THE FOUNTAINS OF THE GREAT DEEP

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ABSTRACT

There are many new reasons for concluding that the earth has experienced a devastating, worldwide flood--a flood whose waters burst forth with extreme violence from beneath the crust of the earth. The standard "textbook" explanations for over a dozen of the earth's major features are scientifically flawed. For the first time we are now able to explain how this cataclysmic event resulted in the rapid formation of all of these features. Many other mysteries seem to be best explained in terms of this literally earth-shaking event--an event that was far more catastrophic than most people have imagined.

INTRODUCTION

The origin of each of the following features of the earth is a subject of controversy within the earth sciences. Each involves numerous hypotheses and unexplainable aspects. Yet all of these features appear to be best explained as direct consequences of a sudden and unrepeatable event--a cataclysmic flood whose waters burst forth from worldwide, subterranean, and interconnected chambers with an energy release exceeding one trillion megatons of TNT. The many consequences of this event, which include the rapid formation of the fourteen features listed below, involved phenomena that are well understood.

mid-oceanic ridge
glaciers and the ice age
frozen mammoths
salt domes
coal formations
major mountain chains
overthrusts
the Grand Canyon
strata
submarine canyons
ocean trenches
metamorphic rock
continental shelves and slopes
submarine volcanoes and guyots

Each feature will be the subject of a subsequent chapter [to be published]. Each chapter will begin with a general description of each feature, with emphasis on the seemingly puzzling characteristics. The various explanations or theories that have been proposed to explain the origin of each feature will be described, including the proposed "subterranean water" explanation. Then each theory will be examined to see if it can explain each characteristic. It will soon become apparent why the origin of each feature is so controversial. Finally, several specific and surprising predictions will be made which can be used in coming years to test the "subterranean water" explanation. The reader will soon see the economic importance of this explanation.

A FEW MYSTERIES

Probably the most dramatic feature on our planet was just discovered in the 1950's by Bruce C. Heezen and Marie Tharp. It is a mountain range that is 40,000 miles long and wraps around the earth. It's called the Mid-Oceanic Ridge. (See Figure 1.) Most of it lies on the ocean floor. So it is not surprising that relatively few people even know it exists. How did it get there? Why is it primarily on the ocean floor? Why does it intersect itself in a "Y" shaped junction in the Indian Ocean? Why is it composed of a type of rock (called basalt) that is so different from the rocks of almost all other mountains? Why is the floor of the Pacific Ocean littered with volcanic cones, called seamounts, some of which are about as tall as Mount Everest. Why are there relatively few seamounts in the Atlantic? One of the main focuses of our attention will be on the Mid-Atlantic Ridge, the portion of the Mid-Oceanic Ridge that runs down through the center of the Atlantic Ocean. Why is the Mid-Atlantic Ridge centered between the Americas and Europe and Africa? If these continents were once connected, how did they break apart?

Figure 1: This dramatic map was produced by Marie Tharp and Bruce Heezen in 1977. Notice the characteristic margins of each continent. Moving seaward from the beach there is a shallow continental shelf, then a relatively steep drop to the ocean floor. This drop is called the continental slope. Notice also the different characteristics of (1) the continents and ocean basins, and (2) the Atlantic and Pacific basins. As one moves toward the polar regions on this type of map projection, the east-west distances are stretched.

