblage-zone. Sutcliffe (1960, 1995) has drawn attention to the absence of horse in the "hippopotamus fauna", a feature which also appears to be true of later OIS 5 and OIS 4 mammal assemblages. This is an important and highly consistent absence which distinguishes Late Pleistocene interglacial assemblages from OIS 7 and earlier temperate stage faunas in which horse is well represented.

The upper and lower boundaries of this assemblage-zone are quite well defined. At Waterhall Farm near Hertford, a fluviatile sequence with a Joint Mitnor Cave assemblage-zone fauna overlay marls containing a particularly large form of the northern vole *Microtus oeconomus*. In Minchin Hole and Bacon Hole on the Gower Coast the same large form of northern vole is associated with deposits immediately underlying the Last Interglacial "Patella Beach" of George (1932). In the Coarse Sands at Bacon Hole, the large northern vole occurs together with red fox and a notably small form of horse in association with a terrestrial molluscan assemblage indicating cold, dry conditions (Currant et al., 1984). This limited assemblage has been attributed to OIS 6 (Schreve, 1997). The Patella Beach and its correlatives in Minchin Hole and the Sandy Breccio-Conglomerate, Sandy Cave Earth and Shelly Sand in the Bacon Hole sequence have yielded faunas entirely consistent with the composition of the Joint Mitnor Cave mammal assemblage-zone, although remains of hippopotamus have not been recovered (Currant et al., 1984; Sutcliffe et al., 1987). One of our reasons for adopting the assemblage-zone concept was to overcome exactly this kind of difficulty. Topographical and taphonomic factors can sometimes influence the composition of mammal assemblages, and we believe that this has happened on Gower where the landscape may have limited hippopotamus distribution. Although one of the key elements is missing, the rest of the mammals found in the above group of deposits is sufficient to confirm the assemblage-zone attribution. The Shelly Sand at Bacon Hole is directly overlain by deposits containing fossils characterizing the succeeding Bacon Hole mammal assemblage-zone. Although the mammalian assemblage may not be expressed in what we have come to accept as its most characteristic form, the stratigraphic sequence at Bacon Hole provides us with the best definition of the upper and lower limits of the Joint Mitnor Cave mammal assemblage-zone.

Human artefacts have been claimed to occur at several Late Pleistocene localities at which hippopotamus has also been found. Currant and Jacobi (2001) have re-examined these and found none to be convincing.

3. The Bacon Hole mammal assemblage-zone

Later Stage 5 faunas, still thoroughly interglacial in character but lacking hippopotamus are known from a number of sites, notably Bacon Hole on the Gower Peninsula in SouthW ales. We assign these assemblages to the Bacon Hole mammal assemblage-zone as defined by the fauna from the Grey Clays, Silts and Sands (Unit G) and the overlying Upper Sands (Unit H) and Upper Cave Earth(Unit I) at Bacon Hole, Southgate, West Glamorgan, NGR SS 559868 (Sutcliffe et al., 1987) (Table 2).

On Gower there is clear evidence of a mammalian assemblage with straight-tusked elephant and narrow-nosed rhinoceros surviving for some considerable time after the high sea level event attributed to Substage 5e. Recent TIMS dating by Mabs Gilmour of The Open University of a flowstone floor capping the Bacon Hole Last Interglacial faunas (i.e. on top of the Upper Cave Earth) has produced an age close to 87 ka and with a very small error margin. We consider that faunas with a strongly interglacial character were present in Britain throughout OIS 5 and in this respect we differ from the interpretation put forward for the Cassington sequence set out by Maddy et al. (1998). Evidence for very open environments in the later substages of OIS 5 is here attributed, at least in part, to the sustained environmental impact of megaherbivores.

