

HISTORIC PAPERS  
OUTLINING  
THE PROGRESS OF  
COSMIC IMPACT  
IN EARTH SCIENCE

BY

ALLAN O. KELLY

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## A NEW THEORY OF THE FLOOD.

By

Allan O. Kelly.

Nov. 1944.

The Bible account of the Flood is a story that has always caused a great deal of argument. Many people are sure that it is true, word for word. Others question how Noah got all of the animals into the Ark and what the lions and elephants ate. Still others point out that Mt. Ararat, where the Ark came to rest, is 16,916 feet in elevation and that if it rained for forty days and forty nights, it must have rained 422 feet per day to have submerged this mountain. These people are sure that the story of the Flood in the book of Genesis is pure fiction and that Moses just made it up to prove that the Hebrews were the chosen people. My own opinion has been, that while the story is fantastic, it was the sincere belief of Moses or who ever first put it in writing. I say this was my belief. Then I read the article in the September ninth issue of the Saturday Evening Post called "When the Comet Struck." Now I begin to wonder if the story is so fantastic. In the following pages I have set forth every fact or theory that might bear out the Bible story of a great flood throughout the world, caused by this comet striking the earth.

The story in the "Post" tells of a cataclysm so super-stupendous, so utterly terrific, that it is almost past human comprehension or imagination. This great load of cosmic buckshot must have been several million times as big as the ones that landed in Siberia and in Arizona. According to the "Post", the one that struck in Siberia in 1908 was something to think about..."400 miles away on the Trans-Siberian railway the crew of a train saw a sudden blaze in the sky and then felt the train rock so violently that they stopped it, fearing it would be thrown from the track." The earth shock was recorded by seismograph 500 miles away in the city of Irkutsk and 4,000 miles away in England at the Kew Observatory the micro-barograph recorded the air pressure waves. This comet has been estimated at 40,000 tons and the one that landed in Arizona at over a million tons. The Arizona comet made a crater three quarters of a mile across and buried itself 2,400 feet in the solid rock.

The story in the "Post" tells of the craters found in the Atlantic coastal plain in North and South Carolina. There are literally hundreds of thousands of these craters of all sizes up to four or five miles across. One school of scientific thought holds that these are the work of a swarm of meteors or a comet, while other professors think they were caused by less spectacular artesian water flowing out of the ground and other geologic processes. I hold with the meteor or comet theory and the rest of this article is an attempt to reason why.

My starting premise is that this swarm of meteorites was much larger than the earth scars indicate (perhaps much of it landed in the ocean) and that it had sufficient speed and mass to actually move the earth and change its axis.

Traveling at a speed estimated at 144,000 miles per hour and striking the earth which would be traveling at 64,000 miles per hour in its orbit and over 1,000 miles per hour in rotational speed, there must have been a really big bump. If this cosmic visitor from outer space was large enough to move the earth, then the waters might well have rushed in over the land and caused that Flood that Noah had so much trouble with in the days of his youth. The maldistribution of weight, along with the terrific blow, could have set the earth to wobbling and resulted in a new alignment of its axis. The realignment of the earth's axis can explain many phenomena that have not been very satisfactorily explained before. For instance:

1. What caused the several ice ages?
2. Why were animals ordinarily found in temperate climates suddenly frozen in arctic regions?
3. How is it that coal and fossils are found in the Arctic and Antarctic where no plant life exists today?
4. What has caused the earth's crust to rise and fall?

Is it

It is possible that the several ice ages were caused by such a conetary collision? ~~and~~ I have read that the inclination of the earth's axis was caused by such a collision, but never that the axis of the earth was actually changed.

The "Post" article speaks of this cosmic visitor as a comet. This does not meet with the approval of some astronomers who point out that comets are largely gas and about the nearest thing to nothing that exists in our solar system. While this is true, it does not necessarily follow that there never was a big comet or a swarm of meteors of sufficient size to move the earth. We do know that a meteor struck in Arizona and that a swarm of meteors struck in Siberia. Also, it is known that cosmic bodies vary all the way in size from meteorites the size of a pea to stars the size of Betelgeuse, whose diameter is said to be about the size of the earth's orbit, (260,000,000 miles) according to Fath in "Elements of Astronomy"

There is much geological evidence to prove this theory, although most of it has been attributed to other causes by geological authorities. Let us look at some of this evidence.

The idea of a world-wide flood did not occur to me until a few weeks after reading the article in the "Post". Then I happened to read an article in the September issue of "Readers Digest" called "Our Search for the Earliest American", which was a description of a trip to Alaska in search of the remains of Folsom Man. It was then that I connected the comet craters in Carolina with the Bible story

of the Flood and began to search for other evidence that might bear out the theory.

In the "Readers Digest", Dr. Frank C. Hibben, anthropologist at the University of New Mexico, tells how they first discovered Folsom arrow points under some 20 feet of soil near the little town of Folsom in New Mexico. How these particular points were found along with the bones of prehistoric animals and how they went to Alaska to see if the remains of Folsom Man could be found there. They did find the flint arrow points, but more interesting to me, they found the bodies of mammoth, bison, camel, horse, moose, deer and all of the carnivores that preyed upon these animals, all frozen in the black muck of the Yukon Valley. At a depth of 75 feet down in the frozen muck they found a Folsom point near the body of a huge Alaskan Lion, an animal similar to the lions found in the La Brea tar pits at Los Angeles.

How did it happen that these large animals usually found in the temperate zone were so quickly frozen at such a great depth? How could a mammoth or any other animal, sink into mud that today is frozen solid the year around to within a few feet of the surface? How could the bones and bodies of these animals be distributed from the surface of this muck (mud, tree trunks, leaves etc) down to 75 feet below the present valley floor? If the ground was not frozen at the time, which must have been the case, it would have required a tremendous amount of erosion to have buried these animals so deeply. Then the temperature would have to had dropped below zero and remained there every since to have preserved the flesh of these animals. Mr. Hibben tells how they ate some of the mammoth meat, but did not relish it greatly. He also tells how the stench from rotting flesh could be smelled for miles as the muck in which they were frozen thawed out in the summer sun. To my mind, these prehistoric animals and the muck in which they are found, is one of the very best proofs that the axis of the earth was suddenly changed.

It is probable that when the comet struck, the North Pole was somewhere near the upper end of Hudson Bay. The fact that this region is one of the most heavily glaciated areas of the world would bear this out. When the North Pole was suddenly changed to its present position, Alask and Siberia were as suddenly shifted far into the Arctic. The mammoths, bear, bison and other animals wandering in the lush pastures of a temperate Alaska were suddenly engulfed in a tremendous tidal wave that swept in over hills and valleys and back again, perhaps several times. The terrific erosion caused by this great tidal wave tore up the trees and soil and everything except the solid rock. The whole mass, together with the bodies of the animals, was slithered out across the Yukon Valley just the way it is found today. The sudden arctic winter froze everything solid and there it has remained these last ten thousand years or more. Many of the animals were torn apart and chewed up in this vast meat-grinding flood and that is how they are found today. The next time a miner finds a mammoth in good condition he should call in an expert to determine if it has salt water in the

lungs. This would be proof that the animals were drowned in sea water. The chances are that Folsom Man was also engulfed in this great cataclysm and that some day a gold ~~mainer~~ miner will uncover with his steam jet and boiling water, the body that will tell us what this ancient man really looked like.

Another point that one might make in respect to the animal life would be this: If the comet struck in Carolina causing the earth to move in a southeastward direction, then the axis about which this movement occurred would have its respective poles in central Africa and in the central Pacific Ocean. These pole areas would have been relatively less affected than the equatorial regions where the movement would have been much more violent. Perhaps this explains why many of the large plains animals such as elephants, camels, horses, and the lions and tigers that preyed upon them, were exterminated from the American Continent and why they were saved on the high plains and mountains of central Africa. It is hard to believe that these widely differing animals, so well preserved in the La Brea tar pits and so often found all over North America, could have so quickly disappeared by evolutionary processes. It is said that the saber toothed tiger became extinct because his saber teeth grew too long for his own good. This is a frail guess. Man breeds animals in this way but Nature does not.

All of these widely varying animals that have vanished from North America have their close counterpart in African animals of today. Of course, these prehistoric animals were not exactly like those in Africa and Asia today, but they resembled them as closely as our present day North American mammals resemble their old world cousins. For example, our deer, sheep, wolves, bear and many others have close relatives in the old world, so close, that it is hard to say whether they survived the flood here in the higher elevations or if they migrated across the land bridges. I believe it more likely that they survived here, because all of the large mammals of North America are found at high elevations, or inhabit high elevations at some time during the year. The buffalo, for example, while essentially a plains animal, was also found in the high valleys of the Rocky Mountains in summer.

The smaller mammals, birds, reptiles, insects, etc, could have migrated by land, air and water, from the old world, or, survived here in the higher elevations.

Australia is the hard continent to figure out, from every angle. It must have been much closer to the South Pole than it is today and all of its western half might have had a climate similar to that of Alaska today. Its animals, as everyone knows, are very different from those of other lands and seem to have been isolated from the other continents for a very long period of time. The number of species is few compared to other continents and most of them are marsupials, a low order of mammals.

If we assume that the North Pole was once near the top of Hudson Bay, then the South Pole would have been in the South Indian Ocean. This would have placed the farther side of the

Antarctic continent well within the temperate zone, and enabled it to produce the plant and animal life that would account for the coal and fossils found there.

It is interesting to note that the North and South magnetic poles do not line up with the axis of the earth and do not even line up with each other. If we take the South magnetic pole as a fixed point, then a point directly opposite on the globe would be in the Atlantic Ocean just off the northeast coast of Greenland at about 72 degrees North latitude. The North magnetic pole is actually about 1,500 miles west of this point at 71 degrees north latitude on Boothia peninsula. This probably indicates that its location is influenced more by the concentration of ferrous metals than by the rotational effects of the earth.

In discussing this collision theory with a friend, Mr. W. S. Adamson, he pointed out that if the axis of the earth were changed, the whole crust of the earth would have to re-adjust itself because of the fact that the earth is about 27 miles greater in diameter at the equator than it is through the axis. This, he said, would require a new flattening process at the new poles and a rounding out of the old flat spots where the old poles had been. That it would account for the rising and sinking of the earth's crust and that movement was probably quite rapid for a time after the collision and would slow down gradually as time went on.

To me, this is a very important point that may well account for much of the recent volcanic action throughout the world because centrifugal and gravitational forces together with the law of the conservation of angular momentum would get to work at once to regain the earth's equilibrium.

We know that gravitation in the earth is a force pulling from all directions equally toward the center and that centrifugal force is an outward thrust due to rotation. Centrifugal force being greatest at the equator and diminishing to zero at the poles and gravitation being an equal pull from all directions toward the center, it would seem that the earth would tend to expand more and more at the equator and draw in more and more at the poles, until it would finally flatten out like a phonograph record and fly apart. This would happen, were it not for the law of the conservation of angular momentum which provides that as the mass of a body moves farther away from its axis of rotation it must slow down to conserve its momentum. Conversely, if the mass or weight is moved closer to the axis of rotation, the object must increase its speed of rotation to conserve its energy.

Assuming then, that the earth did re-adjust its crust how long did this process continue?

Dr. Fath in his book "The Elements of Astronomy", 1944 edition, states that the earth has a density of about 5.5 times that of water and a rigidity about the same as ordinary steel. I am not

in arctic regions.

Getting back to the Bible story of the Flood--it may be more truth than fiction. The fact that other races besides the Hebrew people have similar legends and that geologists find extremely deep beds of gravel that seem to have been deposited in one great flood; all these facts tie together to make one believe that perhaps Moses was not so far from right when he wrote...."all the fountains of the great deep were broken up, and the floodgates of Heaven were opened; and the rain fell upon the earth forty days and forty nights." (Gen. 7-11-12) And again in the 24th verse...."and the waters prevailed upon the earth a hundred and fifty days." Again in the 8th chapter he mentions the fountains of the deep. "The fountains of the deep and the floodgates of heaven were shut up, and the rain from heaven was restrained and the waters returned from off the earth going and coming; and they began to be abated after a hundred and fifty days...and the waters were going and decreasing until the tenth month".

It is plain that rain was not the chief part of the flood, but that the waters of the great deep, the ocean, were probably the chief cause and the coming and going indicates a surging of the waters that fits in well with my collision theory. Also, such a cataclysm might have caused it to rain throughout the world for forty days and forty nights, due to the heating of the atmosphere by the comet and by the volcanic eruptions that followed. The inhabitants who survived at higher elevations, or in the Ark if you wish to believe that part, knew only that they had experience a flood past all experience, and we are told in the Bible that they were so fearful of a re-occurrence of the flood that they lived on high ground for several generations thereafter.

It is difficult to imagine just what would happen in case of such a collision, but it seems likely that the inertia of the water would cause the more rigid earth to move under it. That is, the impact would cause the earth to move under the water, but it would appear to an observer that the water rushed over the land. It is probable that the oceans flooded the major portion of the land surface of the globe and that while the flow in general was opposite the direction of the striking force, there must have been considerable surging about in other directions due to mountain obstructions.

It is interesting to note that the highlands of Tibet and the Himalaya mountains are directly opposite in the northern hemisphere to the area where the comet struck. One wonders if this area were thrust to a new height to compensate for the mass of the comet added to the other side. This is only a faint clue, but we cannot overlook anything.

As the waters subsided to their natural level again, the whole crust of the earth began to re-adjust itself as the force of gravity and centrifugal force acted together to form a new world, flattening began at the new poles and the flat spots at the old poles rounded

a mathematician and so proceed with this theory by simple reasoning, but even though the earth has the rigidity of steel, it is my guess that the gravitational and rotational forces are so great that any change in its shape due to collision would be quickly corrected. Probably 75% of it within ten years and 98% in 100 years. I agree with geologists that it must take millions of years to wear mountains down by erosion, but I doubt that they are made so slowly.

In trying to reason what would happen in case a comet or swarm of meteors struck the earth, many things would be taken into consideration. First, do comets have sufficient speed and weight to move the earth? Fath reports that comets have been measured with nuclei(the solid portion of the head often consisting of many pieces) all the way from 440 yards to 8,000 miles in diameter. The luminous part of the comet may be several million miles in width and up to 200,000,000 miles in length, so it seems that the nucleus is very small compared to the head and tail, but that even so, they still come in sizes large enough to move the earth. Their speeds are about the same as meteors, ranging from 15 to 50 miles per second.

Astronomers are not very clear as to the difference between comets and meteors. Some think that comets disintergrate into swarms of meteors and one such, Biela's comet, was seen to separate into two parts and on its return several years later, the rear portion was some 2,500,000 miles behind the other. On the date of its next return it failed to show, but a swarm of meteors entered the atmosphere of the earth from the part of the sky where it should have appeared.