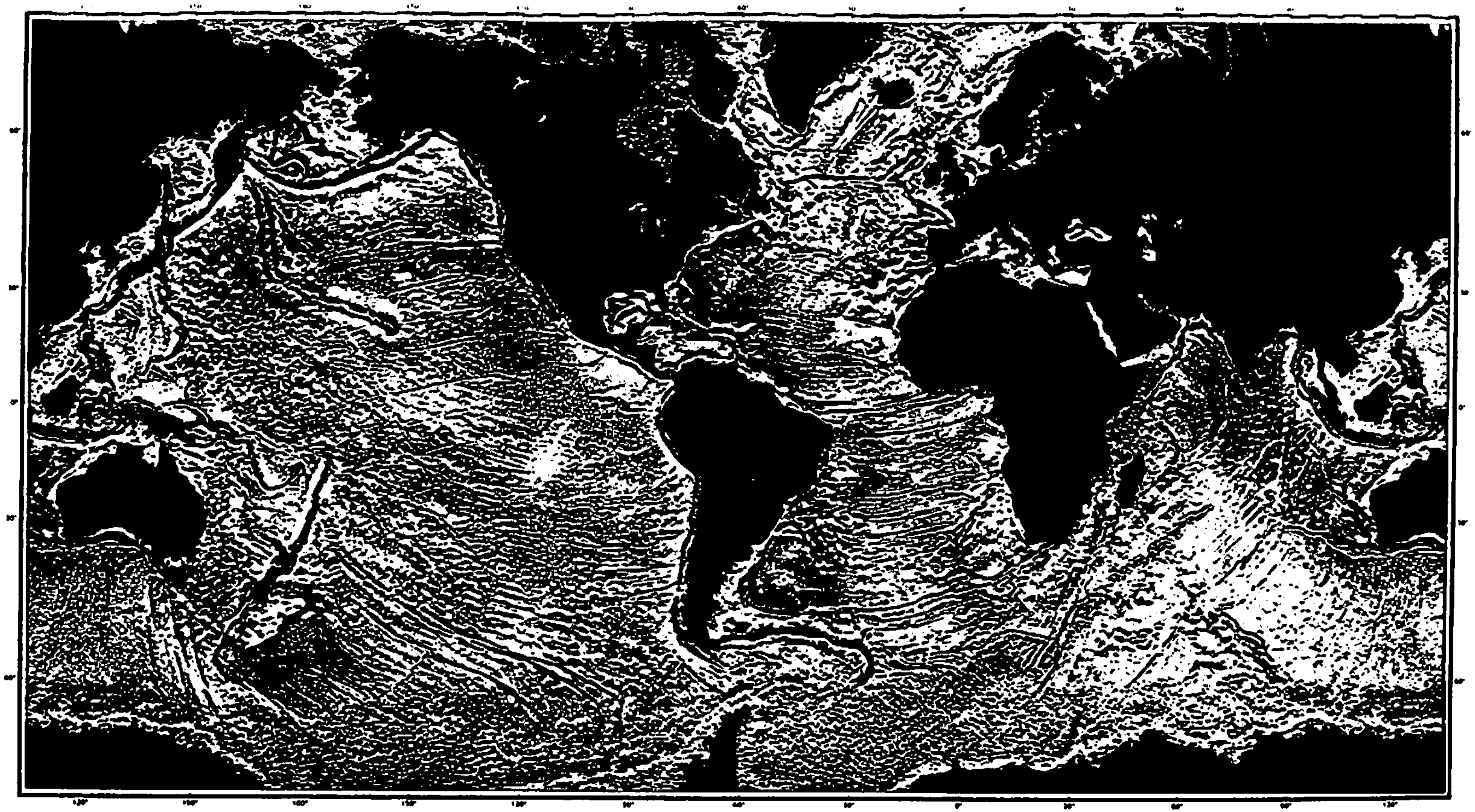


Figure 2: Old details concerning the ocean floor are confirmed and new details exposed by this unique "photograph" of the ocean floor. The U.S. Navy's SEASAT satellite is able to measure with a radar altimeter the satellite's distance above the ocean's surface with an accuracy of about two inches! It was thereby discovered that "sea level" is not level. Instead, the ocean surface "humps up" over mountains and other gravitational features on the ocean floor and depresses over trenches. The gravitational attraction of the Hawaiian Islands, for example, pulls the surrounding ocean water towards it. This moves sea level there about 80 feet further from the center of the earth than it would be without the Hawaiian islands. In 1985, William F. Haxby, of the Lamont-Doherty Geophysical Observatory, took SEASAT data and color coded it to make this amazing picture of the ocean's surface. Notice the long scars or fracture zones that run generally perpendicular to the Mid-Oceanic Ridge. This map shows that the ocean surface is depressed over fracture zones. What theory can provide an explanation for this: (1) plate tectonics or (2) subterranean water? Can you locate the fracture zones that are at such steep angles to each other that they almost intersect? What theory can explain them?

A new and popular theory called plate tectonics offers some possible answers to a few of these questions. On the other hand, you will see that plate tectonics also presents some clear contradictions that are generally not known within the academic community. According to this theory, the earth's crust is composed of about a dozen plates, each about 30 miles (50 kilometers) thick. The plates move with respect to each other, at about an inch or so per year--about the rate a fingernail grows. The continents ride on top of these plates. Sometimes a continent, such as North America, is on more than one plate. Consequently, different parts of North America are moving in different directions with a fault (called a fracture zone) separating them. Supposedly, material from deep inside the earth is rising along the crest of the entire Mid-Oceanic Ridge. Once it arrives at the top, it moves away from the crest of the Ridge, along the ocean floor. This hypothetical motion is similar to that of an escalator that comes up from under a floor and then moves horizontally along the floor.

This escalator-type movement supposedly continues until the moving plate meets and dives under the edge of an adjacent plate. As a plate descends, trenches are supposedly formed. Trenches are long narrow depressions in the ocean floor, sometimes deeper than five Grand Canyons. (See Figures 1 and 2.) If one plate dives beneath another, why aren't the soft sediments and volcanic cones scraped off the top of the descending plate? Why do seismic reflection profiles of these trenches show almost no distortion of the gently layered sediments that are in them?

Cutting across the Mid-Oceanic Ridge at almost right angles are hundreds of long fractures called fracture zones. Sometimes the axis of the Mid-Oceanic Ridge is offset along a fracture zone. (See Figures 1 and 2.) According to plate tectonics, the plates move in the direction of these fracture zones. But fracture zones are not always parallel. In many cases they are over a dozen degrees "out of parallel"!(1) Several sets of fracture zones practically intersect! (See for example, in Figure 2, the "intersecting fracture zones" in the South Pacific and also in the equatorial Atlantic.) How then can solid plates be bounded by or move in the direction of these fracture zones? Can a train move on tracks that aren't parallel?

If plates have moved, what force moved them? Standard answers are given based on plate tectonics, but these answers contradict basic laws of physics--and the real experts on plate tectonics know it. Perhaps the most sought after answer in the earth sciences today is barely verbalized in the classroom or textbooks: "What energy source and mechanism has moved the continents?" In the next several pages a surprisingly simple answer will be proposed, an answer that involves heat and, most importantly, water--lots of it.

Also on the ocean floor are canyons--several hundred of them. Some of these submarine canyons rival the Grand Canyon in both length and depth. One canyon is ten times longer than the Grand Canyon. Another is three times deeper. Many of these V-shaped canyons are extensions of the major rivers. Examples include the Amazon Canyon, the Hudson Canyon, the Ganges Canyon, and the Indus Canyon. How did they get there? What forces can grind out canyons that are sometimes 15,000 feet below sea level? Were continents raised or oceans lowered by this amount? If so, how? The Grand Canyon was formed by the cutting action of the mighty Colorado River, but the flows measured in the submarine canyons are much too slow--generally less than one mile per hour. Frequently the flow is in the wrong direction. Submarine land slides or currents of dense, muddy water sometimes occur. However, they would not form the branching, dendritic patterns that are common to submarine canyons and river systems. Besides, efforts to create mud-ladened water that can cut rock in actual submarine canyons have been fruitless.

Why are large amounts of coal in Antarctica? Various expeditions have reported finding thick seams of coal and fossil tree trunks.(2,3) Some tree trunks were 24 feet long and two feet thick! Was it once warm in Antarctica? If so, how did so much vegetation grow where it is nighttime six months of the year? Could Antarctica have been in a more tropical latitude when the vegetation that formed this coal was growing? Not according to plate tectonics, which places the South Pole well inside Antarctica ever since the coal formed.(4) In fact, according to plate tectonics, the South Pole was within a few degrees of latitude of where "30 beds of anthracite coal, each 3 to 4 feet thick" are located.(5) Do you suppose that vegetation floated there in a large flood?

How does an ice age begin? More importantly, how does an ice age end? If large glaciers begin to grow, they will reflect more of the sun's radiation away from the earth. This would drop the earth's temperature even more, permitting the glaciers to expand further. This cycle would continue. In other words, once an ice age begins, why doesn't the earth's temperature continue to drop until the entire globe is frozen? On the other hand, if glaciers retreat, as they do today, why doesn't the earth reflect less heat, warm up, and melt all glaciers forever?

Why have the remains of about 40 elephant-like animals called mammoths, as well as some rhinoceroses, been found frozen in Alaska and Siberia? Some mammoths still had identifiable food in their mouths and stomachs. All evidence indicates that the outer layers of their skin were quickly frozen down to at least -150°F. How could this have happened?

Why have Soviet drilling engineers recently found hot circulating water at a depth of 7 miles? Surface waters cannot migrate below about 3.5 miles because the weight of the overlying rock seals shut even the microscopic flow channels.

How have mountains formed? The major mountains are usually crumpled like an accordion. Satellite photos of mountain chains show that they resemble wrinkled rugs. But what force could push a long, thick slab of rock and cause it to buckle--and sometimes even fold back on itself? Even if a large enough force could be found to overcome the friction at the base of the slab, that force would crush the end being pushed before movement would even begin. Again, how does this happen?(a) [Lettered superscripts refer to notes at the end of this paper.]