Table 2
The mammal fauna from the Grey Clays, Silts and Sands, Upper Sands and Upper Cave Earthat Bacon Hole, Southgate, West Glamorgan

I Upper Cave Earth/ H Upper Sands	
Arvicola terrestris cantiana (Hinton, 1910)	Water vole
Microtus oeconomus (Pallas, 1776)	Northern vole
Canis lupus Linnaeus, 1758	Wolf
Crocuta crocuta (Erxleben, 1777)	Spotted hyaena
Palaeoloxodon antiquus (Falconer, 1857)	Straight-tusked elephant
Stephanorhinus hemitoechus (Falconer, 1859)	Narrow-nosed rhinoceros
Cervus elaphus (Linnaeus, 1758)	Red deer
Bison priscus Bojanus, 1827	Bison
G Grey Clays, Silts and Sands	
Sorex araneus Linnaeus, 1758	Eurasian common shrew
Clethrionomys glareolus (Schreber, 1780)	Bank vole
Arvicola terrestris cantiana (Hinton, 1910)	Water vole
Microtus oeconomus (Pallas, 1776)	Northern vole
Microtus agrestis (Linnaeus, 1761)	Field vole
Apodemus sylvaticus (Linnaeus, 1758)	Wood mouse
Palaeoloxodon antiquus (Falconer, 1857)	Straight-tusked elephant
Mammuthus primigenius (Blumenbach, 1799)	Woolly mammoth
*Stephanorhinus hemitoechu*s (Falconer, 1859)	Narrow-nosed rhinoceros
Crocuta crocuta (Erxleben, 1777)	Spotted hyaena
Canis lupus Linnaeus, 1756	Wolf
Meles meles (Linnaeus, 1758)	Badger
Cerv*us elaphus* Linnaeus, 1758	Red deer
Capreolus capreolus Linnaeus, 1758	Roe deer
Bison priscus Bojanus, 1827	Bison

Fallow deer and giant deer, both common elements of the Joint Mitnor Cave mammal assemblage-zone, are notably absent from this part of the Bacon Hole sequence. Significant additions to the later Stage 5 fauna at Bacon Hole are the northern vole, mammoth (Fig. 1) and roe deer. The arrival of these species may indicate that Great Britain was not an island throughout all of OIS 5, although the detailed local sea level record is sparse (Keen, 1995). The occurrence of northern vole Microtus oeconomus is one of the key elements which distinguishes the Bacon Hole mammal assemblage-zone from the preceding Joint Mitnor Cave Mammal assemblage-zone, though the exact nature of the transition between these two assemblages remains to be seen.

Fig. 1. Occlusal surface of an upper left DP4, *Mammuthus primigenius,* NHM Palaeont. Dept M33503, from the Grey Clay of Unit G, the Grey Clays, Silts and Sands at Bacon Hole, West Glamorgan (BH75 Area IV #224). This is the first confirmed record of mammoth from a late OIS 5 context in Britain.

Occurrences of deposits containing fossils characteristic of the Bacon Hole mammal assemblage-zone appear to be genuinely rare, possibly because they represent a period in which the interglacial landscape was maturing and relatively few opportunities for longterm burial and preservation were available. The Gower coast is unusual in that a series of caves happen to occur at a level roughly coincident with OIS 5 maximum high sea levels. As sea level fell towards the end of the stage these large caves were open and sediments accumulated on top of the substage 5e littoral deposits. By the same process, during the present interglacial, these deeply buried sequences have been re-exposed by marine erosion.

The upper and lower limits of this assemblage-zone are well constrained at the type locality as discussed elsewhere in this paper.

4. The Banwell Bone Cave mammal assemblage-zone

We have identified a low species diversity vertebrate fauna of widespread occurrence and remarkably consistent composition which occupies the British region during a period later than the interglacial faunas mentioned above but earlier than assemblages usually attributed to the Middle Devensian (Currant and Jacobi, 1997). Bison and reindeer are the dominant elements of this fauna, with wolf, wolverine, mountain hare and an extremely large variety of brown bear (e.g. Kurten, 1964) as their consistent companions. For much if not all of this period the small mammal fauna is restricted to a single species, the northern vole. This community is very similar to that found in the higher latitudes of North America up to modern times. It is clearly the vertebrate assemblage of a cold environment but it should be noted that it is markedly different in character from the fauna of the succeeding stage. Banwell Bone Cave, Banwell, Somerset, NGR ST 383588, has been chosen as the defining locality for this assemblage (Rutter, 1829; Currant and Jacobi, 1997; Currant, 1999) to which we assign the name Banwell Bone Cave mammal assemblage-zone (Table 3) .