Any body striking the earth would certainly encounter an intricate set of forces. If coming from outside our planetary system, it would encounter the motion of the solar system through space toward the star Vega at 12.2 miles per second; then the speed of the earth in its orbit(18.5 miles per second)and finally the rotation of the earth about its axis at a speed of over 1,000 miles per hour. Add to this the gravitational attraction of the sun and the moon and the centrifugal forces, law of conservation of momentum, precession, and a few others. It really gets to be quite a problem. To me, the earth may be thought of as a giant gyroscope rotating in its orbit about 65 times as fast as it rotates about its axis. In fact it is a sort of gyroscope within a gyroscope because it revolves about the sun and would resist any striking force that would tend to move it out of the plane of its orbit. Likewise, it would resist any force tending to move its plane of rotation about its own axis. The real \$64.00 question is this--What happens when the striking body adds its mass to the gyroscope within a gyroscope and forces it to change its shape and so conserve its angular momentum in two planes of rotation at the same time?

This question has been answered , in my opinion, by the geological evidence on every hand of a great flood that covered the earth in very recent geological times, and by the animals found frozen

out again. Re-adjustment must have been violent at first with many volcanic eruptions throughout the world. Great blocks of the earth moving more slowly, rose in some places and subsided in others.

The mud-filled waters of the oceans began to settle and to deposit a layer of clay on the hills and valleys beneath the sea. It is probable that within a few hundred years these hills, at least in my home locality, arose above the sea with their protecting coating of clay. Within a short time vegetation began to grow on these hills and wind and wether did not much affect their shape. Except for the ravages of men, these hills remain much the same today as they were six or fifteen thousand years ago. The article in the Saturday Evening Post places the date when the comet struck from six to sixty thousand years ago, but I doubt that it was more than fifteen thousand years ago because it is doubtful if the legend could have survived much longer. Hibbon estimated the date of Folsom Man in New Mexico at about fifteen thousand years; however, if the Folsom points were covered twenty feet deep by this one flood, then it is hard to tell how long ago it was.

I do know that in the valley where I live and where my people have lived since about 1860, the fill of sand and gravel has practically all been caused by two or three flood years. The years 1916 and 1922 were the big flood years when a total of about five feet of sand and silt was deposited. All other years combined have only deposited a few inches and this is the result of plowing, causing the streams to carry more sand. Under natural conditions, erosion is a very slow process and I have never heard of a river depositing such beds of gravel as are found in many parts of the world, even under the most unusual flood conditions.

Many of these gravel beds are located in places far removed from any river and in the lee of granite hills where they could not possibly have been deposited by a river. In some places they are found overlying igneous rocks and in other places, sedimentary rock. For example: North of Oceanside, California, the 101 highway traverses a mesa that lies between the mountains and the sea. This mesa is about twenty miles long and about five miles wide at the south end. As you travel north it narrows and the mountains on the east grow higher until the mesa is only a quarter of a mile wide and the mountains about 1200 feet high. At this point the little canyons coming out of the mountain are only some two miles long and where they cross the mesa they have cut deep ditches with sheer walls, some of them nearly 100 feet deep, in some places deeper than they are wide. The walls of these canyons show a cross section of this mesa to be one vast bed of coarse gravel averaging about the size of baseballs. The bluff at the ocean is about 150 feet high and at its base can be found the old sedimentary rocks that have been there for millions of years. It is my contention that this vast bed of gravel cannot possibly be the work of the little canyons or any river in the locality. However, if you can imagine a wall of water from 1,000 to 1,500 feet deep rushing up this coast, you can account for the gravel bed and many others in Southern California.

The hills back of Montebello, California, contain another good example. These hills are covered with oil derricks and rise from 300 to 500 feet above the surrounding plain. At the top of this hill is a gravel pit with walls about 75 feet high. This entire wall, excepting a cap of two or three feet of clay, is sand and gravel. There are no intervening strata of silt or clay that would indicate various flood years, it is all the result of one flood. here and there in the gravel a clay "mud ball" can be found showing that the flood ripped out chunks of wet clay and rolled them into balls. To my way of thinking this mound of gravel on top of a ridge could not have been made by any river in the locality and it certainly has nothing to do with the oil structure beneath it.

Other plain evidence of the flood can be seen in the San Gorgonia Pass west of Beaumont, California. Here the granite shoulder of Mt. San Jacinto comes down in a ridge pointing west. Under this ridge was bored the tunnel for the Los Angeles Aquaduct. This granite ridge streamlines out into gravel hills hundreds of feet high with deep canyons cutting down into San Jacinto Valley. What made these gravel hills? Not any river! They were made by the waters of the Gulf of California rushing up through Imperial Valley and boiling through this mountain pass to the west, where they met the waters of the Pacific that had come in from the southwest. Only the mountain tops stood above this flood. Let anyone look at the San Jacinto Valley and explain it by river action. Sharp granite peaks stick out of a valley floor as level as a table. The soil is full of salt and drained by a river that on rare occasions, runs into Lake Elsinore. This valley was the backwater region of Southern California--a sort of big basin that was filled with mud by the slow moving water that covered this region. Many such similar valleys are to be found in southwestern Arizona.

The San Joaquin Valley was protected from any great rush of water by the mountains on its southern side. It was deeply flooded, however, and the "hogwallow" land around its edges, sloping up to the foothills, shows where the deep water moved more gently out to sea. These mounds or "hogwallows" can be seen in miniature in any tidal flat when the tide is out. I have heard "oldtimers" argue at great length as to what caused these mounds of such uniform size and regularity. Some held that they were hogwallows or buffalo wallows while others claimed that they were made on the sea bottom by sharks or other creatures rooting around in the mud. I claim it was deep water moving rather slowly and that their duplicate in miniature can be seen in tidal flats where little mounds from the size of a small clam shell to ones six or eight inches across are made according to the depth of the water and the speed of its flow. This explanation is going to be hard for the "oldtimers" and professors to take, but I am going to stick with it until they can give me a better explanation.

Another more or less unsolved problem that might be explained by this comet-collision flood theory is the existence of once great inland seas in the Salt Lake Basin and the Carson Sink. As everyone knows, these lakes were once vastly greater in size as is shown by

the old shore lines high up on the surrounding mountains and the great salt beds. It may have been that the ocean spilled over into these big basins when it came up the Gulf and that it was held there until most of it evaporated. Certainly this great basin was filled with salt water and there is no evidence to show that a river of any size ever ran into it that could have filled it so full, even with fresh water. The surface indications appear so fresh that it seems likely that this evaporation has taken place in recent times. Knowing the rate of evaporation and assuming no great change in climate, it might be ascertained quite accurately when the great flood occurred.

To return to my home locality, the San Diego coastal plain, one can find plenty of evidence that points to a great flood. Not far from where I live there are two large granite boulders that are far removed from their source. One of these rocks is lying on a hillside about a hundred feet above the valley floor on a sandstone formation. It is about the size of a small office desk and would weigh over a ton. The nearest granite formation is about a mile upstream and no higher in elevation than this boulder. How did it get in this place? I think it was probably lodged in the roots of some large tree and carried to this spot by the flood. The other boulder is about a mile south and also lying on sedimentary formation. It is larger and much farther from its source. A third and more remarkable boulder is to be found in Rose Canyon right alongside the 101 highway and about one quarter mile north of the old leaning chimney at the brick yard. This boulder sits just on top of a 15 foot bank on the west side of the highway and can be seen as you go north. It is not granite but a very hard, green, flint-like material that looks like some of the lava found along the Lower California coast near Rosairo Beach. The nearest other such rock, to my knowledge, is in the canyon below Lake Hodges Dam. This is 15 miles to the north in another watershed and there are several canyons and ridges between. I think that this boulder came from Lower California. It is hard to tell how big it may be because most of it is below the surface, but the part that sticks out is about five feet high and eight feet wide by ten feet long, and must weigh in the neighborhood of 15 tons. It is easy to see what is beneath it because the 15 foot cutbank of the highway shows the cobblestone conglomerate that it rests on. Just to the south of it there is a granite boulder about three feet in diameter. On the very steep hill above it one may find sandstone blocks containing fossils. The part of this boulder above ground is well rounded and without seam or crack. The only place where I could find a sample was on the south side where the weather had shelled off a thin layer. How did this lava boulder get so far from home? Well, in case the reader thinks that water could not have moved it, take a look at the concrete section of Sweetwater Dam that the 1916 flood moved down the canyon some five miles. This piece of concrete was estimated to weigh 125 tons and I think can still be seen just west of the 101 highway where it crosses Sweetwater Valley.

For another evidence of this flood, let us take a look at the cobblestones that are found along our beaches and far down along the Lower California coast. These smooth stones are only made along the shore and by their constant rolling in the surf. Rivers do not

make these stones because the great part of a river bed has little fall and so is filled with sand. The upper reaches of a river where the rocks are found usually has little water except at flood times to move the rocks; hence, the observer will note that river stones are only rounded on the corners and never polished round and smooth like a beach cobblestone.

The San Diego County coastal plain is covered in many places with these beach cobblestones. On the Torrey Pines grade one may see where the deep beds of ancient sandstone were eroded into canyons and gullies and where the cobblestones and mud were flung into these gullies by the tremendous wave that dashed up this coast. Further inland along the Escondido highway there are literally mountains of cobblestones that were carried northward along the granite hills and deposited in ricks and ridges extending in a north and south direction. The farthest north tongue of cobblestones reaches almost to the Lake Hodges watershed and lies on top of hard granite outcroppings. The granite hills to the west are higher here and form a sort of trough through which the ocean funneled these cobbles.

As the water poured back toward the sea over the coastal plain, it scoured out the canyons against their south walls and took the cobblestone and other rocks it had stripped off the hills out to sea again. On the north side of the canyons where the water was less swift, it deposited low hills of sand and gravel and the flat top of Kerney Mesa was left with a thick layer of cobblestones and mud that has hardened into the concrete-like conglomerate that we find there today.

It is my belief that the area in which I live was submerged beneath the sea at the time of the Flood and that the sand and gravel hills were made in the lee of the granite hills as the water rushed back toward its bed. When it had reached its level, the mud settled out and left its cover on the sand hills. Soon after, the land arose, due to the re-adjustment of the earth's crust. While it was yet beneath the sea, the Calavera mountain was formed. This lava plug came up through a weak spot in the crust and was quickly cooled in the water and so split in the five-sided columns that are seen in this well known mountain. Several geologists have confirmed this particular theory. A study of the gravel deposits on the west side of the Calavera show that the lava came up after the flood because no basaltic rock can be found in these deposits.

Getting back to mountains--it seems to me that all surface evidence indicates that mountains are made by relatively quick and violent action, eruptions and bucklings of the earth's crust. Their sheer walls and rugged formation indicate this and the presently erupting volcano in Mexico is proof of how fast mountains can be built. I agree that they are worn down very slowly over vast periods of time by erosion.

The great deeps of the oceans might also be studied in the light of this theory. It will be seen that the greatest flow of water would have been parallel to the coast of Asia, where it flowed south and along the coasts of North and South America where it flowed north.

The great ocean "deeps" are along these coasts.

There are many other angles to this theory that should be studied and the more one studies the geology of this country in the light of this theory, the better it appears. However, I am aware that I am at odds with most authorities on almost every phase of this subject and that such people are not easily convinced by laymen. My hope has been to get some expression from men of science as to why this theory is unsound. So far, the only answers I have been able to get are one sentence answers that say in effect, "it cannot be." One expert said, "I see no reason to believe that the axis of the earth has ever appreciably changed." This gentleman not only ignores all that I have written but much that has been written by so-called authorities. Another says, "A full course in geology at some good university would show you the error of your ways, but without such background I cannot explain it to you." Must I learn all of the four dollar words before he can explain to me, why the animals were frozen in Alaska? Or does he mean that I should learn geology out of his book?

My philosophy in this matter is something like that of Oliver Wendell Holmes, who once said: "No man has earned the right to intellectual ambition until he has learned to lay his course by a star he has never seen; to dig by the divining rod for springs he may never reach."

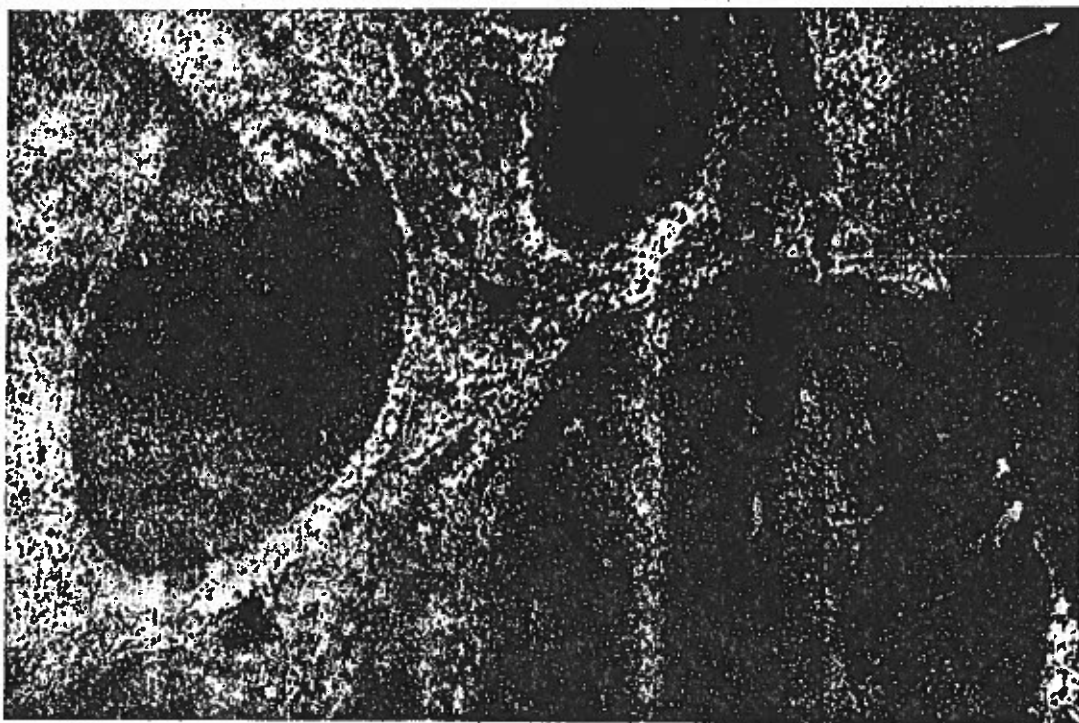
## A BIOLOGICAL EXPLANATION OF THE CAROLINA BAYS

By CHAPMAN GRANT  
Major, U.S.A., Retired

THE coastal plain of the Carolinas is smooth and tilts very slightly southeast toward the sea. It is covered with remarkable scars which are elliptical and parallel. These scars are shallow depressions from a few yards to over a mile in length and can best be visualized by referring to the accompanying illustrations.

Scientists, geologists for the most part, have been endeavoring to explain the origin

utilize volcanism, wind, ocean currents, wind-caused currents, lakes, sink holes, drowned bays, raised pitted sea bottom, segmented lagoons, gyroscopic effect of rotating water or a combination of several of these for their explanation. The latter group base their explanation on bombardment by meteorites or the head of a comet. Not one or any combination of these theories satisfactorily explains the shape or the parallelism of the



BAYS NEAR MYRTLE BEACH, S. C.