We have all seen rocks that are layered like a sandwich that has been folded over on itself. Sometimes these bent rocks are small enough to hold in one's hand. Other folded rocks are miles on an edge. How does brittle rock that shows no evidence of heating or cracking bend into more or less regular folds? Rocks are strong in compression but weak in tension. Consequently, the convex outer surface, which is under tension, should easily fracture. But they haven't! Bent rocks, which are found all over the earth, often look as if they had the consistency of putty when they were squeezed. Is it possible that the pliable sediments that initially formed these rocks were squeezed soon after they were laid down, before they had chemically hardened? If so, how were they squeezed?

Any geologist or mineralogist who stops to think about it will realize that there is too much limestone on the earth, at least based on present processes. The sediments on the continents alone average about 1½ miles in thickness. Somewhere between 10-15% of this is limestone--most of it very pure limestone.(b) Limestone, without the impurities that normally drift in, argues for rapid burial. Limestone sediments form either by precipitating out of solution or by having organisms take it out of solution to produce shells and other hard parts. In either case, oceans supply limestone sediments. Since our oceans already have about as much limestone ($CaCO_3$) dissolved in them as they can possibly hold, where did all the limestone sediments come from? Why is most of it in extensive and very pure sheets, some of it tens of thousands of square miles in area? In the Bahamas, it is over three miles thick!

This has been just a brief sampling of many mysteries associated with some of these fourteen features. We will see many others in subsequent chapters. After a close reading of the remainder of this chapter, you will begin to see how all the "mysteries" are related and how they can be explained in terms of one catastrophic event.

THE FIT OF THE CONTINENTS

Do continents drift? Do plates, composed of large pieces of continents and ocean floor, move over the earth's surface at slow but measurable rates? For centuries, beginning possibly with Francis Bacon in 1620, men have marveled at the apparent jigsaw fit of the continents bordering the Atlantic. It is only natural that bold thinkers, such as Alfred Wegener in 1912, would propose that at one time the continents were all connected as shown in Figure 3, and somehow they moved to their present position. But would the continents, which often extend offshore hundreds of miles to the continental slope, really fit together as frequently shown in textbooks? Since the distortion produced by flattening a globe onto a two-dimensional map makes it difficult to answer this question, two plates, matching the shape and curvature of the continents, were formed on a globe. (See Figure 4.)

The classical fit of Figure 3, proposed by Edward Bullard, appears at first glance to be better than the fit shown in Figure 4. Why? Notice, first of all, that Bullard removed Central America, southern Mexico, and much of the continental material that is in the Caribbean. Where did it go? Also, a slice has been made through the Mediterranean, and Europe has been rotated counterclockwise and Africa clockwise. There is no sound geological explanation for this other than to make a good fit. Finally, notice the rotations of North America and South America. Few, if any, teachers or textbooks ever inform students of these facts. Bullard certainly took great "latitude" in juggling these continents.

Instead of fitting the continents to each other, notice in Figure 5 how well they each fit the base of the Mid-Atlantic Ridge! It is proposed that these continents were at one time in the position shown in Figure 5, that they were connected by crustal material that was quickly eroded and transported worldwide to form most of the earth's sediments, and that the continents have since moved east and west to their present position.(b)

THE CONTINENTS
and
WHERE THE MID-ATLANTIC RIDGE FITS IN

FIGURE 3: This hypothetical repositioning and fitting together of four continents was proposed by Sir Edward Bullard as an ancient location of these land masses. This fit has been popularized in thousands of journals and textbooks. Notice the liberties that were taken to improve the fit:

(1) Central America and southern Mexico were removed;

(2) Europe was rotated relative to Africa; and

(3) The continents were rotated relative to each other.

FIGURE 4: These continental plates were formed from plaster on a large globe. They represent the American and Eurasian-African land masses out to the edge of the continental shelf. Why do they not fit as snugly as the "Bullard Fit"? Is there a better fit?

FIGURE 5: These two plates fit far better against the edges of the Mid-Atlantic Ridge than they do against each other. Such a fit does not require an arbitrary removal or rotation of large land masses. It only requires these continents to move east and west of their present position. This excellent fit against the base of the Mid-Atlantic Ridge suggests that these plates were once in this position and that they were joined. It also raises the question, "What happened to the band of material that existed between them"? The answer to this question gives clues as to how they broke apart, where most of the earth's sedimentary material came from, how fossils formed, how the entire Mid-Oceanic Ridge formed, and how many other apparently strange features on the earth formed rapidly as a result of a major cataclysm.

You will also see that the volume of this eroded material corresponds closely to the volume of the sediments on the earth--the sediments that encase the fossils of the earth. It will become apparent both how and why trillions of animals and plants were quickly trapped and buried, forming the fossil record. You will also see why fossils of sea life are on every major mountain range. Many other observations will also be correlated with these events.

METHODOLOGY

Any attempt to explain scientifically a past event which cannot be repeated and which had no observers must begin by specifying the conditions prior to the event. From these initial, or starting, conditions we then try, as best as possible, to determine what the laws of physics would produce. Three criteria are then applied to help us evaluate our proposed explanations.

Criteria 1: If we can uniquely explain many diverse observations, then our confidence in our understanding of this event will increase. However, if these starting conditions and the operation of physical laws would cause things that we should see but do not, then our confidence in this explanation will decrease.

For example, a frequent and intriguing question is "What caused the sudden extinction of the dinosaurs?" This was an ancient, unobserved event. It cannot be repeated. Therefore Criteria 1 should be applied.

Some explanations for the extinction of the dinosaurs call for drastic climatic variations. By Criteria 1, each type of climate change might explain the extinction of the dinosaurs. However, if this happened there should be other consequences that are not observed such as the extinction of many flowering plants that are sensative to large climatic changes. Since these extinctions are not seen, this "climatic change" theory is weakened.

Criteria 2: If a few starting conditions allow us to explain and show relationships between many things, then our confidence in our hypothesis will be great. Conversely, if many initial conditions only help us explain a few observations, or if we must often add initial conditions or new details as new observations are made, then we will have little confidence in our hypothesis.

For example, another theory attempting to explain the extinction of the dinosaurs claims that an asteroid struck the earth. This impact produced a worldwide dust cloud that blocked out sunlight for several years and adversely affected the dinosaurs' food chain. Support for this theory comes from a thin, but widely spread layer of clay in Europe and New Zealand containing the element iridium which is frequently found in extraterrestrial material. According to this theory, fragments of the asteroid, including the element iridium, were thrown up in a huge dust cloud that later settled to the earth as a thin layer of iridium-rich clay. This layer marks the most recent dinosaur fossils. An asteroid striking the earth, would seem to explain the worldwide extinction of the dinosaurs and a widely spread iridium-rich layer at the upper boundary of dinosaur fossils. In other words, one starting condition explains two important observations. This is good.