The record of leopard Panthera pardus (Linnaeus, 1758) from Banwell Bone Cave previously listed (Currant and Jacobi, 1997) is based on a single canine from the Enniskillen Collection, now in the Natural History

Table 3
The mammal fauna from Banwell Bone Cave, Banwell, Somerset

Lepus timidus Linnaeus, 1758	Mountain hare
Microtus oeconomus (Pallas, 1776)	Northern vole
Canis lupus (Linnaeus, 1758)	Wolf
Vulpes vulpes (Linnaeus, 1758)	Red fox
Vulpes lagopus (Linnaeus, 1758)	Arctic fox
Ursus arctos Linnaeus, 1758	Brown bear; a very large form
Gulo gulo (Linnaeus, 1758)	Wolverine
Rangifer tarandus (Linnaeus, 1758)	Reindeer
Bison priscus Bojanus, 1827	Bison

Museum, London (NHM). This specimen would almost certainly have come from the collection of William Beard, first excavator of the cave. Given that leopard is represented in the fauna from the nearby late Middle Pleistocene site of Bleadon Cavern which was also collected by Beard, we feel that this is the more likely provenance for the NHM specimen. There is only one other confirmed record of leopard from Britain and that is also from deposits of late Middle Pleistocene age at Pontnewydd Cave, Clwyd, North Wales (Currant, 1984)

At Banwell, the sheer volume of bone bearing deposit argues for a long period of relative faunal stability. The Banwell Bone Cave mammal assemblage-zone is here identified at both Cassington and Isleworth. The biota reported from each of these sites suggests interstadial conditions but the beetles and the pollen are sufficiently different for them not to represent the same period of time (Maddy et al., 1998). We see this as a supporting argument for the longevity of this mammal assemblage-zone.

At Tornewton Cave in Devon, deposits containing a Banwell Bone Cave mammal assemblage-zone fauna can be shown to overlie deposits which appear to span the Last Interglacial complex (Currant, 1998). The same relationship may exist at Bacon Hole on Gower where rare fossils of wolverine, brown bear and reindeer have been found in the breccias overlying the deposits characterizing the Bacon Hole mammal assemblage-zone and separated from them by a flowstone floor dated to 87 ka (see above). As this is probably one of the commonest but least familiar of our faunal

Table 4
Sites and stratigraphic units containing a Banwell Bone Cave mammal assemblage-zone fauna

The Arch (also known as ‘‘Lion’s Mouth’’), Creswell, Derbyshire
AshTree Cave, Whitwell, Derbyshire; basal clay
Banwell Bone Cave, Banwell, Somerset (Rutter, 1829)
Bleadon Quarry, Bleadon, Somerset (Anon., 1879)
Bosco’s Den, Southgate, West Glamorgan (Falconer in Murchison, 1868)
Brean Down, Somerset; beds 12 and 13 (Savage in ApSimon et al., 1961)
Cassington, Oxfordshire; facies associations A and B (Maddy et al., 1998)
Hyaena Den, Wookey Hole, Somerset; water laid sediments (Jacobi and Hawkes, 1993)
Kew Bridge Station, Middlesex (Morris, 1850; Kurten, 1964)
Limekiln Hill Quarry, Mells, Somerset; lower fauna
Pen Park Quarry, Bristol
Picken’s Hole, Compton Bishop, Somerset; layer 5 (Tratman, 1964; ApSimon, 1986)
Port Eynon Point Cave, Porteynon, West Glamorgan
Steetley Wood Cave, Steetley, Nottinghamshire
Stump Cross Cave, Pateley Bridge, NorthYorksh ire (Sutcliffe et al., 1985)
Tattershall Castle, Lincolnshire; upper silt bed (Rackham, 1978)
Tornewton Cave, Devon; sediments in Price’s Passage
Twickenham, Middlesex (Leeson and Laffan, 1894)
Willment’s Pit, Isleworth, Middlesex; basal silts (Coope and Angus, 1975; Kerney et al., 1982)
Windsor, Berkshire (Dawkins, 1880, pp. 155–156)
Windy Knoll Cave, Castleton, Derbyshire (Dawkins, 1877).