ARROW POINTS NORTH. *Left:* TYPICAL PERFECT BED  $\frac{1}{4}$  MILE LONG. NOTE GREATER SAND RIDGE ALONG EASTERN SIDE AND SHARPER CURVE OF NORTHEASTERN QUADRANT. *Below, right:* TYPICAL LARGE INDEFINITELY SHAPED BED.

of these scars which we will call by their vernacular name "bays." Two types of explanations have been used: the terrestrial and the extraterrestrial. The former variously

bays. Of them all, the most easily disproved are those attributing the origin of the bays to volcanism or meteorites.

In the following pages we disclose a third

<sup>1</sup> All illustrations of this article were reproduced from Johnson's *The Origin of the Carolina Bays*, by permission of Columbia University Press; i.e., his figures 10, 27, 29, and 34, respectively.

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I got to know Major Chapman Grant (nephew of Pres. Grant) soon after writing my first paper in 1944. He was a student of herpetology and took an active interest in geology and astronomy and at this time had gotten into the Carolina Bays origin debate that was then raging. He went there before writing this long paper, advocating great schools of fish all swimming together in the same direction.

# POPULAR ASTRONOMY

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# POPULAR ASTRONOMY

## The Geology of the Moon

By ALLAN O. KELLY

*This paper once more attempts to explain the various features seen on the surface of the moon. After all that has already been written on this subject, it is not very likely that the final word will be contained in a brief discussion such as this. However, the photographs and keys to them furnish interesting material for a detailed study of certain lunar formations, even though the conclusions drawn from them in the paper do not meet with the approval of all readers. EDITOR.*

It was once thought that insanity was caused by looking at the moon too often and too long. Hence the word lunacy. This, of course, was before the days of photography. Now, anyone may study the moon by the use of photographs and avoid the blinding light that the ancients thought affected the mind. One might, however, suspect that most of the present day observations have been made by the direct visual method, judging by the different results obtained, especially as they pertain to the origin of the craters on the moon.

The moon is, indeed, a very interesting subject and more than ever in the mind of the public because of the statements in the Press that we may soon get to view it from a much closer vantage point, due to the development of rocket propulsion.

The study of the physical aspects of the moon is one that has gone on continuously since the invention of the telescope. All of its features, craters, mountains, and so-called seas, have been closely studied. Names have long since been given to all of its prominent features and endless argument has been carried on as to the cause of these features.

In fairness it should be said, that probably nothing is more certainly known than the motions of the moon, and its physical dimensions. The argument, the difference of opinion, arises out of man's desire to know the causes of these physical features.

The moon has a prominent part in nearly every book about astronomy and most of them devote some space to the question of what caused the craters. It has become such a moot question that most, if not all, of the modern astronomy books give all of the arguments, pro and con, and let the reader take his choice. They say in effect,—your guess is as good as ours!

It is the purpose of this article to bring out some new facts about the relationship between these craters and so-called seas, and to show how the geology of the moon is the key to a new concept of the geology of the earth. The following observations were made from a study of a series of photographs (7x9 inches in original) obtained from the Mount Wilson Observatory and more particularly from three photo-

graphs designated by the Observatory as H-8, H-13, and H-17. These pictures will be here-in-after referred to by the above numbers.

These 7 x 9 inch photographs were enlarged to 21 x 27 and hung on the wall so that they could be studied from a distance and so that the finer detail could be better seen. This method of study resulted in the conclusion that every feature on the moon, large or small, is directly or indirectly the result of impact by some cosmic body — meteorite, comet, or planetoid—and that the same thing is true of the earth except that we have had the added effects of erosion and gravitation.

Let us begin with a study of the smaller craters on the moon. There are thousands of them, of all sizes down to about three miles in diameter, the smallest that can be seen on photograph H-8. These small craters are uniformly alike. They resemble the crater made by an explosive shell. Their inner walls are more nearly vertical than the outer, which slope away gradually. Apparently the rock material was thrown out by the force of the explosion but not sufficient heat was generated to melt the floor of the crater. This general condition seems to prevail until we reach craters of about twenty miles in diameter when a small central peak begins to appear. This central peak continues to grow in proportion to the side walls of the crater, until a crater diameter of about sixty miles is reached. From sixty miles upward to seventy-five miles the central peak diminishes until it practically disappears at about seventy-five miles. The walls appear to remain about the same height up to a crater diameter of about 140 miles, the diameter of Clavius.

The probable reason for this correlation between crater diameter and height of central peak is this. As the size of projectile increased, the diameter of the resulting crater increased. Likewise the heat generated was greater so that the magma produced became progressively more fluid. At a diameter of about 20 miles, the heat generated was sufficient to partially melt the floor of the crater around the projectile so that a small mound of very viscous lava was left in the center of the crater. The center of this mound usually fell in, leaving a small crater within a crater. Examples may be seen in photograph H-8 to the right of the center. As the size of crater increased, the heat generated was greater and the lava or magma produced became less viscous. This viscosity decreased until it no longer was able to stand up and harden in that position. Beyond that point it began to slump down a little before it cooled. This trend continues until a point is reached at a diameter of about 75 miles where the lava becomes so fluid that no central peak can remain. Perhaps the best example of the maximum central peak and crater walls is seen in the crater Theophilus (left center of photograph H-17). In this case the viscosity of the lava was just right so that it stood up like whipped cream. It has long been known that similar craters can be made by shooting a projectile into mud of the

right consistency. All of the various types of craters seen on the moon, from those 20 miles in diameter to ones the size of Mare Imbrium, can be produced by changing the fluidity of the mud.

From a diameter of 75 miles up to about 140 miles, little difference is apparent in the shape of craters. Their floors seem to be level, smooth, lava beds, with here and there smaller craters of later origin scarring their surfaces. The names of some of these larger craters or "walled plains" are, Clavius, Schickard, and Schiller. Their diameters are 140, 134, and 110 miles, respectively (See photograph H-13). Their walls are about the same height as other craters of much smaller diameter so that the ratio of wall height to diameter seems to decrease with increasing size. Clavius is usually considered to be the largest crater on the moon by those who believe in the collision theory although it should be plain to anyone who will study the photographs, that the so-called seas are also of impact origin.

Astronomers have named ten of these circular lakes of lava although there are really about fifteen on the visible side of the moon. Some are much older than others and their outlines are not very plain and nearly all are joined closely to others or intersect other circles. The fact that all of the seas on the moon are nearly round is a good argument for impact origin, but there are many more. While the seas on the moon appear to be round when seen on a small scale picture of the full moon, a closer study of any of these seas shows that their edges are quite irregular. The heat produced by impact was so great that the lava flowed like water, welling up and overflowing all of the lower surrounding areas and partially engulfing old craters along its edges. Mare Humorum is a fine example of this condition (See photograph H-13). It shows every indication that it was made by impact. Frozen waves of lava are seen around its edges like ripples from a stone dropped in a pool. Other circular cracks and ridges are seen far out in the surrounding mountains, formed around the same point of impact. Several older and smaller craters around the sides of Mare Humorum have tipped into this once molten sea, so that their inner rims are submerged. What evidence could be plainer? The largest of these craters tipping into Mare Humorum is called Gassendi. It is about 73 miles in diameter and shows a group of three low central peaks. Mare Humorum has a longer diameter of about 200 miles and a shorter one of 180 miles.

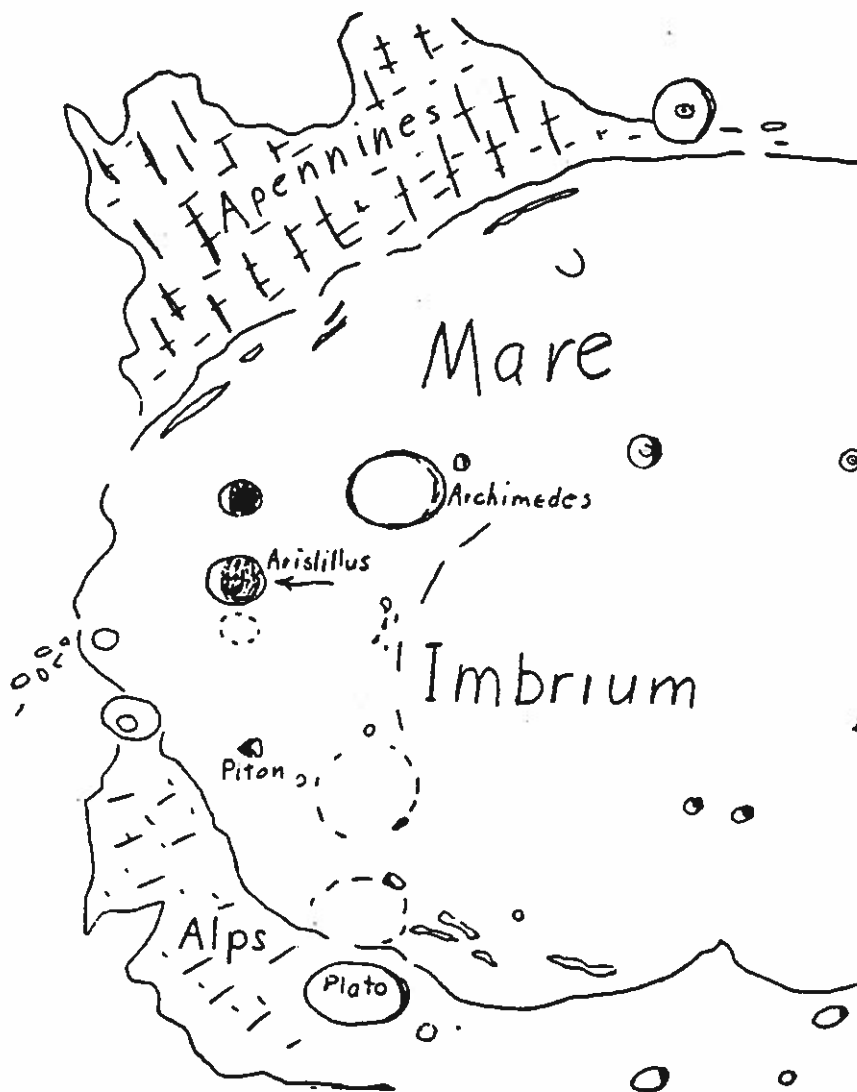
The largest of the so-called seas on the moon is Mare Imbrium. It is roughly 500 by 700 miles and was probably made by a planetoid that came in at an angle, because a high rim of mountains was thrown up on one side and none on the other (See photograph H-8). It is apparently of later origin than most of the other seas because it has thrown out material across the others nearby. There are many signs of grooves and ridges radiating from Mare Imbrium, some of which are nearly 1000 miles from its center. The Apennine mountains forming its upper

left-hand rim are so obviously of impact origin that it seems impossible that anyone could overlook the fact. Their inside edge forms the crater wall and they have been flung out in ridges like the fingers of two hands. A series of shock-waves have cut across all these fingers at right angles, making a screen-like pattern, but somewhat less noticeable than the radiating features. The lower left-hand rim of Mare Imbrium is formed by a ring of mountains known as the Alps. They are about as high as the Apennines, some peaks rising to over 19,000 feet but not so broad across the base. Apparently the greater part of the blast was directed toward the upper left-hand quadrant, judging by the greater mass thrown out and by other features such as the direction taken by lava waves on the surface of Mare Imbrium and by a secondary wave or ridge at the foot of the Apennines which is lacking along the Alps. The right-hand half of the crater of Mare Imbrium has no rim of any consequence because, being away from the direction of blast, the molten magma merely flowed out into the lower areas of old seas and craters along its sides, leaving a less definite rim.

The largest crater within Mare Imbrium is one called Archimedes, located toward the upper left-hand rim (Photograph H-8). It must have been made by a body immediately following the main planetoid which struck while the lava was still viscous because its floor is the same level as that outside its rim. Other meteorites, which struck after the floor of Mare Imbrium had hardened, have left deep pits far below the surrounding surface. This would indicate that craters like Archimedes and Plato (directly below in the rim of Mare Imbrium) were either made while the magma was still hot or else they were old craters whose floors were remelted by the great heat from below. The first possibility seems more likely than the second, especially in the case of Archimedes, which, being directly in the path of the material thrown out, should have been completely filled with debris. However, there are other signs that old craters were completely submerged or nearly so. There are signs of faint rims directly between Archimedes and Plato, and toward the top of the photograph (H-8) there is a horseshoe-shaped crater whose upper rim has been melted by a wave rebounding from the Apennine wall.

Other interesting features are isolated peaks such as Piton which rises more than 19,000 feet above the level of Mare Imbrium. It, and other peaks like it, are probably the remains of old craters, either the central peak which was protected by its surrounding rim, or the more protected side of a crater whose other rim was completely melted.

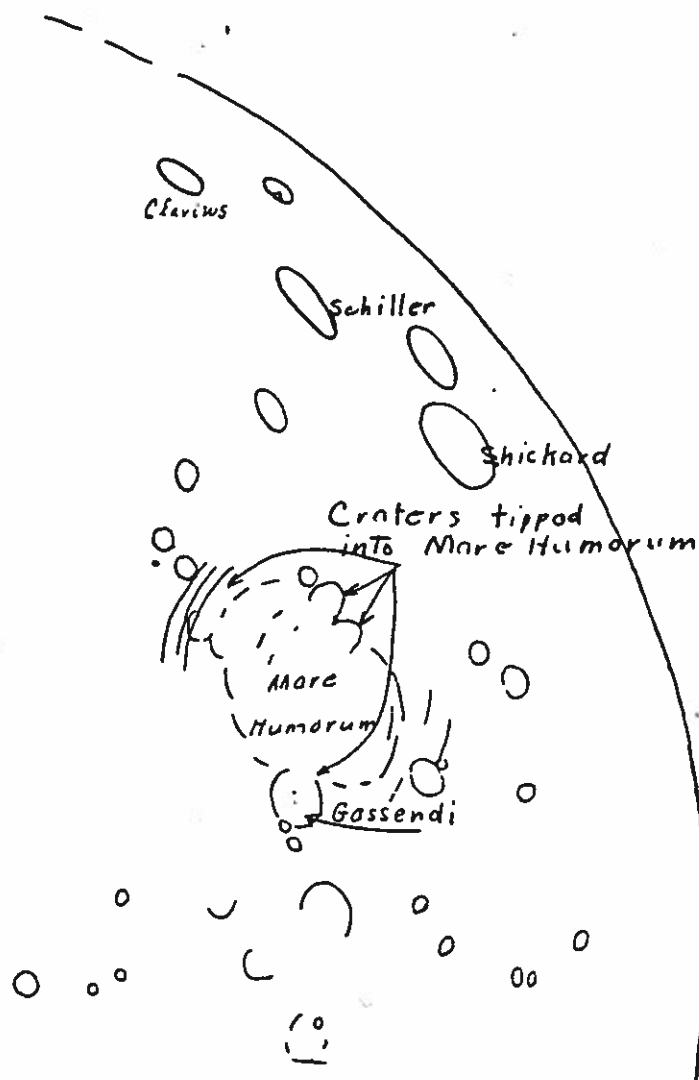
There are many recent craters on the surface of Mare Imbrium as before mentioned. Aristillus, the largest of these, has a fine central peak. It is about 35 miles in diameter and has a depth of about 15,000 feet. Just below its rim can be seen the faint rim of an older and smaller crater. To the right of Piton about 60 miles may be seen a tiny groove



TRACING OF PHOTOGRAPH H-8, CALLING ATTENTION TO CROSS HATCHING PATTERN IN ALPS AND APENNINES AND OTHER FEATURES MENTIONED IN TEXT.