New evidence, however, has come to light that requires more initial conditions. Other iridium-rich layers have now been found above and below the original layer. Did other asteroids strike the earth before the one that destroyed the dinosaurs? Why did the dinosaurs survive those impacts? Why were no other extinctions associated with the asteroids that struck the earth much later? Each question can be answered by suitably adjusting the initial conditions. However by Criteria 2, this reduces our confidence in the theory.

Criteria 3: If our hypothesis allows us to predict unusual things which we should see in the near future if we look in the right places and make the right measurements, then this explanation becomes a testable hypothesis. Our confidence will be greatly increased or decreased by its confirmation or lack of confirmation. Such predictions are the most important test of any scientific theory.

What predictions can be made based on the "climatic variation" and "asteroid impact" theories? None have apparently been made publicly. This does not inspire confidence in these explanations. Unfortunately, most theories that claim to explain events in the ancient past fail to make predictions. Since it is hard to imagine unique consequences of climatic changes that we can discover today, the climatic variation theory does not seem to be very scientifically fruitful.

However, a number of predictions are possible for the impact theory. For example, a very large impact crater should be found whose age correlates with the time of the extinction of the dinosaurs. So far none has been found. If, as time passes, no suitable crater is discovered, the impact theory will tend to lose favor. There are many other ways that these three criteria can be applied to both theories. There have also been over a *dozen* other attempts to explain the extinction of the dinosaurs. Our purpose here is not to address this question but instead to illustrate briefly how scientific reasoning can be applied to past, unobserved, and nonreproducible events. Incidentally, another theory on the extinction of the dinosaurs will soon become obvious to the reader of this paper.

Actually, we can never be certain, using scientific methodology, that we have correctly explained an ancient, unobserved event. Perhaps another starting condition might work as well or better. Perhaps we have overlooked a physical consequence or have not applied the laws of physics properly. Certainly we will never have all the data.

Unfortunately, this is the only way we can attempt to understand past, unobservable events using science. Ancient records, such as legends or the Mosaic account in the Bible, cannot be used as scientific support for the truth or falsity of an ancient event. Such records may provide important historical support for those who have confidence in a particular ancient record. This, however, is not science. The methodology used here will be that of science.

A working hypothesis will now be proposed which will allow each person to judge its ability to explain the fourteen features mentioned earlier. Although many details are specified in this working hypothesis, the reader will observe after several careful readings that they all are direct consequences of two initial conditions or basic assumptions.

A WORKING HYPOTHESIS: STARTING CONDITIONS (OR ASSUMPTIONS)

Before the major features listed earlier were formed, such as major mountain chains or the Grand Canyon, the earth had a large amount of subterranean water--about half of what is now in our oceans. (See Figure 6.) This liquid water was contained in interconnected chambers which collectively formed a thin spherical shell, about five-eights of a mile (one kilometer) thick, lying about 6 miles (ten kilometers) beneath the earth's surface. Many minerals were dissolved in this water, especially NaCl (normal table salt) and $CaCO_3$ (limestone).

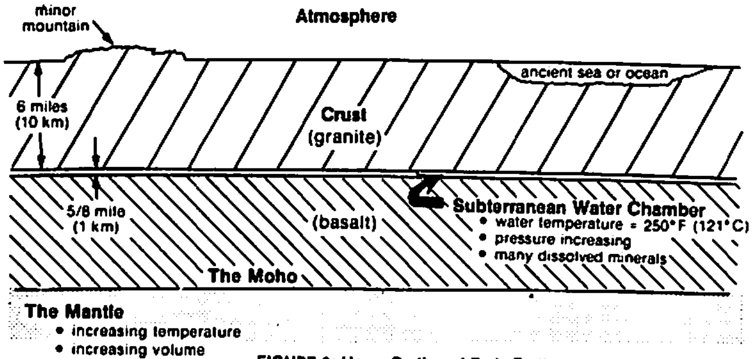


FIGURE 6: Upper Portion of Early Earth
(drawn to scale)

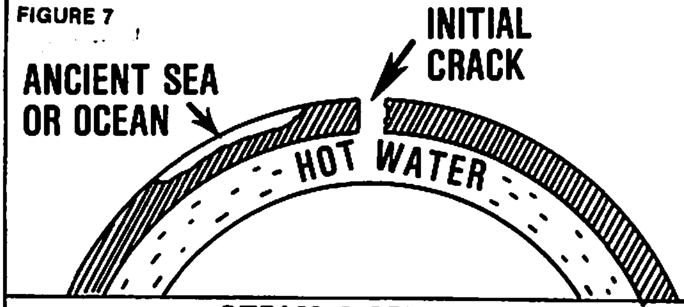
For about ten kilometers beneath the subterranean water there was a layer of basaltic rock. Beneath it was the top of the earth's mantle. An important distinction between the basalt and upper mantle was discovered in 1909 by Andrija Mohorovicic, a seismologist living in what is now Yugoslavia. He noticed that earthquake waves traveled at quite different velocities in each material. The boundary between these layers is now called the Mohorovicic discontinuity. For obvious reasons this term has been shortened to "The Moho."

The final basic assumption is that the temperature within the mantle was slowly but steadily increasing. This resulted in the thermal expansion of the mantle, or a very slight increase in the volume of the mantle. This, in turn, caused a slow but steady increase in the pressure in the subterranean water chamber. The temperature of the subterranean water is assumed to have reached about 250°F (121°C).

No attempt will be made to determine what caused these initial conditions, and what caused those causes, ad infinitum. Each reader must be the judge of the ultimate cause, or as Sir Isaac Newton wrote, "The First Cause." Instead, it will simply be assumed that (1) there was a large shell of hot and salty, subterranean water, and (2) the temperature was increasing within the mantle.