assemblages we list significant occurrences, several of which further confirm its stratigraphic position, in Table 4. The faunal remains from most of the sites in the following list have been re-examined by the authors. We have not seen the material from Cassington or the collections from Tattershall Castle.

At Stump Cross Cave new TIMS dates on flowstone enclosing bones of wolverine are close to 74 ka (Mabs Gilmour, pers. comm.), significantly postdating the flowstone capping the interglacial sequence at Bacon Hole. Previously reported dates on this stalagmite in the order of 83 ka (Sutcliffe et al., 1985) lack the precision of the new results (Gilmour et al., in preparation).

Despite a very thorough review, we find that there are no verifiable records of either artefacts or human fossils found in association with the Banwell Bone Cave mammal assemblage-zone.

5. The Pin Hole mammal assemblage zone

Human populations appear to return to Britain in association with a vertebrate fauna including spotted hyaena, mammoth, horse and woolly rhinoceros during OIS 3. A large number of the cave sites representing this faunal grouping are interpreted as spotted hyaena dens. Previously we had proposed Coygan Cave, Laugharne, Dyfed, SN 284091 as the defining locality for our "Coygan-type fauna" (Currant and Jacobi, 1997). Sadly, Coygan Cave was completely destroyed by quarrying some years ago and although investigations at this site have been extensively reviewed by Aldhouse-Green et al. (1995) we feel that it is vitally important to have a type locality which is still available for reference and future investigation. Pin Hole, Creswell, Derbyshire, in the Creswell Crags S.S.S.I., NGR SK 533742, has been substituted as the defining locality for this faunal grouping, specifically the material from the Lower Cave Earthat Pin Hole, and this is accordingly named the Pin Hole mammal assemblage-zone (Table 5). Other reasons for preferring this locality are its rich, but as yet unreported, small mammal fauna collected during excavations from 1984 to 1989, birds, fish, amphibians and the preservation of contemporary pollen both within the cave deposits (Coles, 1987) and in spotted hyaena coprolites (Mark Lewis, pers. comm.). The age of the fauna is also particularly well constrained by a combination of Uranium-series, ESR, and radiocarbon dates. These are consistent with accumulation during the interval 50–38 ka (Jacobi et al., 1998).

Red deer *Cervus elaphus* (Linnaeus, 1758) has not been identified as part of the Pin Hole fauna but is a consistent component of Middle Devensian faunas in Southern Britain where it is usually represented by an extremely large form. Remains of Arctic fox *Vulpes lagopus* from Pin Hole are unstratified, but this species is recorded from other Middle Devensian localities including Coygan Cave (Aldhouse-Green et al., 1995). There is also a record of wolverine from Pin Hole but its associations are unclear. Small mammals recovered from excavations in nearby Robin Hood Cave (Area

A, S.W. corner of Western Chamber) in direct association with a Pin Hole mammal assemblage zone fauna include *Dicrostonyx torquatus, Microtus oeconomus, Microtus gregalis and Arvicola terrestris*.

Recent fieldwork and associated research at least six localities confirm Banwell Bone Cave mammal assemblage-zone faunas as being older than those of the Pin Hole mammal assemblage-zone: Ash Tree Cave, the sand cliff at Brean Down, Cassington, the Hyaena Den at Wookey Hole, Limekiln Hill Quarry and Picken's Hole. Nowhere can a Pin Hole mammal assemblage-zone fauna be shown to underlie or be interstratified with a Banwell Bone Cave mammal assemblage-zone fauna.