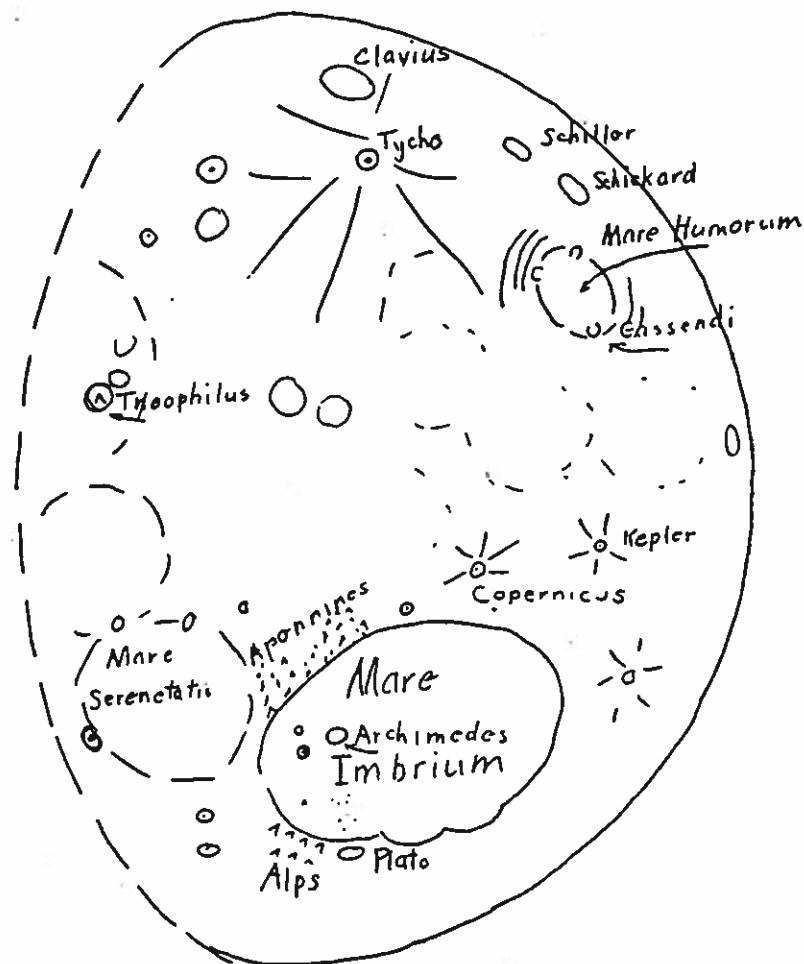
light colored rays radiating from these craters extend for hundreds of miles across every other feature on the moon. They are probably the most recent of the craters and the rays are doubtless made of rock flour hurled out of these craters.

The theory that the craters on the moon are of meteoric origin was advanced many years ago, but only one scientist, so far as the writer knows, has ever advanced the theory that the seas on the moon are of



TRACINGS OF PHOTOGRAPHS H-13 SHOWING SOME OF THE FEATURES MENTIONED IN TEXT.

the molten magma, according to Dr. Clyde Fisher, an authority on the moon. The writer has been unable to determine if Shaler carried his theory any further or connected it in any way with terrestrial geology. In any event, other scientists did not take the idea seriously, because if they had, it is very difficult to understand how they could have reached any other conclusion. The writer reached this conclusion without knowing of Shaler's statement.



TRACING TO IDENTIFY CERTAIN FEATURES IN PHOTOGRAPH H-17.  
MOON 19 DAYS OLD.

many of them of such great size that we fail to recognize their craters. If we could reverse our position and view the earth from the moon, we might be able to see the outlines of these craters. They could not be as plainly visible as the lunar ones, however, because we have all of the agents of erosion that are lacking on the moon. Study the globe carefully with these things in mind, and you will see that the mountains and oceans of the earth form a series of intersecting circles of all sizes. Their forms are sometimes very dim but they are there to see and study. The oceans are the beds of most of the large craters and the mountains are their rims. These old crater rims have not only been worn away by the ordinary means of erosion but also by the cataclysmic floods that accompanied these major collisions. These floods must have

removed most of the scars as soon as made and covered over still older scars with deep layers of sedimentary material that later hardened into rock. The shock of such a collision would also disrupt the crust of the earth in adjacent parts, allowing lava to flow out and mountains to be built. The great revolutions noted by geologists as bringing epochs to a close represent these major collisions. Long periods of ordinary erosion accompanied by lesser collisions were interspaced between these major ones but the main source of change in the earth's crust has been collision. The surface of the moon is our best visible proof of this fact.

In 1904, T. C. Chamberlin, one of the great geologists of all time, and F. R. Moulton, a mathematical astronomer, proposed a new account of the earth's origin which they called the "planetesimal hypothesis." They began at the very beginning of things and carried the growth of the earth thru to maturity by the process of planetesimal accretion, but there they stopped. They failed to see the implications of their theory, that collisions would cause change in the earth's surface. They failed to connect the evidence on the moon with that on the earth. They saw no reason for believing in cataclysmic deluges, a theory quite commonly held by early geologists, so they continued with the principles of Sir Charles Lyell.

Sir Charles, it will be remembered, stated his chief premise in the year 1833: "That no causes whatever have changed the earth except those which still do so under the eyes of man." Lyell denied cataclysmic change so forcefully that his premise is still held after 114 years by the vast majority of scientists. Of course, many religious people believe in the Bible story of the flood, a story that is certainly of cataclysmic nature, and one borne out by the legends of many other races of people.

The error that Sir Charles Lyell and his followers have made is this. They have taken the 4000 years of recorded history (leaving out the legends they didn't like) as a fair sample of time. Four thousand years is "but a grain of sand on the shores of time." Because such a cataclysm has not occurred in the last few thousand years is no valid argument that such things are impossible. Lyell made a positive statement that has been taken as truth just because it was conservative.

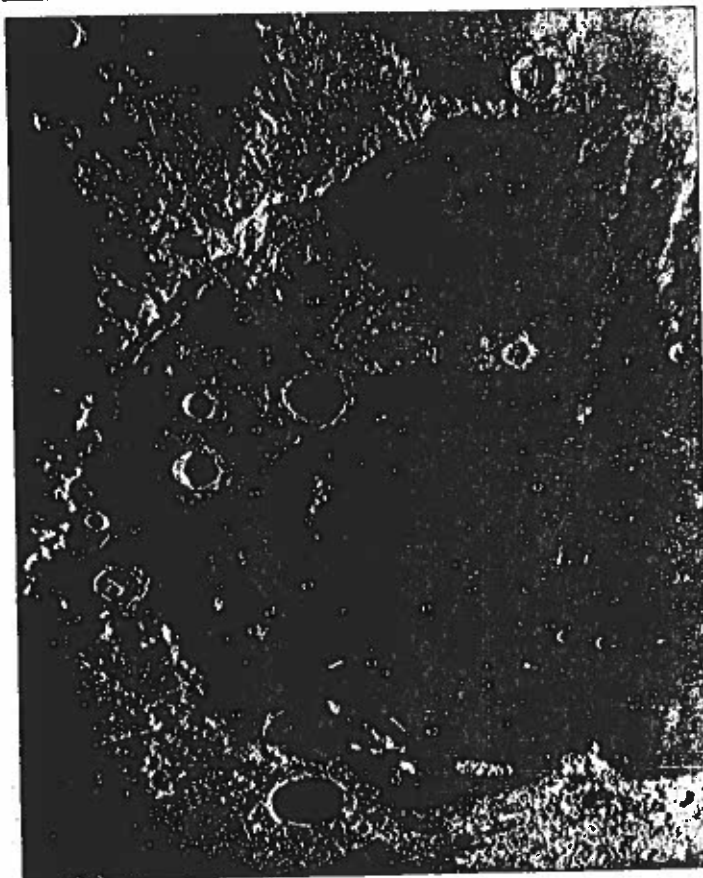
From this brief account of the geology of the moon it will be seen that great vistas of speculation open before us as we look back down the "corridors of time." We see how, under the collision theory, the earth and moon could have had different orbital speeds, rotational speeds, inclination of axes, eccentricity of orbits, realignment of axes, and many other minor and accompanying changes during past ages. The moon is a mirror of time unchanged by the ravages of erosion.



PHOTOGRAPH H-13  
(Made at the Mount Wilson Observatory)

impact origin too.\* That man was Nathaniel S. Shaler (1841-1906), professor of geology and paleontology in Harvard University. Shaler thought that these lava seas were caused by meteorites ten to fifteen miles in diameter crashing thru the crust of the moon, and liberating

\*Since writing this paper I have learned that Dr. H. H. Nininger in a paper in *Scientific Monthly* for March, 1943, advanced the same or at least a very similar idea.



PHOTOGRAPH H-8  
(Made at the Mount Wilson Observatory)

crater. This may have been made by a glancing blow from some meteorite or from a rock thrown out of Aristillus. There are many other interesting details on the surface of Mare Imbrium, but the foregoing should be sufficient to show that it could have been made by the impact of a planetoid. Let those, who will, try and explain the above details by any other means!

Still other interesting features on the lunar landscape are the Ray Craters. The largest of these are Tycho, Kepler, and Copernicus. The



PHOTOGRAPH H-17  
(Made at the Mount Wilson Observatory)

Most textbooks and books on popular astronomy, in discussing the craters on the moon, bring out as the chief objection to the theory of impact origin, that no such multitude of meteoritic craters are found on the earth. Only 27 on the earth and the largest of these the Arizona Crater. Why, they ask, has the earth not been struck by even greater numbers of these bodies, considering its greater mass and gravitational power? The answer to this question is simply this. The earth has been struck by thousands upon thousands of these cosmic bodies of all sizes,

# THE ORIGIN OF PENEPLANES

BY  
Allan O. Kelly.

1949

In offering any new theory about such a subject as peneplanes, one should probably preface it with a short history of the previous thinking, so the readers or listeners may refresh their memories or get some background, if they are not familiar with the subject.

In preparing this paper I spent considerable time in refreshing my own memory, and in trying to learn what the current thinking might be. While the study was not exhaustive, I did reach the conclusion that the trend has been toward negative rather than positive thinking: that the old theory has been generally discarded without anything new being offered.

The last report of any consequence on the subject seems to be that of William Morris Davis. He was professor of geology at Harvard from 1898 to 1912 and has been called the great "Great Systematizer" of the science of geomorphology, and the acknowledged leader of the American School of Physiographers." In 1896 he wrote an article called "The Plains of Subaerial Denudation" which appeared in the Bulletin of the Geological Society of America, Vol/ 7, pages 377-389. In this paper he reports upon the thinking of that day as follows: "Geologists today, may be divided into two schools regarding the origin of regions of comparatively smooth surfaces from which a large volume of overlying rocks have been removed. These regions occur under two conditions; First as buried oldlands on which an unconformable cover of later formation has been deposited, the oldlands being now more or less locally revealed by the dissection or stripping of the cover; second, as uplands or plateaus whose once even surface is now more or less roughened by the erosion of valleys.

The older school now chiefly represented by the English geologists, follows the theory of Ramsey, and regards these even oldlands as plains of denudation. The new school, chiefly represented by American geologists, but also by a number of continental European geologists, may be said to follow Powell, who first emphatically called attention to the possibility of producing plains by long continued subaerial denudation.

Davis continued by a discussion of the two schools of thought, favoring the American himself, but making it clear that in certain cases,

-2-

the problem of origin remained unsolved. In such cases, he said, \_\_\_  
" It is advisable to announce indcision as clearly as a decision is  
announced in the others." This was a noble and scientific attitude, but  
a difficult one to follow.

Davis also said that one of the most striking differences of opinio  
between the two schools of thought was that concernig the origin of  
unconformable strata that might , or might not, be found lying upon the  
oldlands.\* The English held it essential to the solution of the problem  
which the Americans did not. To my mind, all of the evidence was, and  
still is, important. However, the most important points to be solved are,  
and always have been, the assumptions. A search of textbooks and period-  
ic literature indicates that the asumptions are gradualll being taken  
for facts. Textbooks explain with block diagrams and photographs how  
uplift and submergence, (assumptions) and long continued erosion have  
produced mature landscapes and the articles, in periodicals describing  
various sections of the world, take it for granted that their readers  
will know what a mature landscape is and how it was formed. The words  
mature landscape are no generally used to indicate a near level surface  
cut by an intricate stream pattern and covered by a considerable depth  
of unconsolidated material. Little is said bout the hard rock surface  
worn to near level that may underlie the mature landscape, or in other  
regions lie uncovered, but this is the real crux of the problem. the  
facts are that surfaces worn to near level in hard rocks are very diffi-  
cult if not impossible to explain as the work of ordinary subaerial or  
marine erosion. Yet this is what our textbooks say or imply. Anyone  
who has observed stream erosion carefully, knows that streams simply  
cannot wear down hard rocks down to wide, nearly level plains. He knows  
that such slow moving water can only deposit fine sediments on such  
surfaces. He knows too, that streams can only cut hard rocks in canyons  
where the current is swift and at times when they are carrying much  
abrasive material. A clear mountain mountain torrent may be swift and  
deep but doing little cutting. At flood stage, however, it may move  
large boulders and produce a great deal of erosive work but always in a  
narrow V shaped grove, never in a wide, flat plain. Yet these wide, flat  
\* The two words, oldlands and peneplanes, have almost disappeared from  
common usage, modern geologists preferring more descriptive words, such  
as youthful, middle are or old age in referring to landscapes of erosion.

plains of hard rock do exist in many parts of the world. What was their origin?

In recent years geologists have become increasingly aware that the old theory did not fit the observed facts, but little interest in the problem has been evinced, rather, a sort of undeclared impasse has been reached, nothing is said, no controversy rages, \_\_\_ the whole subject is left dangling in mid-air. There is no "clear announcement of indecision" as Davis called for. In fact, his report on the controversy is the last we have been able to find. Yet here and there, one may read that the old theories about marine planation are no longer widely held, of, that subaerial denudation does not account for all the types of mature landscapes, but nowhere do we find a bold attack upon the problem of why these theories are no longer held.

Have scientists become so sensitive that they no longer dare to reason with their fellows lest they be considered impolite, or as implying something less than genius in their colleagues? Is it no longer possible to be a "Gentleman and a Scholar"? Is it such a scientific sin to propose a new theory? These are questions that need to be asked and answered, if the science of geology is ever to regain its former glory.

Perhaps its time for a new report; time to announce decision and indiscision clearly. What do the geologists now believe about the origin of peneplanes?

Returning to the old wave-cut theory of the English School, we find that geologists now generally consider that beaches tend to reach a state of equilibrium as soon as their wave-cut terraces reach a width of a few hundred yards. That most of the wave energy is then expended on the bottom and on the beach slope, rather than undercutting the bluffs. This is well illustrated by the fact that flat, sandy beaches along low coasts can take a tremendous beating during storms without cutting back into the land. The southern coast of the United States is a fine example, where mile upon mile of narrow beaches bywide lagoons, take the brunt of hurricanes year after year. If it were not for the wide underwater beach terraces in front of these frail shorelines, they would soon disappear.