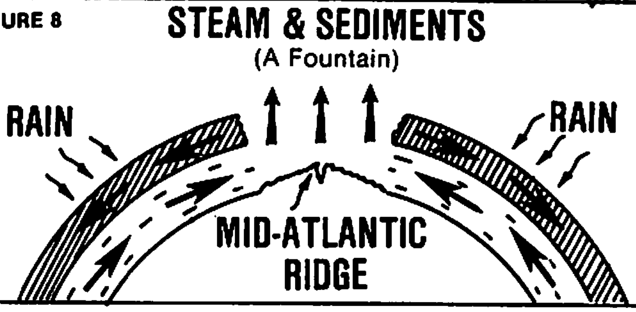
THE MAJOR GEOLOGICAL EVENTS DURING THE FLOOD

FIGURE 7



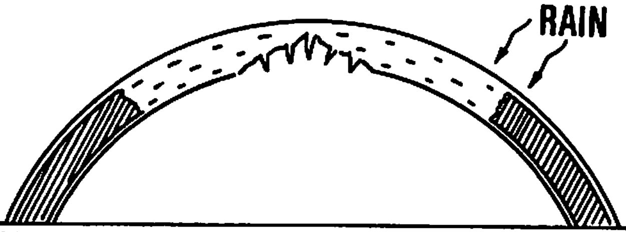
THE RUPTURE
(Not to scale)

FIGURE 8



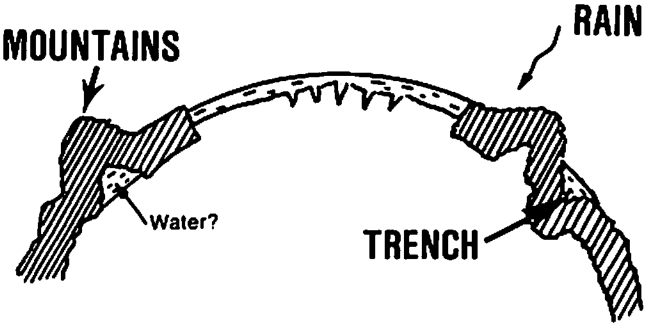
THE RECOILING CONTINENTS

FIGURE 9



THE EARTH FLOODED

FIGURE 10



THE BUCKLED CRUST

It appears that all fourteen features are consequences of these two basic assumptions and the connected continents astride what is now the Mid-Atlantic Ridge. The sequence of events that would flow naturally from these starting conditions will now be described. For clarity, they are divided into six phases--phases which, strictly speaking, overlap to some degree. To aid in visualizing the many interrelated events, these phases will be described in narrative fashion, without detailed justification at this point of the physical consequences or available evidence. This description (or working hypothesis) will constitute the framework against which we can compare the evidence we see today. [A few notes have been added at the end of this paper to help explain how some of the detailed events in each phase follow logically from these starting conditions. The more technical and extensive notes and derivations have been omitted from this paper in the interest of simplicity and because of space limitations.]

SEQUENCE OF EVENTS

The Rupture Phase. As stated earlier, the steadily increasing temperature in the mantle would result in the thermal expansion of the mantle. As the volume of the mantle expanded by perhaps one one-thousandth, the crust overlying the subterranean water stretched, just as a balloon stretches when the pressure inside increases. Strain energy continued to be added to this shell of rock until it reached its failure point.(c) Failure began with a microscopic crack. The stress concentrations at both ends of that crack resulted in the rapid propagation of the crack in the north and south direction.(d) (See Figure 7.) The crack followed the path of least resistance, generally along a great-circle path. Its velocity was approximately that of sound in rock, or about three miles per second. The two ends of the crack traveled in opposite directions, circling the earth in less than two hours.(e) The initial stresses were largely relieved when one end of the crack ran into the path left by the other end. In other words, the path traveled by this crack was initially in the north-south direction, and it intersected itself (or formed a single "T" or "Y") somewhere on the opposite side of the earth from where the rupture began.

The Erosion Phase. As the crack raced around the earth, the six-mile-thick "roof" of overlying rock opened up like a surgeon's incision into tightly stretched skin. The pressure in the subterranean chamber immediately beneath the rupture suddenly dropped to almost atmospheric pressure. The surface of this 250°F liquid was now almost 40°F above its boiling point (212°F). Steam exploded with great violence out of the six-mile-deep "slit"--a slit that wrapped around the earth like the seam of a baseball. The steam expanded supersonically up through the crack, rising about seventy miles above the earth. This expanding steam added huge quantities of water to the atmosphere, primed the hydrodynamic cycle, and produced torrential rains such as the earth has never experienced--before or after. All along this globe-circling rupture, a fountain of liquid water jetted ten miles into the atmosphere.(f) Much of this liquid, as it entered the violent wind system caused by the expanding steam, fragmented into "an ocean" of droplets and fell to the earth great distances away. Some of this water reached elevations where the temperature was about -150°F. The huge masses of extremely cold ice particles that formed could not stay suspended (or "float") in the atmosphere as could the water vapor (steam). Consequently, massive ice dumps occurred--burying, suffocating, and freezing many animals, including some mammoths.

The extreme force of the high pressure jet of water rapidly eroded the material on both sides of the crack. These eroded particles or sediments were swept up in the waters that gushed out from the rupture. Most sediments were transported in the waters that flowed over the earth's surface. Other sediments entered the atmosphere and the wind patterns of the earth; some sediments were even carried far above the stratosphere and settled to the earth during the next several decades.(g) Most of the eroded material settled out over the earth's surface in days, trapping and burying many plants and animals, thereby forming most of the fossil record we have today. Much of this material was eroded from between the two continental plates when they were in the position shown in Figure 5.

As the weight of the overlying crust was rapidly removed by erosion, the pressure on the chamber floor beneath this widening crack also dropped. Consequently, this floor rose beneath this eroded region. This elevated floor is now called the Mid-Oceanic Ridge. It lies beneath and marks the path traveled by the initial rupture.

The Recoil Phase. (See Figure 8.) Once the crack began to propagate, the stretched crust recoiled away from the rupture, similar to the way the rubber in a balloon will initially recoil from a puncture. Strain energy was converted to kinetic energy. Calculations show that the huge, continental plates, which were on an essentially frictionless, liquid surface, would recoil at about one foot per second. This motion continued until most of the lubricating water layer was depleted. Retarding the liquid flowing out of this chamber was (1) the very high back pressure from the exploding steam that vented from underneath the edges of the plates, and (2) the very large length-to-depth ratio of the flow channel and the accompanying frictional effects, especially as the depth of the chamber diminished.

The Flood Phase. The steam expanded, cooled, and condensed as it entered and mixed with the atmosphere and especially the sediments in the atmosphere. Violent, driving rainfall began. Other water sprayed great distances from the ten-mile-high fountain itself. The sedimentary particles that entered the atmosphere during the erosion phase provided an abundant source of cold nuclei on which steam must collect if condensation is to occur. Nevertheless, most of the flood waters came not from falling rain, but from the waters that surged out of the rupture itself. Extensive flooding occurred over the relatively smooth topography of the earth, since the major mountains had not yet formed. (See Figure 9.)