The Pin Hole Lower Cave Earth fauna is a western extension of the characteristic later Quaternary assemblage of much of central Asia north of the Himalayas. As such, we may assume that its occurrence in Britain indicates the extension of extreme continental conditions right up to the Atlantic seaboard (cf. Coope, 1973; Ullrich and Coope, 1974). Guthrie (1982) uses the term "Mammoth Steppe" to describe the vegetation associated with and to a large extent maintained by this distinctive animal community.

It seems to us that this fauna is most likely to be principally of OIS 3 age and we have found nothing to contradict this interpretation (Jacobi et al., 1998).

With this assemblage-zone we pass into the period in which faunal remains are susceptible to radiocarbon dating. As spotted hyaenas are one of the characteristic components of these faunas we have used radiocarbon dates on this species to gauge the time span of the Pin Hole mammal assemblage-zone. This series of age determinations (Table 6) is on recently collected specimens from caves in the Creswell area.

Although we do not yet have a very precise fix on the earlier end of the timescale, it is likely that the Pin Hole mammal assemblage-zone spans at least 30,000 years. It should be noted that no investigator has so far reported any internal biostratigraphic patterning within deposits containing Pin Hole mammal assemblage-zone faunas in spite of the climatic instability also documented for this period by the Greenland ice core data (e.g. Bond et al., 1993). It is very likely that the faunal material assigned to this assemblage zone represents something of a mixture, reflecting the coarse grain of the recovered fossil record as compared with the increasingly fine grain of the global environmental signal as derived from ice core data and continuous pollen sequences (e.g. Woillard and Mook, 1982).

Humans are represented as part of the fauna of the Pin Hole mammal assemblage-zone by skeletal material at Kent's Cavern and Paviland and by artefacts of Middle and Early Upper Palaeolithic types at more than 30 other localities (Currant and Jacobi, in press).

Table 5
The mammal fauna from the Lower Cave Earth at Pin Hole, Creswell, Derbyshire

Homo sp.	(Artefacts)
Lepus timidus Linnaeus, 1758	Mountain hare
Spermophilus major Pallas, 1779	Red-cheeked suslik
Canis lupus (Linnaeus, 1758)	Wolf
Vulpes vulpes Linnaeus, 1758	Red fox
Ursus arctos Linnaeus, 1758	Brown bear
Mustela erminea Linnaeus, 1758	Stoat
Mustela putorius Linnaeus, 1758	Polecat
Crocuta crocuta (Erxleben,1777)	Spotted hyaena
Panthera leo (Linnaeus, 1758)	Lion
Mammuthus primigenius (Blumenbach, 1799)	Woolly mammoth
Equus ferus Boddaert, 1785	Wild horse
Coelodonta antiquitatis (Blumenbach, 1799)	Woolly rhinoceros
Megaloceros giganteus (Blumenbach, 1799)	Giant deer
Rangifer tarandus (Linnaeus, 1758)	Reindeer
Bison priscus Bojanus, 1827	Bison

Table 6
Radiocarbon dates on Crocuta crocuta remains from the Creswell area

Robin Hood Cave	OxA-6115	22,8807240	1.
Robin Hood Cave	OxA-6114	22,9807480	1.
Church Hole	OxA-5800	24,0007260	2.
AshTree Cave	OxA-5798	25,6607380	2.
Church Hole	OxA-5799	26,8407420	2.
West Pin Hole (Dog Hole)	OxA-5803	29,3007420	2.
Robin Hood Cave	OxA-5802	31,0507500	2.
Pin Hole	OxA-1206	32,20071000	3.
Robin Hood Cave	OxA-5801	33,4507700	2.
Pin Hole	OxA-1207	34,50071200	3.
Pin Hole	OxA-4754	37,80071600	2.
Pin Hole	OxA-1448	42,20073000	4.

(References: 1. Hedges et al., 1998; 2. Hedges et al., 1996; 3. Hedges et al., 1988; 4. Hedges et al., 1989.)