Perpendicular sea cliffs are not uncommon along the sea coasts of

the world but most of them are protected by shallow beach terraces. What is rare, is a cliff or a steep mountain descending immediately into deep water. In such cases the rocks are either very durable or of recent volcanic origin. If it were possible to remove the terrace from in front of a comparatively soft cliff, it would probably be found that only a few score of years would be required to produce a new wave-cut terrace. Then the forces of subaerial erosion would take over, rainwash and stream erosion would begin to change the cliffs into steep slopes and plants would send down their roots to hold the soil in place. Onshore winds might carry some beach sand inland, but the streams would return a good part of it to the shore again, thus helping to maintain equilibrium in that never-ending battle between the land forces and the sea. Waves striking the beach at an angle, tend to transport sand along the beach in a see-saw kind of motion toward the open end of the angle formed by the wave and the shore. The waves carry the sand up the beach slope at an angle and gravity pulls it straight down again in a ceaseless ever-changing rhythm, sometimes weak, sometimes strong, according to the wind and the tide.

Waves striking parallel to the beach do not move the sand along the shore, but tend to build a cusped or scalloped beach or sometimes a straight smooth slope, depending somewhat on the coarseness of the sand and the weather.

Storms usually move the sand off the beach and deposit it as bars out near the breaker line. This tends to make the storm waves break farther and farther out and create an equilibrium out of its own violence, thus saving the beach from destruction. When calm weather returns, the sand is moved back on the beach within a few weeks. New residents on our California beaches sometimes think that their lovely sand beach is gone for good, after some storm removes everything but the cobblestones.

Another factor tending to maintain beach equilibrium on rocky coasts is the presence of harder rocks jutting out into the sea, and protecting to some extent, softer bluffs that may lie on either side. However, the most important factor is the tidal range. Very little if any cutting can be accomplished below the low tide line, and beach-cut terraces do not grow infinitely wide, because as the terrace widens, the wave friction

on the bottom increases, slowing the waves down until they can do little work upon reaching the shore. Thus the beach terraces are held to a definite width depending upon the range of the tide. The greater the tidal range, the wider the terrace will be cut. This fact is proved by the old elevated beach lines or terraces which are all comparatively narrow, like those now active. The English geologist mentioned by Davis probably supposed that the old beach terraces around the English Coasts, only represented short stands of the ocean at those levels, and that long continued beach erosion at one level would finally reduce the whole island to a wide peneplane. This, we now see, is impossible.

The American School long ago saw the fallacies of marine planation and also some of the inconsistencies of their own subaerial theory, but failed to see any better solution. Hence the impasse.

As mentioned earlier, the real rock on which subaerial theory is wrecked, is the existence of wide peneplaned areas worn to near level in hard crystalline and sedimentary rocks. These plains of erosion occur in many parts of the world and under many different climatic conditions. The Laurentian Plateau in eastern Canada, for example, is said to cover an area of over 200,000 square miles; all of it in hard crystalline rocks. Did ice produce this gigantic work? Probably, for it is nearly devoid of any loose covering of soil or gravel, being a wide expanse of bare rock with numberless shallow lake basins and other signs of ice erosion. Ice was no doubt the immediate agent, but what moved the ice is another matter.

In Greenland and Antarctica where thick ice sheets prevail over wide areas, it still remains to be proved that the ice moves over the rock below. Rather, there is good evidence that, as reported by Hobbs\* and others, that high winds caused by heavy cold air descending from the center of the ice cap and blowing outwardly, moves the snow accumulation towards the edges of the land mass where it descends as glacial ice to the coast. The winds are so powerful, and the snow so dry and light, that this means of transportation seems far more likely than the slow plastic movement of the whole body of ice. In both Greenland and Antarctica, the ice gradient from the center towards the sides is so small that it would hardly produce sufficient pressure differential to cause flow, and, if it did, it is not likely that the highly compressed bottom ice, well locked to the uneven surface of the rock, would move. More probable, movement

\*Dr. W. H. Hobbs---Early Glaciation in North America--Quarterly Review, May 1947.

movement would take place in the upper layers, as is the case in mountain glaciers where the friction of canyon walls and bottom, cause these parts to hold back while the center of the glacier moves faster. However, the evidence in Canada shows that the ice did move against the rock.

Other types of peneplanes that should be mentioned are:-----

1. The remnant type in which an old peneplane has been elevated and the softer parts eroded away until only isolated surfaces having a uniform skyline remain. The Appalachian plateau is an example.
2. The mature landscape of low relief, near sealevel and usually covered by considerable depths of unconsolidated material. This is the type most often stressed by modern textbooks.
3. The very ancient peneplane (unconformity) seen to best advantage in the Grand Canyon and in lesser canyons and sea cliffs of the world. These are very instructive because we see the peneplane and the material deposited above it, in cross sectional (section view) offering a better chance to diagnose its manner of origin.

In every case we find that the best indication of a true peneplane is a hard rock surface worn to near level. Anything else that may lie upon it was put there after the erosion of the hard rock surface was complete. That which followed was sedimentation, not planation which brings us to our conclusion: That peneplanes and unconformities are always hard surfaces worn to near level, and cannot possibly be the work of ordinary erosion. The very word, planation, indicates work, something done on a hard surface. We have then, two kinds of plains, plains of erosion and plains of sedimentation.

Turning now to my own explanation of the origin of peneplanes, I offer a theory that will seem fantastic in the extreme on first thought, but further consideration, I feel, will bring the realization that it is based upon sound scientific principles. I offer cosmic collision as the chief moulder and sculpter of our earth in all of its aspects, peneplanes being but one feature of those mighty cataclysms. First, however, I must make my basic point, that collision between the earth and other cosmic bodies is a fact as certainly known and well established as any other fact of science. It is not an assumption, a theory or hypothesis, like Continental Drift or Isostasy, but an established fact as well proven as the law of Gravity. Meteorites do strike the earth, the only question is, how big?

Less than a century and a half ago, Thomas Jefferson, no mean scientist himself, refuse to believe that stones had fallen from the sky over New England, and not long before that, the French Academy of Science had denied such a possibility too, although the stones were brought for their inspection and hundreds of people had witnessed this fall in southern France. Since that time many meteoritic falls have been recorded, some of large size, and in recent years, a number of large meteor craters have been discovered, such as the Canyon Diablo Crater in Arizona, the Wolf Creek Crater in Australia, the Ungave Crater in Canada and more recently, one in Algeria reported to be a little more than a mile in diameter. The recognition of these impact craters, together with the growing sentiment among astronomers favoring the impact theory for the origin of the craters on the moon, is forcing geologists to turn their attention more and more to the possibilities of collision geology. In my opinion, very good evidence of much larger collision craters exists on the earth in the shape of Island Arcs, mountain arcs, and many lesser features indicating collision. In fact, if collision occurred on the earth at all, in any manner comparable to that seen on the moon, then at least 90% of the earth's features are due to collision, directly or indirectly, rather than the long-accepted theory of slow erosion, culcanism and diastrophic movement. This is not to say that the ordinary forces of erosion cannot produce plains of low relief, such as the Mississippi Valley or the Amazon Valley, given sufficient time, but this is a process that consists mostly of aggradation rather than degradation: in reality, a reworking of collision flood gravels which have been thrown high on the land surfaces in bygone ages. Beneath this recent alluvial fill of the Mississippi Valley, there is now doubt, a hard rock floor which could be called the Mississippi Peneplain, or at least, the Mississippi Unconformity. It may very likely be that the Mississippi submarine canyon found off the mouth of the river in the Gulf of Mexico, also extend inland a considerable distance and could be located by cross sectional boreings or other geophysical exploration. The real problem is to explain the origin of those hard rock surfaces and the cnyons cut therein, not to question the reality of erosion and sedimentation..

Peneplanes are just on phase of collision geology, for it can be readily seen that if a large body were to strike the earth (for example one 200 miles in diameter) the effects would be world wide and of many

and of many kinds. Erosion and sedimentation would be but one phase. The earth's crust would be faulted and displaced in all directions. Mountains would be built and volcanic action would take place thousands of miles from the point of impact. Every part of the earth would be affected and the atmosphere surrounding it would be so heated and so charged with dust and gases, generated by the millions of degrees of temperature\*\* produced at the impact center, that the whole climate of the earth would be changed for years to follow, probably never returning to the exact previous conditions. Storms of unbelievable proportions and power would rage over the earth and continue for a long time, greatly increasing the rainfall and covering the mountains and polar regions with vast accumulations of snow and ice. At the point of impact, probably all of the meteorite and a large part of the earth's crust was vaporized, but beyond that and surrounding it, water, air, and rock debris would be blasted outward at incredible speeds, slicing off mountain tops and starting ice caps half-floating and skidding across the landscape in a way to produce peneplanes in short order. More erosion and sedimentation block faulting, vulcanism and general diastrophic action would take place in a few hours, days, or weeks than in all of the millions of years between collisions.

The evidence of these collisions is everywhere, as might be expected, but has been masquerading under another name, Uniformity. This assumption that all the earth's features have been moulded by the same mild forces of erosion and vulcanism as we see going on today, is now more than 120 years old. Quite a venerable assumption!

The Grand Canyon, as everyone knows, is perhaps the best and most complete record of the earth's history found anywhere in the world. In its walls are found the five major unconformities that mark the five great eras into lesser periods of time. The only one missing from the Grand Canyon is the last great revolution that separates the very recent from the Pleistocene and that is only missing in the sense that the Pleistocene formation is missing in that area. Any surface of the earth laid bare of recent unconsolidated material, constitutes that last great unconformity which I think was made by collision flood a little more than 8,000 years ago.

In the time charts used to illustrate the history of the earth by means of the rock column, photographs of the Grand Canyon walls and the

higher parts of the Colorado Plateau nearby are nearly always used to illustrate how the biological events of the past show up in the rock column in the evolution of the various forms of life. It is also general thought that the unconformities represent vast periods of time in which the mountains of the earth were worn down to near sea level, and that at the close of each of these eras or periods, great revolutions in mountain building and continental uplift took place, leaving only remnant of the old peneplanes and unconformities. The periods of time elapsed between revolutions is determined by the depth of sediments laid down between peneplanes, the greater the amount, the greater the elapsed time. The rate being determined by the rate at which present day rivers deposit sediments.

No cause or causes for these revolutions has been determined, but it has usually been held that they originated from within the earth.

Collision geology does not view these peneplanes and unconformities as the evidence of vast elapses of time, but as sudden cataclysms in which both the planation, deposition, and mountain building took place all at the same time. These major collisions were no doubt separated by great stretches of time, but only chance dictated the time when collisions would occur, so that we have no way of knowing whether they were closely spaced or far apart, so far as depth of sediment is concerned, for obviously, the amount of sediment would depend on the size of the collision and a great many other factors. More modern methods, such as determining the radio-active age of the various strata in the Grand Canyon, might give us the true picture.

Between major collisions, the uniform forces of erosion no doubt took over, but all traces of their work was removed by the following collision flood, for any unconsolidated material would be churned up in the flood waters and redeposited according to size and weight. For that reason, most of the peneplane surfaces are followed by basal (boulder) conglomerates and then ---the lighter materials. It is perhaps significant that peneplane surfaces are not followed by aggraded landscapes of intricate stream pattern in the Grand Canyon sequences, yet that is the only thing that can happen under conditions today where the hard rock surface is above sea level. Orthodox geologists, of course, see the rock column of the Grand Canyon as having been heaved up and down or, as sea level

raised and lowered, in order to account for the alternating land and marine strata.

Collision geology sees the whole Colorado Plateau as an old sea basin that was gradually filled by some 12 collision-floods of sufficient size to leave their peneplane record. Many lesser ones nodoubt occurred by collision. At the same time or other times distant collisions brought latteral pressures to raise the whole area above sea level, and to scour out the canyon with later floods. This is certainly the evidence displayed in the Grand Canyon, for nothing short of a collision-flood could have produced the tremendously thick beds of uniform material. No known river or any combination of erosive forces known today could have produced the Coconino Sandstone, \_\_\_310 feet thick and covering hundreds of square miles, this clean, uniform, white sand, makes sharp contrast with the very different Red Supai formation below it, and the Kaibab Limestone above. Why did all of the rivers flowing into the ancient Colorado Sea, suddenly begin to carry nothing but pure white sand? Was there no other kind of rock in the water shed? Is there any evidence that modern rivers can produce so uniform a bed of so even a thickness?

The cross-bedding seen in the Coconino and other sand stone formations is not the result of wind deposition as sometimes claimed, but rather, a condition in which sand rained down from the sky around some collision cloud, fine sand falling in deep water moving to and fro. The main layers in this sandstone vary in thickness from a few feet to as much as ten feet, and the individual strata in the thicker layers show the direction in which the water was moving by the innumerable small deltas that were formed with their flat surfaces and steep frontal slopes all pointing in the same direction. As these flood waters moved across the Colorado Basin (then probably below sea level), they piled up on the opposite shore, then a returning tide set in, the water moved in the opposite direction, so all the little deltas pointed that way. As the sand sank through the water and came to rest on the bottom, a sorting took place that fits the picture. So vast a body of water could not turn quickly so while it came to a slow stop and gradually turned, there was time for the finer sediment to sink to the bottom that would otherwise have remained in suspension. This produced a well- defined contact between the thick layers and helped to explain why this monstrous and unnatural river, ran first in one direction and then in the other. The sand was fine and uni-

form in nature because of the cataclysmic, vaporization process by which it was refined.

Such a collision as pictured would probably resemble a gigantic atomic bomb. Its cloud column and mushroom top would probably rise several thousand miles above the earth's atmosphere, its incandescent vapors mushrooming outwardly and some of it probably escaping the earth altogether. In the outer fringes of this cloud, vast quantities of molten rock might rain down as sand or metals, the whole effect being something like that of a giant "cracking plant"---sorting out the various elements in annular rings according to their chemical properties.

Certainly, peneplanes and unconformities are but a small fraction of the effects of such a blast, but in order to explain their possible origin by collision, it has been necessary to diverge somewhat from the true course.

IN SUMMARY:

- 1. The history of the subject has been reviewed.
- 2. The general lack of interest in the problem.
- 3. The nature of marine shoreline erosion.
- 4. The nature of subaerial denudation and its inability to produce peneplanes and unconformities.
- 5. The collision-flood explanation of peneplanes and unconformities.

Carlsbad, Ca. Aug. 27, 1988:

This is a retyping of the original carbon copy, (the original having been sent away) that was so blurred that it was difficult to read. The carbon copy has been saved because I want to be able to show the growth in this idea and the changes that I have made in my thinking.

Allan D. Tully

# POPULAR ASTRONOMY

April 1951

Carolina Bays and the Oriented Lakes of Alaska

199

CARLSBAD, Feb. 28, 1988

After reading this article once more, I find very little that I would change after 37 years.

This article stopped the great debate, and there followed a great silence which has lasted right up to the present day. It was just a matter of common sense and layman reasoning about facts of nature well known to the average lay citizen

How much better for education and the academic world if they simply given credit where credit was due and left the field open for further study.

A.O.K.