The waters that burst forth and flooded the earth left a high pressure condition in the subterranean chamber and entered a low pressure condition as it flowed over the earth. Since high pressure liquids can hold more dissolved gasses than low pressure liquids, gasses bubbled out of the newly vented flood waters. This same process occurs when we open a pressurized can of carbonated beverage. The carbon dioxide gas that is dissolved in the beverage quickly bubbles out as the pressure drops. The most significant gas to vent from the flood waters was carbon dioxide. As it escaped to the atmosphere, the chemistry of the process required a corresponding quantity of calcium carbonate (or limestone) to precipitate.(h) Through this and other processes, vast sheets of nearly pure limestone were deposited.

The flooding uprooted most of the earth's vegetation. This vegetation was transported by ocean currents, often in floating mats, to regions where it accumulated in great masses. Some even drifted to the South Pole. The sediments falling through the atmosphere periodically sank and buried the floating mats of water-soaked vegetation--sometimes layer upon layer. Later, during the compression phase, the buried layers of vegetation would experience the rapid heating that accompanies sudden compression--precisely the conditions that form coal and oil.

The Compression Phase. Eventually the lubricating layer of water was pressed out from under a small portion of each moving plate. When this happened, the frictional resistance on the lower surface of that plate suddenly increased. As each plate decelerated, the compressive forces within the plate increased sharply. These major compression events were so great that the various plates (and their soft, unlithified sediments) sheared or buckled.(i) The sequence of events involved in the shear type of failure are shown in Figure 11. Once shearing occurred, water would be forced up through the sheared fracture and continue to lubricate the trailing plate as it rode up over the leading plate. Portions of the Appalachians, for example, were formed by this type of thrusting.

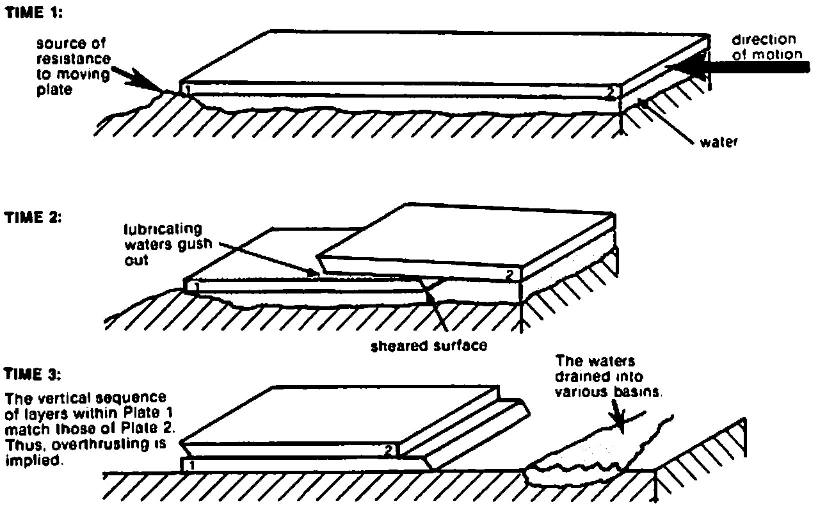


FIGURE 11: Overthrusting Explained

A second type of compressive failure is buckling.(j) The downward buckling formed the trenches, and the upward buckling formed the major mountain ranges. (See Figure 10.) The long axis of each buckled mountain and each trench was generally perpendicular to the particular plate's motion. Thus the Rocky Mountains, the Appalachians, and Andes have a north-south orientation. Likewise, trenches are usually parallel to a nearby mountain chain.

Furthermore, the Pacific basin, in whose direction most of the plates moved, is generally surrounded by trenches and mountain chains that parallel each other.

The newly formed mountain ranges were initially much taller than they are today. Since they constituted a very large mass concentrated on a relatively small base, they slowly subsided into the mantle during the next several decades. In doing so, these mountains depressed the Moho immediately beneath them to depths of typically 30-50 kilometers. (See Figure 12.) As the water was forced out from under each plate and the plate settled to the floor of the chamber, it also depressed the mantle beneath it. However, the flat, undeformed portion of a plate depressed the mantle to a lesser extent since the plate and the freshly deposited sediments on it provided less of a load on its foundation than did the new mountains. Conversely, those regions of the chamber floor which no longer carried a load rose several miles to become our ocean basins. This is why continental material is so different from oceanic material, and why the Moho is so deep beneath mountains and yet so shallow beneath the ocean floor.

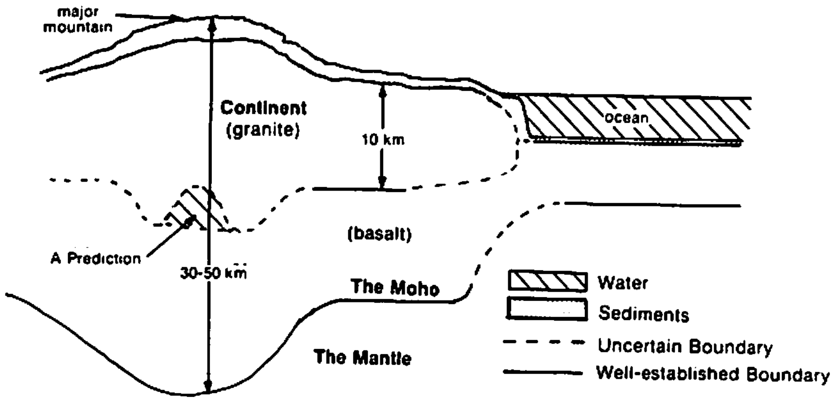


Figure 12: This is a typical cross section of the continents and oceans as they appear today. Notice the relative depths of the Moho (the Mohorovicic discontinuity). It is deepest under the major mountains and shallowest under the ocean floor. Although geophysicists are uncertain of the exact location of some boundaries, most of these general characteristics are well-established. Notice also that a large pocket of water may be under major mountains. This is one of the many predictions that will be made in subsequent chapters.(k)

When this buckling began, the mountains rose very rapidly. Later their growth slowed to several inches per second.(l) As the earth's topography became more irregular, the flood water's drained off the more elevated regions. The violent force of the upward surging subterranean waters was "choked off" as the plates settled onto the floor of the subterranean chamber. Without the high pressure flow out from under these sinking plates, water could no longer be forced up from these very deep basins. Instead, the deep basins became reservoirs into which the flood waters returned. As you will recall, these deep reservoirs were initially part of the floor of the subterranean chamber, several miles below the present ocean bottoms.