6. The Dimlington Stadial interzone

The upper limit of the Pin Hole mammal assemblage-zone as currently envisaged is defined by an interzone corresponding to much of the Dimlington Stadial, the main Late Devensian glacial advance (Rose, 1985) in which mammalian fossils are comparatively rare. Although there are radiocarbon age determinations on various individual fossils which may relate to this period, it is not possible at this stage to select a type locality or define a characteristic vertebrate assemblage which would have biostratigraphic integrity. The interzone name given above is given no formal status in the model presented here but we believe that the concept is useful.

7. The Gough's Cave mammal assemblage-zone

The Late Glacial period in Britain is generally characterized by mammal faunas in which horse and reindeer are relatively common, but it is clear from radiocarbon age determinations from around the country that there is quite marked regional patterning in the distribution of particular species (Housley, 1991). Finds representing such species as the elk *Alces alces* and mammoth (other than in the form of human artefacts) have a northern distribution, while the most northerly Britishrecord of pika *Ochotona pusilla* is from Robin Hood Cave at Creswell in the East Midlands. Red deer *Cervus elaphus* certainly seems to be much better represented in the southwest of Britain, at times to the exclusion of reindeer. Against this background of regionality we have tried to identify faunal groupings within the Late Glacial which have a more than local biostratigraphic utility and which also have viable type localities. In spite of changes in the relative abundance of individual species and changing patterns of presence and absence of some of the rarer elements of the fauna, we can only identify one overall mammalian assemblage. The fauna from the cave earth and breccia unit at Gough's Cave, Cheddar, Somerset, NGR ST 467539, can be taken as broadly representative of the whole of the Late Glacial or Windermere Interstadial and much, if not all, of the Loch Lomond Stadial and terminal Pleistocene. We assign the name Gough's Cave mammal assemblage-zone to deposits containing this faunal grouping (Table 7).

Records of pika *Ochotona pusilla,* beaver Castor fiber and water vole *Arvicola terrestris* from this unit at Gough's Cave have not been confirmed in recent excavations or by direct dating of fossils in existing collections. For present purposes they are omitted from the faunal list given above, but these species are certainly present within the Late Glacial mammal fauna. The stratigraphic position of this assemblage-zone is inferred from a major series of radiocarbon age determinations on material collected from Gough's Cave (Currant, 1991). These determinations give an age range for the Gough's Cave mammal assemblage-zone at the type locality in the order of 12,900–9900 radiocarbon years (Housley, 1991). In the earlier part of the Gough's Cave cave earth and breccia sequence red deer is the dominant local cervid with reindeer only being represented in the form of human artefacts, but higher in the unit reindeer is represented by teeth and unworked skeletal elements. We have found no evidence of bison, spotted hyaena or woolly rhinoceros in deposits attributable to this assemblage-zone and these notable absences help establish a distinction between the Gough's Cave and Pin Hole mammal assemblage-zones.

Much of the Gough's Cave material is fairly clearly a human predation assemblage and many of the recorded findings show evidence of deliberate butchery and breakage. The record of mammoth is based solely on artefacts which may have been transported to the cave, but there are contemporary radiocarbon dates for this species from elsewhere in Britain (Housley, 1991; Lister, 1991). Such occurrences are an important extension of the potential utility of this biostratigraphic unit. Human artefacts from Gough's Cave are Upper Palaeolithic and principally Creswellian (Jacobi, 1991). Elements of this faunal grouping have also been found in association with Creswellian artefacts at Soldier's Hole (Parry, 1931), Aveline's Hole (Davies, 1921), King Arthur's Cave (Taylor, 1928), Kent's Cavern and Three Holes Cave (Hedges et al., 1996) and in each case the age has been confirmed by radiocarbon dating.