## The Origin of the Carolina Bays and the Oriented Lakes of Alaska

By ALLAN O. KELLY

*The "Carolina Bays" have been the subject of discussion in a number of papers in this magazine in the last few years. Here is another paper in which a new point of view is presented as an explanation of them. The degree of conviction induced by this argument will, no doubt, vary with the experience, background of thinking, and subjectivity of the reader. EDITOR.*

The origin of the Carolina Bays and the Oriented Lakes of Northern Alaska is a problem that has long intrigued the scientific world. Probably the great interest in this scientific puzzle arises from the fact that Melton and Schriever, geologists from the University of Oklahoma, who first discovered the Carolina Bays, attributed them to a gigantic shower of meteorites. This interpretation was made in 1933. Such a spectacular theory immediately aroused the interest of the Press and several articles appeared in popular magazines describing the fearful holocaust that must have occurred. Following this introduction to the public, the scientific world began to investigate. Many different hypotheses were proposed but none seemed to fulfill all the requirements.

Dr. Douglas Johnson, geologist of Columbia University, said of these bays or depressions: "They are without doubt one of the most remarkable geomorphic features on the surface of the earth. They share with submarine canyons the distinction of being among the most difficult of earth forms to explain." Johnson was unaware of the Oriented Lakes of Alaska.

The Oriented Lakes of Northern Alaska were first investigated by R. F. Black and W. L. Barksdale of the United States Geological Survey. They published a rather complete article about these lakes in the *Journal of Geology* in March of 1949. They did not propose a complete theory of origin but they did give a table of comparisons between the Carolina Bays and these lakes. It was shown that out of 17 items of comparison, the two groups were similar in all but five. Among other things they concluded that "The Carolina Bays and the Oriented Lakes of Alaska are so strikingly similar that it is believed that the conditions operating to produce them must have been, at least in part, similar." No one else, so far as we know, has made any investigation or any proposal as to the origin of these lakes.

It is not our purpose in this short article to criticize other theories of origin but rather to advance one which we believe answers all of the requirements, so far as we know them.

This theory is based on cosmic collision as the motivating energy that produced these bays or lakes, and, in fact, the force that has produced most of the physical features of the earth. Such collisions and the oceanic floods that must have followed, can explain every unexplained problem of modern geology, including submarine canyons. Many thousands of these collisions have occurred in the earth's long history and the last major one caused the Biblical Flood which is also recorded by many other races of people. The physical evidences of this last great flood are found all around the world, in tremendous gravel deposits in unusual locations; in old shore lines high above the present levels of inland lakes such as Great Salt Lake and the Dead Sea; in recent glaciation and evident change of climate; in prehistoric animals found frozen in the Arctic, and a vast array of other physical evidence that cannot be mentioned here.

The Carolina Bays and Oriented Lakes of Alaska are only a small part of this great array of collision evidence, but they are the immediate concern of this article and one more step in proving the collision theory. Our reasoning is as follows: Before this last great catastrophe, the North Pole was located near Apatak Island in Hudson Strait. This fact is proved by drawing an arctic circle around this point, which is then found to contain all the glaciated area of North America, including Greenland and Iceland. These two islands were in practically the same relative position to the old arctic circle as they are today, so that their ice conditions have not changed.

It will be seen, then, that a considerable part of the North Atlantic

was well within this old arctic circle and so must have contained large quantities of sea ice and glacial ice. On the other side of the circle, the Arctic Ocean also was in a position suitable to the production of ice.

The meteorite or asteroid, which caused this last cataclysm, struck the earth at a point which was then just outside the arctic circle but now off our South Atlantic Coast. It formed a great under-sea crater whose outlines can be traced for hundreds of miles as a nearly perpendicular wall (Figure 1). When this collision occurred it moved the surface of the earth in relation to the rays of the sun and at the same time changed the axis of the earth to its present location. A new alignment would certainly follow if the striking body penetrated the crust of the earth



FIGURE 1

and added its weight to one side of the earth flywheel. On the other hand, if it only struck a glancing blow, the earth would probably wobble a little like a spinning top and soon regain its former axis. All the evidence seems to indicate that this object did penetrate the crust of the earth.

Such a collision would, of course, cause a terrific earth shock felt all over the world. The polar ice cap would have been shattered and the oceanic flood that followed would have floated vast quantities of ice far away from its source. Geologists have estimated the ice over Hudson Bay to have been over two miles thick. This ice and the ice in the Great Lakes apparently melted in place but the old polar cap was elevated and the ice moved off the land in all directions as the grooves in the rocks so plainly indicate. The glacial ice and sea ice that was floated by this flood must have rushed back with these waters to fill the impact point. This ice would have melted quickly in such an inferno\* but some of the sea ice far away near the coast of Greenland might have trailed far behind and missed this hot water bath. This ice could have been stranded like a great fleet of ships, for wind and tide would have tended to orientate them to some degree. When they grounded on the coastal plain, the seaward end of each berg or cake of ice would float more easily. Thus the bergs were grounded or anchored like ships in a harbor and would swing with the tide, all pointing in the same direction as the outgoing tide. As the tides receded, there came a time when the bergs failed to float on the incoming tide and so remained in this fixed position until melted.

Once the stranded bergs were firmly fixed on the bottom, the tides began to shape the land surfaces between. Since ice floats with about nine-tenths of its mass below the surface, this grounding would take place while the tidal floods were still quite deep for these cakes of ice might have been several hundred feet thick, judging by Antarctic sea ice. The ice in the Carolina Bay region probably remained for a year or so after the tides had returned to normal but in Alaska, they may have remained hundreds of years before melting completely.

The length of time that might have passed before the tides returned to normal would be difficult to determine by geological observation but the Biblical account of the Deluge tells us that the waters were "Going and returning continually for one hundred and fifty days." This seems like a reasonable estimate of the time that might have been required.

Major Chapman Grant, of San Diego, California, who visited the Carolina Bays in 1948, describes the area as not really a flat plain but a region in which low gravel hills are interspersed with Bays of a little lower elevation and with stream channels a little lower than the Bays. He also pointed out that seldom, if ever, does a stream flow from one bay to the next as is the case in all other lake country, but always around the Bays. In like manner the gravel hills do not encroach upon the

\*The Finns have a legend of a hot water flood.

bays nor do the so-called beach ridges. Johnson and others were at a loss to explain why these old surf lines or beach ridges, as they called them, did not cross the bays for the ridges are no higher than the bay rims. All these questions are easily answered if we imagine a cake of ice in each bay and tidal waters flowing in and out among these obstructions.

At first, when the tides were deep and strong, the gravel hills were deposited in the larger open areas between bergs. At the same time, channels were eroded out where the bergs were closer together and the current stronger. This kept the gravel hills from approaching too close to the bergs and produced the "kettle holes" or basins around each berg. Big bergs usually produced the dominant current and so the bays formed by little bergs close by seldom overlap the rims of bays made by bigger bergs. There are exceptions to this overlapping of rims, but, in general, the rule holds good. There are, in fact, exceptions to every general feature of uniformity in the Carolina Bays but all of these exceptions can be explained by the varying shape of the bergs, by distance of separation, and by the varying current of water flowing between them. Aerial photographs show this flow pattern around fixed objects so plainly that one wonders why this explanation was not forthcoming long ago.

Another characteristic feature of the Bays is the occurrence of rows or chains of Bays. Many chains of three or more are found nearly touching one another and with stream channels on either side. Usually these chains are made up of bays of nearly equal size and may have resulted from a large berg breaking up after grounding. In any event, such a chain would force the water to flow parallel to the sides of such group and the current would tend to arrange them in better alignment. These chains occur so frequently in the Carolina Bay region that they became a stumbling block to the advocates of the meteoritic theory, for it seemed beyond the realm of chance that meteorites should fall in many rows.

Since the ice probably remained long after the tides receded, the final melting took place without any passing current. Thus the final melt-water overflowed the bowl in which each berg was sitting and produced the delicate sand rims, even improving upon the symmetry that the tidal current had produced. Later, small channels were cut in the rim of each bay, allowing the greater part of each lake to drain into the stream channels.

The Oriented Lakes of Alaska show greatest deviation from the Carolina Bays in that the water drains from one lake to the next. This may be explained by the fact that Alaska was moved from a north temperate climate into the arctic; that the ice bergs stranded there did not melt for many hundreds of years; and that the streams and vegetation built up the land around them so that when the bergs did finally disappear, the streams were forced to flow from one lake to the next.

The Alaskan Lakes cover an area somewhat larger in size than the Carolina Bays, being about 450 miles east and west and extending from Point Barrow south about 100 miles. As in the Carolina region, the biggest lakes are found near the coast for the largest bergs grounded first. Farther inland the lakes become more scattered, less elongated, and more erratic in orientation. A few scattered lakes of smaller size are also found near the coast, but on higher ridges and plateaus, apparently because smaller bergs were thrown to greater heights by the first great tides and were less well orientated because of the shallower tidal currents following.

In outline, the Alaska Lakes are more rectangular than the Carolina Bays. This was probably due to a different fracture pattern and to the different orientation relative to the sun. The Carolina Bays are oriented in a northwest-southeast direction and therefore the northeast and east side of most bergs received more sunlight and melted faster. This difference in exposure to the sun produced the curious ovoid shape with the straighter side on the shady side. Where bergs were close together so that one might shade the other, the curvature on the shady side fits the theory. Another point bearing this out, is the fact that in large bays with multiple rims, the outer older rim is always a more perfect oval, showing that as the berg melted faster on the sunny side the new formed rims changed in shape with the berg. No other theory has ever been able to account for these multiple rims or the ovoid shape.

In Alaska the lakes are pointed more nearly north and south, the average trend being 12 degrees west of north. Being well above the Arctic Circle (most of them above 70 degrees north) the summer sun shone on all sides of the bergs with little favoritism, so that a more even rectangular shape was achieved.

Another possible reason for the uniformity in outline of these bays and lakes would be that the shock waves from the collision, through the water and through the earth, produced a uniform pattern in cracking the ice. This same collision shock pattern may be seen in the grid-like pattern of the mountains on the moon, especially in the mountain rim around Mare Imbrium. Shock waves traveling outwardly and upwardly might fracture ice floating on a sphere, in boat-shaped forms. In Alaska, which was much more distant from the point of collision than the Atlantic ice, the shock might have cracked the ice in a more rectangular pattern. Such a shattering of ice would almost surely produce a uniformity of some shape but there would be many minor variations. Such is the case, in both Alaska and Carolina, and, as the old proverb goes, "The exception proves the rule."

Conclusion. We believe that the Carolina Bays and the Oriented Lakes of Alaska were formed by strong tidal currents flowing around fixed objects that have since disappeared, that cakes of sea ice are, so

far as we know, the only large objects in nature that could have fulfilled all the requirements, and that cosmic collision flood is the only possible force that could have moved them into place. We therefore rest our case and await the onslaught of our critics.

CARLEBAD, CALIFORNIA, P. O. Box 512

THE ORIGIN OF PENEPLANES

BY  
Allan O. Kelly.

1949

In offering any new theory about such a subject as peneplanes, one should probably preface it with a short history of the previous thinking, so the readers or listeners may refresh their memories or get some background, if they are not familiar with the subject.

In preparing this paper I spent considerable time in refreshing my own memory, and in trying to learn what the current thinking might be. While the study was not exhaustive, I did reach the conclusion that the trend has been toward negative rather than positive thinking: that the old theory has been generally discarded without anything new being offered.

The last report of any consequence on the subject seems to be that of Willaim Morris Davis. He was professor of geology at Harvard from 1898 to 1912 and has been called the ~~great~~ "Great Systematizer" of the science of geomorphology, and the acknowledged leader of the American School of Physiographers." In 1896 he wrote an article called "The Plains of Subaerial Denudation" which appeared in the Bulletin of the Geological Society of America, Vol/ 7, pages 377-389. In this paper he reports upon the thinking of that day as follows: "Geologists today, may be divided into two schools regarding the origin of regions of comparatively smooth surfaces from which a large volume of overlying rocks have been removed. These regions occur under two conditions; First as buried oldlands on which an unconformable cover of later formation has been deposited, the oldlands being now more or less locally revealed by the dissection or stripping of the cover; second, as uplands or plateaus whose once even surface is now more or less roughened by the erosion of valleys."

The older school now chiefly represented by the English geologists, follows the theory of Ramsey, and regards these even oldlands as plains of denudation. The new school, chiefly represented by American geologists, but also by a number of continental European geologists, may be said to follow Powell, who first emphatically called attention to the possibility of producing plains by long continued subaerial denudation.

Davis continued by a discussion of the two schools of thought, favoring the American himself, but making it clear that in certain cases,

the problem of origin remained unsolved. In such cases, he said, \_\_\_  
 " It is advisable to announce indcision as clearly as ~~a~~ decision is  
 announced in the others." This was a noble and scientific attitude, but  
 a difficult one to follow.

Davis also said that one of the most striking differences of opinion  
 between the two schools of thought was that concernig the origin of  
 unconformable strata that might , or might not, be found lying upon the  
 oldlands.\* The English held it essential to the solution of the problem  
 which the Americans did not. To my mind, all of the evidence was, and  
 still is, important. However, the most important points to be solved are,  
 and always have been, the assumptions. A search of textbooks and period-  
 ic literature indicates that the asumptions are gradually being taken  
 for facts. Textbooks explain with block diagrams and photographs how  
 uplift and submergence, (assumptions) and long continued erosion have  
 produced mature landscapes and the articles, in periodicals describing  
 various sections of the world, take it for granted that their readers  
 will know what a mature landscape is and how it was formed. The words  
 mature landscape are now generally used to indicate a near level surface  
 cut by an intricate stream pattern and covered by a considerable depth  
 of unconsolidated material. Little is said bout the hard rock surface  
 worn to near level that may underlie the mature landscape, or in other  
 regions lie uncovered, but this is the real crux of the problem. the  
 facts are that surfaces worn to near level in hard rocks are very diffi-  
 cult if not impossible to explain as the work of ordinary subaerial or  
 marine erosion. Yet this is what our textbooks say or imply. Anyone  
 who has observed stream erosion carefully, knows that streams simply  
 cannot wear down hard rocks ~~down~~ to wide, nearly level plains. He knows  
 that such slow moving water can only deposit fine sediments on such  
 surfaces. He knows too, that streams can only cut hard rocks in canyons  
 where the current is swift and at times when they are carrying much  
 abrasive material. A clear mountain ~~mountain~~ forrent may be swift and  
 deep but doing little cutting. At flood stage, however, it may move  
 large boulders and produce a great deal of erosive work but always in a  
 narrow V shaped grove, never in a wide, flat plain. Yet these wide, flat  
 \* The two words, oldlands and peneplanes, have almost disappeared from  
 common usage, modern geologists preferring more descriptive words, such  
 as youthful, middle are or old age in referring to landscapes of erosion.

plains of hard rock do exist in many parts of the world. What was their origin?

In recent years geologists have become increasingly aware that the old theory did not fit the observed facts, but little interest in the problem has been evinced, rather, a sort of undeclared impasse has been reached, nothing is said, no controversy rages, \_\_\_ the whole subject is left dangling in mid-air. There is no "clear announcement of indecision," as Davis called for. In fact, his report on the controversy is the last we have been able to find. Yet here and there, one may read that the old theories about marine planation are no longer widely held, or, that subaerial denudation does not account for all the types of mature landscapes, but no where do we find a bold attack upon the problem of why these theories are no longer held.