Shifts of mass upon the earth created stresses and ruptures in and just beneath the earth's crust. This was especially severe in the region that is now the Pacific Ocean, since the major continental plates all moved toward the Pacific. The portion of the plates that buckled downward were thrust (or subducted) into the earth's mantle. This subduction, along the borders of the Pacific Ocean, produced the ocean trenches and the region called the "ring of fire." The sharp increase in pressure under the floor of the Pacific caused ruptures and an outpouring of lava which formed submarine volcanoes called seamounts. This was a brief but violent period of global volcanic activity.

The Recovery Phase. The heat from the chamber floor continued to pass into the oceans but at a reduced rate due to the insulating blanket of sediments laid down during the flood phase. For many years, the warm oceans and the resulting high evaporation rates produced heavy rains. The sediments that were in the atmosphere shielded the earth's surface from much of the sun's rays, producing the ultimate "nuclear winter." At the higher latitudes and elevations, such as the newly elevated and extremely high mountains, this combination of high precipitation and low temperatures produced very heavy snow falls--perhaps 100 times that of today. The large temperature differences between the land and oceans generated high winds which rapidly transported the moist air to regions where heavy snow fall would occur--especially over glaciated areas. As snow depths increased, periodic and rapid movements of the glaciers occurred in "avalanche fashion." During the spring and summer months, rain fell instead of snow, causing the glaciers to partially melt and retreat, thus marking the end of that year's "ice age."

Sea level remained substantially below today's level for some time, since the ocean floor began its rise from a depth of over 6 miles (11 kilometers). During the summer months, the cold, swollen rivers cut deeply into the soft, freshly deposited sediments along the steep continental slopes. This erosion occurred down to the sea level of that day, thousands of feet below our present sea level. Thus were formed the hundreds of submarine canyons which are usually extensions of our present rivers. Many seamounts grew up to the surface of the lowered ocean, where their peaks were eroded and flattened by wave action. These flat-topped or truncated cones are now called guyots, and their eroded tops are also several thousand feet below today's sea level. Sea level continued to rise as the glaciers melted and retreated to their positions of today. This glacial retreat continues today.

These then are the large scale events which follow naturally from the starting conditions stated earlier. We will now take a more detailed look at these events by devoting one chapter to each of the fourteen features. The many seemingly strange characteristics of each feature will be discussed. Then a summary will be given of the hypotheses that have been proposed to try and explain the origin of that feature. A more detailed description will be given in that chapter of how the subterranean water produced the feature in question. Finally, we will look at the ability of each hypothesis to explain each characteristic. [This will be accomplished insofar as time permits during the 3 hour conference presentation. A book-length manuscript, as an extension of this paper, is in progress.]

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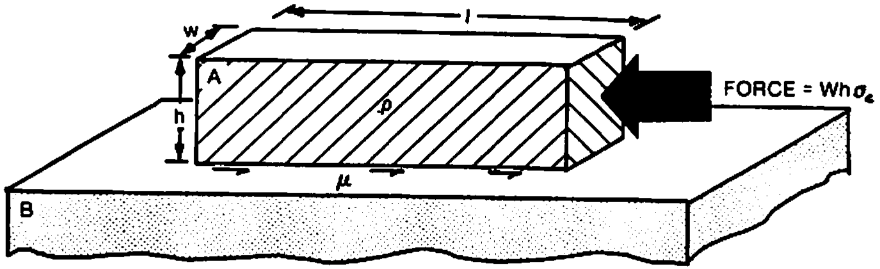
NOTES

a.



Slab A has a length, height, width, and density of l, h, w, and ρ respectively. Slab A is resting on Slab B and is being pushed from the right on a horizontal surface. The pressure or force that is attempting to move Slab A over Slab B exerts a uniform stress that equals the maximum compressive strength (σ_c) of Slab A. Resisting the movement is the friction at their interface having a coefficient of μ. For motion to occur the following must hold:

$$w\ h\ \sigma_c > \rho\ g\ (l\ w\ h)\ \mu$$

The coefficient of static friction for most rocks is at least .6 if temperatures are less than about 300°C.(7) Letting g = 980 cm/sec^2 and using the properties of granite of

$$\rho = 2.7\ \text{gm/cm}^3 \quad \text{and} \quad \sigma_c = 2 \times 10^7\ \text{N/m}^2\ (2910\ \text{psi})$$

$$l < \frac{\sigma_c}{\rho g \mu} = \frac{2 \times 10^7 \times 10^{-4}}{2.7 \times 980 \times .6} = 1.26\ \text{km}$$

In other words, if a slab of rock is longer than 1.26 km, the end being pushed will be crushed before movement begins. This result holds regardless of the other dimensions of the slab.

b. Continental size plates do not move in a north-south direction, despite such claims by the advocates of the plate tectonics theory. One claim, for example, is that India broke away from Antarctica and drifted across the equator and crashed into Asia!

Since the earth's equatorial diameter is 44 kilometers (27.4 miles) greater than the polar diameter, any plate moving toward the equator would stretch. To grasp the implications of this, first consider a band of granite wrapped around the earth from pole to pole. Then assume there is some force capable of stretching that band enough to fit around the equator. The circumference of the earth, as measured from pole to pole, is 40,000 kilometers. The equatorial radius is 6,378.16 kilometers. Therefore this band of rock must stretch

$$2\pi(6378.16) - 40{,}000 = 75.16\ \text{km}$$

However granite has a modulus of elasticity of 5.0 X 10^{10} N/m^2 (7.3 x 10^6 psi) and a tensile strength of 1.28 X 10^7 N/m^2 (1850 psi). Therefore this band can only stretch 10 kilometers before it will rupture.

$$\frac{1.28 \times 10^7 \times 40{,}000}{5.0 \times 10^{10}} = 10\ \text{km}$$

Therefore, stretching this band of rock 75 kilometers would produce perhaps 7 or 8 north-south ruptures. Since these ruptures are not found, it appears that the crust of the earth has never moved with a large north-south component.

c. At the time of this rupture, the strain energy alone would be about 2 X 10^{29} ergs. One can obtain a feel for this amount of energy by comparing it with two of the most violent volcanic explosions of modern times. The energy release from Krakatoa in 1883 has been estimated at 10^{25} ergs, and that from Tambora in 1815 was about 8.4 X 10^{26} ergs.(8) The thermal energy in the subterranean chamber constitutes an additional source of energy.

d. Since the earth is not a sphere but bulges at the equator and is slightly flattened at the poles, the greatest strain of the crustal plates before the rupture would be in the east-west direction. This follows from the fact that materials always deform in the way that minimizes strain energy. Therefore, this predominant east-west deformation avoids the bending that would accompany any north-south strain. Strain in the east-west direction would result in a crack oriented in the north-south direction. Therefore the rupture would initially propagate in the north and the south directions.