The lower boundary of the Gough's Cave mammal assemblage-zone is poorly constrained. At Gough's Cave the cave earth and breccia unit lies unconformably on an unfossiliferous waterlain conglomerate of unknown age. Individual components of this fauna have been found at King Arthur's Cave, Wye Valley, in the "Second Hearth" lying directly above deposits containing a Pin Hole mammal assemblage-zone fauna (Taylor, 1928; ApSimon et al., 1992). At sites such as Kent's Cavern and Soldier's Hole elements of the Gough's Cave fauna are recorded as from the topmost part of deposits which otherwise contain a Pin Hole mammal assemblage-zone fauna. In each case radiocarbon dating indicates a considerable lapse of time between the faunal groupings.

The upper limit of the Gough's Cave mammal assemblage zone can currently only be inferred. The most recent excavations at Gough's Cave were confined to the lower part of the cave earth and breccia unit. Remains of reindeer mentioned above, which have yielded age determinations in the range 10,500–9900 radiocarbon years, rather later than the rest of the assemblage (Currant, 1991). In the now destroyed sequence reported from Chelm's Combe, Cheddar the local faunal record appears to have continued

Table 7
Late Glacial Interstadial mammals from the cave earth and breccia unit in the entrance to Gough's Cave, Cheddar

		AMS dated
Homo sapiens Linnaeus, 1758	Human	+
Lepus timidus (Linnaeus, 1758)	Mountain hare	+
Dicrostonyx torquatus Pallas, 1779	Collared lemming	
Lemmus lemmus (Linnaeus, 1758)	Norway lemming	
Microtus oeconomus (Pallas, 1776)	Northern vole	
Microtus gregalis (Pallas, 1779)	Narrow-skulled vole	
Canis lupus Linnaeus, 1758	Wolf	
Vulpes vulpes (Linnaeus, 1758)	Red fox	
Vulpes lagopus (Linnaeus 1758)	Arctic fox	+
Ursus arctos Linnaeus, 1758	Brown bear	
Lynx lynx (Linnaeus, 1758)	Lynx	+
Mammuthus primigenius (Blumenbach, 1799)	Mammoth (human artefacts)	+
Equus ferus Boddaert, 1785	Wild horse	+
Cervus elaphus Linnaeus, 1758	Red deer	+
Rangifer tarandus (Linnaeus, 1758)	Reindeer	+
Bos primigenius Bojanus, 1827	Aurochs	+
Saiga tatarica (Linnaeus, 1766)	Saiga antelope	+

from the red deer to reindeer transition suggested at Gough's Cave up to the end of the Pleistocene and into the Holocene (Jackson, Palmer et al., 1927), but no surviving parallel to this important site has yet been identified.

Recent work by Coard and Chamberlain (1999) has also begun to resolve some of the faunal changes taking place across the Pleistocene to Holocene boundary, but their argument is dependent on radiocarbon age determinations on individual faunal elements taken from a number of sites. It is perhaps inevitable that the level of discrimination being sought to determine the finer detail of the faunal response to a period of rapid environmental change requires a different kind of analysis to that which is appropriate to the coarser grained fossil record of earlier periods.

8. Concluding remarks

It is one of the principles of biostratigraphy that absence of evidence is not necessarily evidence of absence (Lister, 1992, p. 330). In preparing this paper, we have kept this point firmly in mind.

Here, we have outlined a simple biostratigraphic framework for the British Late Pleistocene against which the factors governing human presence and absence can be assessed and the details of faunal history recorded. It appears to us that human activity in Britain during the Late Pleistocene is restricted to the Middle and Late Devensian, particularly the Lateglacial Interstadial (Jacobi, 1991). It should be emphasized that this is a practical biostratigraphy based on the physical attributes of the fossil record as it is currently known. The area of its direct application is intended to be the island of Great Britain but for all practical purposes the evidence on which our model is based is restricted to England and Wales. However, although it is beyond the scope of the present paper, we would expect the biozonation outlined here to be broadly applicable to adjacent parts of NW Europe and possibly ever further afield but this will need to be tested by those with detailed knowledge of local sequences and collections. Island insularity during the early part of OIS 5 may account for the apparent uniqueness of the Joint Mitnor Cave mammal assemblage-zone, but there is good evidence for a greater or lesser degree of land connection between Britain and the rest of Europe during much of the rest of the Late Pleistocene.