Have scientists become so sensitive that they no longer dare to reason with their fellows, lest they be considered impolite, or as implying something less than genius in their colleagues? Is it no longer possible to be a "Gentleman and a Scholar"? Is it such a scientific sin to propose a new theory? These are questions that need to be asked and answered, if the science of geology is ever to regain its former glory.

Perhaps its time for a new report; time to announce decision and indiscision clearly. What do the geologists now believe about the origin of peneplanes?

Returning to the old wave-cut theory of the English School, we find that geologists now generally consider that beaches tend to reach a state of equilibrium as soon as their wave-cut terraces reach a width of a few hundred yards. That most of the wave energy is then expended on the bottom and on the beach slope, rather than undercutting the bluffs. This is well illustrated by the fact that flat, sandy beaches along low coasts can take a tremendous beating during storms without cutting back into the land. The southern coast of the United States is a fine example, where mile upon mile of narrow beaches *and low bluffs are protected* by wide lagoons, taking the brunt of hurricanes year after year. If it were not for the wide underwater beach terraces in front of these frail shorelines, they would soon disappear.

Perpendicular sea cliffs are not uncommon along the sea coasts of

the world but most of them are protected by shallow beach terraces. What is rare, is a cliff or a steep mountain descending immediately into deep water. In such cases the rocks are either very durable or of recent volcanic origin. If it were possible to remove the terrace from in front of a comparatively soft cliff, it would probably be found that only a few score of years would be required to produce a new wave-cut terrace. Then the forces of subaerial erosion would take over, rainwash and stream erosion would begin to change the cliffs into steep slopes and plants would send down their roots to hold the soil in place. Onshore winds might carry some beach sand inland, but the streams would return a good part of it to the shore again, thus helping to maintain equilibrium in that never-ending battle between the land forces and the sea. Waves striking the beach at an angle, tend to transport sand along the beach in a see-saw kind of motion toward the open end of the angle formed by the wave and the shore. The waves carry the sand up the beach slope at an angle and gravity pulls it straight down again in a ceaseless ever-changing rhythm, sometimes weak, sometimes strong, according to the wind and the tide.

Waves striking parallel to the beach do not move the sand along the shore, but tend to build a cusped or scalloped beach or sometimes a straight smooth slope, depending somewhat on the coarseness of the sand and the weather.

Storms usually move the sand off the beach and deposit it as bars out near the breaker line. This tends to make the storm waves break farther and farther out and create an equilibrium out of its own violence, thus saving the beach from destruction. When calm weather returns, the sand is moved back on the beach within a few weeks. New residents on our California beaches sometimes think that their lovely sand beach is gone for good, after some storm removes everything but the cobblestones.

Another factor tending to maintain beach equilibrium on rocky coasts is the presence of harder rocks jutting out into the sea, and protecting to some extent, softer bluffs that may lie on either side. However, the most important factor is the tidal range. Very little if any cutting can be accomplished below the low tide line, and beach-cut terraces do not grow infinitely wide, because as the terrace widens, the wave friction

on the bottom increases, slowing the waves down until they can do little work upon reaching the shore. Thus the beach terraces are held to a definite width depending upon the range of the tide. The greater the tidal range, the wider the terrace will be cut. This fact is proved by the old elevated beach lines or terraces which are all comparatively narrow, like those now active. The English geologist mentioned by Davis probably supposed that the old beach terraces around the English Coasts, only represented short stands of the ocean at those levels, and that long continued beach erosion at one level would finally reduce the whole island to a wide peneplane. This, we now see, is impossible.

The American School long ago saw the fallacies of marine planation and also some of the inconsistencies of their own subaerial theory, but failed to see any better solution. Hence the impasse.

As mentioned earlier, the real rock on which subaerial theory is wrecked, is the existence of wide peneplaned areas worn to near level in hard crystalline and sedimentary rocks. These plains of erosion occur in many parts of the world and under many different climatic conditions. The Laurentian Plateau in eastern Canada, for example, is said to cover an area of over 200,000 square miles; all of it in hard crystalline rocks. Did ice produce this gigantic work? Probably, for it is nearly devoid of any loose covering of soil or gravel, being a wide expanse of bare rock with numberless shallow lake basins and other signs of ice erosion. Ice was no doubt the immediate agent, but what moved the ice is another matter.

In Greenland and Antarctica where thick ice sheets prevail over wide areas, it still remains to be proved that the ice moves over the rock below. Rather, there is good evidence that, as reported by Hobbs\* and others, that high winds caused by heavy cold air descending from the center of the ice cap and blowing outwardly, moves the snow accumulation towards the edges of the land mass where it descends as glacial ice to the coast. The winds are so powerful, and the snow so dry and light, that this means of transportation seems far more likely than the slow plastic movement of the whole body of ice. In both Greenland and Antarctica, the ice gradient from the center towards the sides is so small that it would hardly produce sufficient pressure differential to cause flow, and, if it did, it is not likely that the highly compressed bottom ice, well locked to the uneven surface of the rock, would move. More probable, movement

\*Dr. W. H. Hobbs---Early Glaciation in North America--Quarterly Review, May 1947.

movement would take place in the upper layers, as is the case in mountain glaciers where the friction of canyon walls and bottom, cause these parts to hold back while the center of the glacier moves faster. However, the evidence in Canada shows that the ice did move against the rock.

Other types of peneplanes that should be mentioned are:-----

1. The remnant type in which an old peneplane has been elevated and the softer parts eroded away until only isolated surfaces having a uniform skyline remain. The Appalachian plateau is an example.
2. The mature landscape of low relief, near sealevel and usually covered by considerable depths of unconsolidated material. This is the type most often stressed by modern textbooks.
3. The very ancient peneplane (unconformity) seen to best advantage in the Grand Canyon and in lesser canyons and sea cliffs of the world. These are very instructive because we see the peneplane and the material deposited above it, in cross sectional (section view) offering a better chance to diagnose its manner of origin.

In every case we find that the best indication of a true peneplane is a hard rock surface worn to near level. Anything else that may lie upon it was put there after the erosion of the hard rock surface was complete. That which followed was sedimentation, not planation which brings us to our conclusion: That peneplanes and unconformities are always hard surfaces worn to near level, and cannot possibly be the work of ordinary erosion. The very word, planation, indicates work, something done on a hard surface. We have then, two kinds of plains, plains of erosion and plains of sedimentation.

Turning now to my own explanation of the origin of peneplanes, I offer a theory that will seem fantastic in the extreme on first thought, but further consideration, I feel, will bring the realization that it is based upon sound scientific principles. I offer cosmic collision as the chief moulder and sculpter of our earth in all of its aspects, peneplanes being but one feature of those mighty cataclysms. First, however, I must make my basic point, that collision between the earth and other cosmic bodies is a fact as certainly known and well established as any other fact of science. It is not an assumption, a theory or hypothesis, like Continental Drift or Isostasy, but an established fact as well proven as the law of Gravity. Meteorites do strike the earth, the only question is, how big?

Less than a century and a half ago, Thomas Jefferson, no mean scientist himself, refuse to believe that stones had fallen from the sky over New England, and not long before that, the French Academy of Science had denied such a possibility too, although the stones were brought for their inspection and hundreds of people had witnessed this fall in southern France. Since that time many meteoritic falls have been recorded, some of large size, and in recent years, a number of large meteor craters have been discovered, such as the Canyon Diablo Crater in Arizona, the Wolf Creek Crater in Australia, the Ungave Crater in Canada and more recently, one in Algeria reported to be a little more than a mile in diameter. The recognition of these impact craters, together with the growing sentiment among astronomers favoring the impact theory for the origin of the craters on the moon, is forcing geologists to turn their attention more and more to the possibilities of collision geology. In my opinion, very good evidence of much larger collision craters exists on the earth in the shape of Island Arcs, mountain arcs, and many lesser features indicating collision. In fact, if collision occurred on the earth at all, in any manner comparable to that seen on the moon, then at least 90% of the earth's features are due to collision, directly or indirectly, rather than the long-accepted theory of slow erosion, vulcanism and diastrophic movement. This is not to say that the ordinary forces of erosion cannot produce plains of low relief, such as the Mississippi Valley or the Amazon Valley, given sufficient time, but this is a process that consists mostly of aggradation rather than degradation: in reality, a reworking of collision flood gravels which have been thrown high on the land surfaces in bygone ages. Beneath this recent alluvial fill of the Mississippi Valley, there is now doubt, a hard rock floor which could be called the Mississippi Peneplain, or at least, the Mississippi Unconformity. It may very likely be that the Mississippi submarine canyon found off the mouth of the river in the Gulf of Mexico, also extend inland a considerable distance and could be located by cross sectional boreings or other geophysical exploration. The real problem is to explain the origin of those hard rock surfaces and the canyons cut therein, not to question the reality of erosion and sedimentation..

Peneplanes are just on phase of collision geology, for it can be readily seen that if a large body were to strike the earth (for example one 200 miles in diameter) the effects would be world wide and of many

~~and of many~~ kinds. Erosion and sedimentation would be but one phase. The earth's crust would be faulted and displaced in all directions. Mountains would be built and volcanic action would take place thousands of miles from the point of impact. Every part of the earth would be affected and the atmosphere surrounding it would be so heated and so charged with dust and gases, generated by the millions of degrees of temperature\*\* produced at the impact center, that the whole climate of the earth would be changed for years to follow, probably never returning to the exact previous conditions. Storms of unbelievable proportions and power would rage over the earth and continue for a long time, greatly increasing the rainfall and covering the mountains and polar regions with vast accumulations of snow and ice. At the point of impact, probably all of the meteorite and a large part of the earth's crust was vaporized, but beyond that and surrounding it, water, air, and rock debris would be blasted outward at incredible speeds, slicing off mountain tops and starting ice caps half-floating and skidding across the landscape in a way to produce peneplanes in short order. More erosion and sedimentation block faulting, vulcanism and general diastrophic action would take place in a few hours, days, or weeks than in all of the millions of years between collisions.

The evidence of these collisions is everywhere, as might be expected, but has been masquerading under another name, Uniformity. This assumption that all the earth's features have been moulded by the same mild forces of erosion and vulcanism as we see going on today, is now more than 120 years old. Quite a venerable assumption!

The Grand Canyon, as everyone knows, is perhaps the best and most complete record of the earth's history found anywhere in the world. In its walls are found the five major unconformities that mark the five great eras into lesser periods of time. The only one missing from the Grand Canyon is the last great revolution that separates the very recent from the Pleistocene and that is only missing in the sense that the Pleistocene formation is missing in that area. Any surface of the earth laid bare of recent unconsolidated material, constitutes that last great unconformity which I think was made by collision flood a little more than 8,000 years ago.

Nov-11, 1900 - 1988

In the time charts used to illustrate the history of the earth by means of the rock column, photographs of the Grand Canyon walls and the

higher parts of the Colorado Plateau nearby are nearly always used to illustrate how the biological events of the past show up in the rock column in the evolution of the various forms of life. It is also generally thought that the unconformities represent vast periods of time in which the mountains of the earth were worn down to near sea level, and that at the close of each of these eras or periods, great revolutions in mountain building and continental uplift took place, leaving only remnants of the old peneplanes and unconformities. The periods of time elapsed between revolutions is determined by the depth of sediments laid down between peneplanes, the greater the amount, the greater the elapsed time. The rate being determined by the rate at which present day rivers deposit sediments.

No cause or causes for these revolutions has been determined, but it has usually been held that they originated from within the earth.

Collision geology does not view these peneplanes and unconformities as the evidence of vast elapses of time, but as sudden cataclysms in which both the planation, deposition, and mountain building took place all at the same time. These major collisions were nodoubt separated by great stretches of time, but only chance dictated the time when ~~when~~ collisions would occur, so that we have no way of knowing whether they were closely spaced or far apart, so far as depth of sediment is concerned, for obviously, the amount of sediment would depend on the size of the collision and a great many other factors. More modern methods, such as determining the radio-active age of the various strata in the Grand Canyon, might give us the true picture.

Between major collisions, the uniform forces of erosion nodoubt took over, but all traces of their work was removed by the following collision flood, for any unconsolidated material would be churned up in the flood waters and redeposited according to size and weight. For that reason, most of the peneplane surfaces are followed by basal (boulder) conglomerates and then ---the lighter materials. It is perhaps significant that peneplane surfaces are not followed by aggraded landscapes of intricate stream pattern in the Grand Canyon sequences, yet that is the only thing that can happen under conditions today where the hard rock surface is above sea level. Orthodox geologists, of course, see the rock column of the Grand Canyon as having been heaved up and down or, as sea level

raised and lowered, in order to account for the alternating land and marine strata.

Collision geology sees the whole Colorado Plateau as an old sea basin that was gradually filled by some 12 collision-floods of sufficient size to leave their peneplane record. Many lesser ones nodoubt occurred by collision. At the same time or other times distant collisions brought latteral pressures to raise the whole area above sea level, and to scour out the canyon with later floods. This is certainly the evidence displayed in the Grand Canyon, for nothing short of a collision-flood could have produced the tremendously thick beds of uniform material. No known river or any combination of erosive forces known today could have produced the Coconino Sandstone, \_\_\_310 feet thick and covering hundreds of square miles, this clean, uniform, white sand, makes sharp contrast with the very different Red Supai formation below it, and the Kaibab Limestone above. Why did all of the rivers flowing into the ancient Colorado Sea, suddenly begin to carry nothing but pure white sand? Was there no other kind of rock in the water shed? Is there any evidence that modern rivers can produce so uniform a bed of so even a thickness?

The cross-bedding seen in the Coconino and other sand stone formations is not the result of wind deposition as sometimes claimed, but rather, a condition in which sand rained down from the sky around some collision cloud, fine sand falling in deep water moving to and fro. The main layers in this sandstone vary in thickness from a few feet to as much as ten feet, and the individual strata in the thicker layers show the direction in which the water was moving by the innumerable small deltas that were formed with their flat surfaces and steep frontal slopes all pointing in the same direction. As these flood waters moved across the Colorado Basin (then probably below sea level), they piled up on the opposite shore, then a returning tide set in, the water moved in the opposite direction, so all the little deltas pointed that way. As the sand sank through the water and came to rest on the bottom, a sorting took place that fits the picture. So vast a body of water could not turn quickly so while it came to a slow stop and gradually turned, there was time for the finer sediment to sink to the bottom that would otherwise have remained in suspension. This produced a well- defined contact between the thick layers and helped to explain why this monstrous and unnatural river, ran first in one direction and then in the other. The sand was fine and uni-

form in nature because of the cataclysmic, vaporization process by which it was refined.

Such a collision as pictured would probably resemble a gigantic atomic bomb. Its cloud column and mushroom top would probably rise several thousand miles above the earth's atmosphere, its incandescent vapors mushrooming outwardly and some of it probably escaping the earth altogether. In the outer fringes of this cloud, vast quantities of molten rock might rain down as sand or metals, the whole effect being something like that of a giant "cracking plant"---sorting out the various elements in annular rings according to their chemical properties.