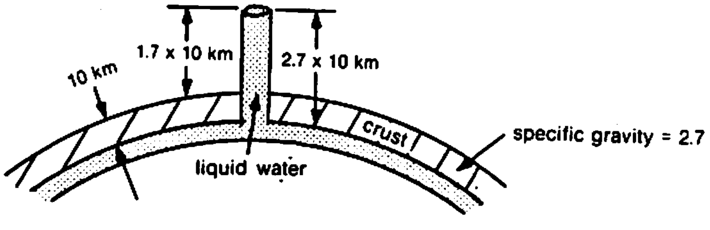
e. The speed of sound in Precambrian granite is 5.23 km/sec.(9) Using 6371 kilometers as the mean radius of the earth, one end of the crack would circumscribe the globe in just over two hours.

$$\frac{2\pi \times 6371\text{ km}}{5.23\text{ km/sec} \times 3600\text{ sec/hr}} = 2.13\text{ hours}$$

Therefore, two ends moving in opposite directions along a wiggly path that approximates a great circle would require a little more than half as much time--probably between one and two hours.

Of course, the pressure would tend to drop in the subterranean chamber immediately after the rupture began. However, this pressure drop would propagate through this liquid shell at the velocity of sound in water. Since the velocity of sound in water is only about one-third of that in rock, the crack would race ahead of the pressure drop in the water below. In this respect, the example of a rupturing balloon is not analogous with the rupture of the earth's crust.

f. Consider an imaginary tube that extended from the top of the subterranean water up through the crust and high into the atmosphere. How far would the water rise in the tube?



If the rock overlying the liquid water in the subterranean chamber had a specific gravity of 2.7, then the liquid would rise 2.7 times the thickness of the crust. When measured from the top of the crust (the earth's surface), the height of the liquid column would be 1.7 times the thickness of the crust. If the crust were 10 kilometers (6 miles) thick, the water would rise 17 kilometers (6 miles x 1.7 = 10.2 miles) above the surface of the earth. Consequently, a jet of pure liquid water from this subterranean chamber would also rise 17 kilometers (10.2 miles) if air resistance were neglected. While the air resistance to this jet would initially be significant, it would soon become negligible.

Actually, the upward flow would be a three phase mixture consisting of liquid water, eroded sediments, and water vapor. For discussion purposes, it will be assumed that the density of this mixture is 1.00.

g. Measurements of solar radiation showed that the dust from the eruption at Krakatoa remained in the atmosphere for three years.(10)

h. Next to water vapor (steam), carbon dioxide is easily the most common constituent of the gases escaping from volcanos. Typically 20% of the volcanic gasses are CO_2.(11)

The equation governing the balance between dissolved carbon dioxide and limestone (calcium carbonate) in water is

$$CO_2 + H_2O + CaCO_3 \rightleftarrows Ca^{2+} + 2HCO_3^-$$

For each mole of carbon dioxide that comes out of solution, a mole of calcium carbonate must precipitate out.

i. Shearing would be analogous to laying two playing cards end-to-end on a slick surface. If they were pushed from one end and the leading card met some resistance, the trailing card will frequently override the card in front.

j. A long train of railroad box cars rolling downhill would experience a similar buckling event if one of the cars suddenly stopped. The momentum of all the trailing box cars would cause them to jackknife. A more accurate analogy would be that of pushing a rug across a generally slick floor. Once the rug reached a sticky portion of the floor, it would buckle upward and form long parallel "mountain chains," perpendicular to its initial motion.

k. Obviously, as a mountain buckled up, the remaining water under the plate would tend to fill in the void. Much of that pooled water should still be there, encased in contorted layers of rock. (See Figures 10 and 12.) This would largely explain the well-known absence of mass beneath mountains that has been detected by gravity measurements for over a century.

The United States Government is presently funding a 3-year, 45 million dollar project to drill a deep hole into the southern Appalachian mountains. The hole is intended

> "to test among other things, the hypothesis that a sheet of crystalline rock about 10 kilometers thick was shoved 225 kilometers westward over underlying sedimentary rock by a continental collision. In 1979, despite the seeming improbability that such a thin sheet would hold together like that, deep seismic reflection profiling revealed a layer that is presumably the previously proposed boundary between the crystalline sheet and the underlying sedimentary rock. The hole would penetrate this reflector of seismic waves at a depth of about 8 or 9 kilometers and return samples to verify its nature."(12)

Of course, this subterranean water theory provides an explanation for why and how a thin sheet of rock was shoved westward. The thrusting of an 8 or 9 kilometer layer for 225 kilometers would no longer be an enigma. Consequently the need for this $45,000,000 project is much less urgent. From another point of view, such a drilling project may be extremely dangerous.

If the prediction of water under mountains is correct, then this drilling project might have disastrous consequences. Deep drilling requires that mud with a very specific density be added to the hole as it is being drilled. This mud counteracts the tendency for the deeper sections of the hole to collapse on itself. If the drill bit intersects a large pool of water and the mean density of the mud exceeds the mean density of the surrounding rock, the mud would drop out of the hole and into the liquid pool. If the reverse is true, the mud would probably be blown out of the hole. In either event, the high-pressure water would escape upwards and quickly erode and greatly enlarge the drilled hole. To get some idea as to how high the liquid jet would travel, see note f. As the water escaped from beneath the entire length of the Appalachians, voids would be created. The Appalachians would collapse in many stages. The densely populated eastern United States would experience earthquakes such as the earth has not experienced in modern times. Water or gas that is sometimes encountered at moderate depths is usually not pooled, but rather flows through tiny cracks and crevices. Consequently, the type of failure described above would be unique and one that present safety equipment is unprepared to handle. Similar dangers exist for other deep-drilling projects that West Germany and the Soviet Union are planning into mountainous regions.

Most portions of the continental plates would not buckle or shear during the compression phase. As these flat plates settled onto the chamber floor, they would sometimes trap thin patches of water. Such a patch may have been recently encountered in the Soviet Union, on the Kola peninsula near the Arctic Circle. Soviet engineers, undertaking the most ambitious drilling project ever, have reported encountering "strongly mineralized waters" flowing or "circulating" (not percolating or seeping) at a depth of 11.5 kilometers or 7.1 miles.(13) Water at this depth is especially surprising since surface water should not be able to seep below rock depths of 5 kilometers. At that depth the lithostatic pressure is so great that any pore space in rock should be pinched shut. Of course, if water originated below that level, this result would not be surprising.

l. When a long, thin object, such as a yardstick, is steadily compressed, there is no bending or displacement until the compressive force reaches a certain critical amount. When this force is exceeded, the yardstick or any compressed beam or plate "snaps" into a bowed position--or more accurately into the shape of one-half of a sine wave. As further compression occurs, the amplitude of the sine wave increases.