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367 McCanney says his discovery that the solar wind had to be differentially charged actually came while he was studying auroral activity. The fact that a remanent magnetic field is locked into Earth's solidified mantle/crust suggested to him that Earth had been exposed to a continuously charged plasma field during its early history when the planet was still cooling. Nor is Earth unique in this respect. Other planets also have magnetic fields and auroral displays. I've already mentioned the cases of Jupiter and Saturn. These facts, and McCanney's growing certainty of the electrical nature of comets, led him to search for the charging process. Thanks to early work by Kristian Birkeland, the acknowledged pioneer in the field of the aurora borealis, and subsequent research by Hannes Alfven, it was already known that charged particles from outside the planet were causing the so called northern lights. In the early years of the 20th century Birkeland organized and led an expedition to the arctic to study the auroral phenomenon up close, and he succeeded in measuring the associated magnetic fields. Birkeland found that the fields were extremely localized at the surface of the earth, and on this basis he reasoned they could only have been caused by nearly vertical currents of electrons. Birkeland hypothesized that electrons were spiraling down Earth's magnetic field lines and reacting with the atmosphere, thus causing the northern lights, an idea that was later confirmed by the early space probes.

But where did the charged particles originate? Birkeland believed that the sun was the source and he guessed that the current was made up wholly of electrons. Later, another brilliant Scandinavian physicist, Hannes Alfven, revived and built upon Birkeland's early work. Alfven, who won the Nobel Prize in 1970, realized that the solar current could not be made up solely of electrons, for in that case the sun would soon develop a positive charge and the flow would cease. Alfven proposed that the current was a plasma made up of equal parts of protons and electrons. He reasoned that when the particle stream encounters the Earth's magnetic field an electrical potential develops as the protons move west and the electrons east, a view that gained wide acceptance after the discovery of the solar wind. McCanney realized, however, that while this accounted for the aurora it failed to explain how the earth acquired its magnetism in the first place. The key point, here, is that a planetary magnetic field does not just come into existence by itself. Clerk Maxwell's field equations assert the priority of electricity over magnetism, which is a secondary phenomenon. On this basis McCanney reasoned that a preexisting electrical field in space must have surrounded the earth when the molten metals in Earth's crust finally cooled to the Curie point, at which time our Earth acquired its remanent magnetism. All of this, in turn, implied the existence of a differentially charged solar wind.

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About the Author

Mark H. Gaffney is an environmentalist and peace activist. In 1970, while still a student, Mark organized the first Earth Day at Colorado State University. Between 1989–1993 Mark served as a member of the National Audubon team that inventoried the ancient forests of eastern Oregon. Today, the maps that Mark helped to develop are a part of the GIS data base used to manage and protect old growth forest ecosystems.

Mark's first book, *Dimona: the Third Temple* (1989) was a pioneering study of Israel's clandestine nuclear weapons program. The book told the remarkable story of nuclear whistleblower, Mordechai Vanunu, who was nominated numerous times for the Nobel Peace Prize. For attempting to warn the world about the nuclear peril, Vanunu suffered a fate worse than death: eighteen years in Ashkelon prison, eleven and a half of them in solitary confinement.

Mark's second book, *Gnostic Secrets of the Naassenes* (2004), was a personal investigation of early Christianity, based on an original source text from the first century CE. The book was a finalist for the 2004 Narcissus Book Award.

Mark's next two books, *The 9/11 Mystery Plane* (2008) and Black 9/11 (2012) exposed dark truths about the September 11, 2001 attacks that were swept under the carpet and remain taboo to this day.

Mark's novel, *Never Summer* (2017) is a fictionalized account of one of the most colorful chapters in Colorado history, the epic battle to save Bowen Gulch, one of the last great places.

Over the years, Mark's articles, poetry and op/eds have appeared in many journals and newspapers, as well as on the Internet. Mark lives in Oregon.

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