Certainly, peneplanes and unconformities are but a small fraction of the effects of such a blast, but in order to explain their possible origin by collision, it has been necessary to diverge somewhat from the true course.

IN SUMMARY:

1. The history of the subject has been reviewed.
2. The general lack of interest in the problem.
3. The nature of marine shoreline erosion.
4. The nature of subaerial denudation and its inability to produce peneplanes and unconformities.
5. The collision-flood explanation of peneplanes and unconformities.

Carlsbad, Ca. Aug. 27, 1988:

This is a retyping of the original carbon copy, (the original having been sent away) that was so blurred that it was difficult to read. The carbon copy has been saved because I want to be able to show the growth in this idea and the changes that I have made in my thinking.

Allan D. Tully

### A CRANK'S-EYE VIEW

LAURENCE J. LAFLEUR's article in the November issue of THE SCIENTIFIC MONTHLY, called "Cranks and Scientists," impels us to write an answer for the other side. Being an old and experienced crank of the letter-writing variety, we feel that our experience with scientists, editors, and book publishers is such that we are well qualified to give a crank's-eye view of the average scientist.

In his article Dr. Lafleur has listed seven ways to identify a crank or a crank theory. He has accused the cranks of certain mental characteristics that set them apart from scientists, as well as from other men, and thus places upon them a certain stigma. It must be admitted that he has gone at the job in a pleasant manner and ended on a note of hope for their redemption. It is our hope to do as well for the scientists.

Being a crank and prone to come at any problem in a hasty manner, we at first thought to settle the whole matter by one simple test for the scientist—namely, to ask him a question and if he gives a straightforward answer, he is not a scientist. On further consideration, we decided this might cut out some of the fun, so we launch forth with the following diagnosis.

First, we must decide what manner of person a scientist is and who may qualify under the meaning of the term. The dictionary defines a scientist as "One versed in science or devoted to scientific study or investigation; a savant." This definition, it will be noted, says nothing about educational background. It is generally assumed, however, that an accredited scientist should have at least four years of college work in some field of science and that he practice his science to some extent. What kind of people, then, are those who come under this educational classification? What is typical of them, and how do they differ from the typical crank or layman?

Dr. Lafleur has said that there are all kinds of cranks, ranging from the very ignorant to the highly intelligent. What he did *not* say is that there are all kinds of scientists, from the very mediocre to the few top-flight men. If we were to single out the few scientists who have made great names for themselves by proposing and proving new theories, we would probably find that they are in no greater proportion to the whole body than the cranks who have made good in the same way. Probably not so numerous.

It is our observation that the great majority of people who deliberately decide to be scientists, and so educate themselves, are those who are psychologically unfitted to be real creative thinkers. They go into science because they are afraid to think for themselves. They lack self-confidence: they want to lean on the orthodox, the great authorities. The average scientist never dreams of questioning an authority. He takes for granted what

he reads in his textbooks and rarely looks up their source material. Dr. Lafleur points up these latter facts, to our great delight, when he says that most scientists form their opinions from secondary sources, and that they depend to a great extent upon the editors and publishers to weed out those articles and books that are not authoritative. And that teachers and instructors, in selecting a textbook, usually glance through the table of contents, read a section or two to see if it is readable and sound, but rely for the most part upon the reputation of the author or publisher. What now, doctor! Is this the new scientific approach? It may be typical of many so-called scientists, but certainly not of the crank, who is always doubting authorities.

Another characteristic of the average scientist is his fear of making a mistake, of being found in error. Seldom will he make a positive statement or offer an opinion, even in his own field, and almost never in some other field of science. That's not cricket! Since the building of a new theory may require knowledge in several different fields of science, this fashion of thinking within narrow limits becomes a brake on the possibility of scientists' producing many new theories. Basically, however, the average scientist fears to be different; he fears to be called a crackpot or a crank. He may claim that he cannot afford to jeopardize his job or his professional standing, but actually he knows that he hasn't got what it takes. The true crank, on the other hand, is so sure of himself that he will risk fortune and family, everything! The scientist usually takes this as a sign of selfishness or ignorance or both. He decides that the crank's new world-shaking theory is the result of ignorance and he recommends certain books. Sometimes this has the desired effect, but as often as not the crank has already read the books and is sure they are wrong. This stops the scientist! He is flabbergasted! The conceit of this fellow who puts himself above the world authorities! It is beyond his comprehension. Living by authority himself, he cannot understand one who does not, and often cuts the crank off without even reading his arguments, so offensive is this egoism to him.

The crank seldom realizes that he is making himself offensive in this manner. His conceit is natural to him. He grew up that way and has never felt inferior to other people. He has no fear of making mistakes; not because he doesn't realize the possibility but because it wouldn't occur to him to be ashamed of it if he did make a mistake. This is a major requirement for anyone who would propound a new theory or do creative work. Edison, as everyone knows, was the outstanding example of a crank who made thousands of mistakes and cared not a whit what anyone thought or said. He had many of the characteristics of the crank and few

This letter to the editor produced the greatest response from professors and educators of anything I have ever written, most of it in agreement.

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of the scientist, but perhaps the thing that set him apart and above the common crank was his wisdom in never writing letters to scientists, or going to scientists for approval of his ideas. This would have been a waste of time, and Edison was a doer. If a crank has any feeling of inferiority it is this one, that he must get the approbation of the scientist for his theory.

As a rule, cranks have little formal education, probably because of their natural ego, their certainty that they are destined to become second Edisons. Always in a hurry to succeed, they are impatient of any sort of laborious study of the commonplace. Hence, they seldom go to college and do the hard groundwork necessary to become a really great scientist.

Imagination is also a necessary ingredient in creative thinking. This is what the crank often has and the scientist often has not, so he resents the crank. Some scientists, of course, have plenty of imagination, but their training often makes them afraid to use it. They take nothing for granted. George F. Carter points this out in an article called "Man in America: A Criticism of Scientific Thought," in the same November issue of THE SCIENTIFIC MONTHLY. He says that it is the fashion among scientists to glorify a limited and unimaginative style of thinking. He illustrates his statement with a story about the layman and the scientist riding on a train. The layman gazed out the window and said, "Look at those newly shorn sheep!" The scientist, after some thought, said, "Well they *do* appear to be shorn on one side." This is typical of the average run-of-the-mill scientist. He considers himself a thinker or as belonging to a class of outstanding individuals who *are* thinkers. He has been trained to believe that conservatism and book knowledge are thinking and will somehow lead to the advancement of science without imagination. He will not allow himself to imagine what is on the other side of the sheep.

The average layman is apt to think of a scientist as the man who taught science in high school, or perhaps some college professor. He usually remembers this man as a mean or colorless individual (according to what grades he received) and almost never as a scientist who was investigating anything new or unusual. This lack of quality in our teachers is partly due to the low salaries paid but more to the fact that they are psychologically willing to accept low salaries. Most of them knew that they would never receive much when they went into the teaching profession. These are the people who spend their spare time playing bridge or reading mystery stories. They are not interested in science and probably never were. They have no desire to investigate anything, much less to criticize the contents of textbooks. Like the layman, they imagine that the scientists, somewhere, must have the right answers. The layman has been taught to venerate science, if not the teacher, and like the teacher he supposes that the books contain nothing but the truth and that the publishers somehow know enough to check up on the authors.

Lafleur argues that we cannot afford to discard accepted theory for new, when the great body of scientists

agrees with the old; that we cannot ignore this great weight of scientific opinion. We should like to inquire how, if they refuse to think for themselves, they can be said to have an opinion or how it can carry much weight?

The greater part of Lafleur's article is devoted to a discussion of Velikovsky's book *Worlds in Collision*. He uses it to illustrate how much time and trouble may be required of a scientist to refute a crank theory, and thus excuses all scientists for not answering crank letters. He claims that scientists are too busy to give the time and that the cranks could get the answers if they would only read the right books in the libraries. This is probably true as to the great majority of crank theories, but there are some which, in whole or in part, cannot be so easily turned aside. In our opinion, it is not fair nor scientific to cast aside all a crank's work because a part of it, or even most of it, is invalid. It is easy to point out the glaring examples of bad science and to ignore the questions for which science has no answer. This is the way in which Lafleur has criticized *Worlds in Collision*. He concentrates on Velikovsky's theories that the planets Venus and Mars slipped out of their orbits, made several passes at the earth, and returned to their orbits; how the earth stood still and then resumed its motion; etc. These things are easy to refute, and he did a good job of it. He made one mistake himself, however, although he hedged with the word "practically."

In applying "Test 2," Lafleur makes the following statement: "The collision theory is in fundamental contradiction with practically every tenet of mechanics, both classical and modern, to which Velikovsky adds occasional disagreements with other branches of physics." He makes this broad statement without saying what these tenets are and then goes on to belabor Velikovsky for using myths and legends to prove his near-collision theory. It must be remembered that Velikovsky did not postulate actual collision but only close approaches. Actual collision between the earth and smaller cosmic bodies is an absolute and undeniable fact, as certain and as susceptible of proof as any physical law of science. Small meteorites have been seen to strike the earth hundreds of times, and the great Siberian fall in 1908 shook the earth for several hundred miles around—but not many of our scientists. Now that larger and larger craters are coming to light, such as the Wolf Creek Crater in Australia and the Chub Crater in northern Quebec, scientists are not quite so sure that no object greater than a few hundred tons has ever struck the earth. There is no law of celestial mechanics (classical or modern) that can deny this fact, yet scientists (especially geologists) have refused to consider the possibility. When confronted with a whole book full of physical evidence (not just theory), they refuse to consider it or discuss it in any way. They refuse to examine the other side of the sheep.

When we go to the libraries to discover what the

books say (since the scientists are too busy to make reply), we find something like this: Since no major collisions have occurred on the earth within the past few thousand years of recorded history, it is concluded that nothing of the kind has ever happened. Also, they say, why should the scientist call upon cataclysmic forces to account for earth features if ordinary processes working over long periods of time will account for the phenomena?

In answer it may be said that the few thousand years of recorded history are only a grain of sand on the shore of time and not a fair or scientific sample of all time. The fact that no major collision has occurred on the earth within the past few thousand years does not prove that such cataclysms have never happened. The facts are that the evidence of collision is much greater and more positive than the evidence of uniformity. The ordinary processes of erosion working over long periods of time will not account for all the earth phenomena, many of which show every sign of sudden and violent catastrophe.

Here, then, is a new and revolutionary theory that will pass all Dr. Lafleur's tests except the seventh. In this test Dr. Lafleur asks: "Does the proposer show

a disposition to accept minority opinions, to quote individual opinion opposed to current views, and to overemphasize the admitted fallibility of science?" It appears to us that this test is unfair and can only be answered in the negative by the proposer of any new theory. Since the majority of scientists are almost certain to oppose any new and revolutionary theory, it follows that the proposer has nothing left to quote. He therefore would be forced to give nothing but his own opinions and make himself liable to criticism for egotism and lack of outside scientific support. This is quite a burden to place upon anyone advancing a new theory, for even the scientist would be required to appeal to individual views and minority opinions if he were to advance a new theory.

In the final analysis, it is very difficult for anyone to view objectively, whether he be crank or scientist, the facts and philosophies of this world. If we may end on a note of hope, then, it is this: that the scientists will look more objectively upon the cranks and their theories and that the cranks will not overemphasize the fallibilities of the scientists.

ALAN O. KELLY

Carlsbad, California

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Carlsbad, Calif.  
Dec. 8, 1966.

Mr. John Lear, Science Editor  
SATURDAY REVIEW  
380 Madison Ave.  
New York, N. Y. 10017.

Dear Mr. Lear: Thank you for your letter of Dec 5 and the opportunity to clear up some of your questions about my letter of Nov. 15/66.

You ask for more detail about the Bermuda Collision. This is an idea difficult to set forth in a few sentences but I shall try.

The Bermuda collision scar was pointed out in TARGET:EARTH as probably the most recent great collision point on the earth; the cataclysmic event that produced a world-wide oceanic flood, brought the Pleistocene epoch to a close and changed the axis of the earth some 25 to 30 degrees. It was our position at that time (1953) that the island of Bermuda was the central peak of a tremendous crater whose south and west walls were outlined by the highest and steepest submarine scarp in all the world and therefore the most recent. We still think it is the most recent major impact scar but not that Bermuda is a central peak. We had thought that this island which rises so abruptly off the deep Atlantic floor was of lava but later we learned that deep drilling has shown it to be limestone of great depth. This was enough to convince me that it was not a rebound peak but a further consideration of the facts shows that large impact craters like the maria on the moon do not produce central peaks, the heat generated is probably so great that the lava is too liquid to stand up but slumps, taking the curvature of the moon by gravitation. It is a strange fact that both Frank and I had failed to see that we had already stated in the previous chapter on the moon that large impact craters the size of this one could not have central peaks.

It is now my thesis that Bermuda and its nearby submerged peaks to the north are drift features; that the Kelvin Seamounts to the north of Bermuda drifted there on a sea of heavy molten magma from the Bahama rim which is also thick limestone.

I have just completed a long paper on this subject called CONTINENTAL DRIFT: IS IT A COMETARY IMPACT PHENOMENON?

This paper points up the fact that only gigantic meteoritic or cometary impact could generate the heat to melt the tens of thousands of cubic miles of lava that are seen on the moon and on Mars and most certainly on the earth. It requires super-fantastic amounts of heat applied quickly to produce a basin of lava as big as Mare Imbrium. The slow heating produced by the supposed radio-active elements that some geologists are now calling up to account for the drifting of continents is simply impossible. The formation of a pool of lava as large as the Pacific basin was not a slow process. Let the scientist produce lava in the laboratory by any process slower than heat radiation into air or water. There is no scientific merit in calling upon a process so slow that its movements cannot be measured, this is speculation without scientific support. As an example, a cutting torch must be held with the tip almost against the

metal and then the concentrated heat burns through the iron instantly, hold it six inches away and a whole tank of gas can be burned up without heating the metal more than redhot. In a million years a candle will produce a great deal of heat but it won't melt rock; nor will radio-active heat generated over many millions of years melt its way to the surface and produce vast ocean floors of molten rock.

Second Question in your letter:

I did not say the Dort's field work in Kansas supported my thesis but that it cast grave doubt on the accepted theory that there were five advances and as many retreats in the million years of Pleistocene time. His finding five tills and six soil surfaces in Kansas where only two of each were supposed to exist helps to prove the accepted theory wrong. Here again, the earth scientist is calling upon the doctrine of infinite time to work a miracle, the miracle of thick ice moving so slowly across the older beds of till and soil surface that it did not disturb them. Scientific speculation when advanced by a great authority and hallowed by time, becomes dogma. We take it for granted and fail to see its side effects and implications. And when I say we I mean "me too". Dort has discovered that the authorities were wrong about the number of beds in Kansas but he has not seen that the whole theory of advances and retreats was un-natural. That it would make no difference whether the ice moved across the previously deposited till or if it formed from compacted snow and melted in place for in the second case, the meltwater would erode and cut the older tills and soil surfaces to ribbons.

The only way that I can see to account for these five tills and five soil surfaces is as follows: The collision flood waters moved into the Mississippi Valley at great speed, cutting away all unconsolidated material down to bed rock, striating the bed rock with the heavy material carried. As the flood waters returned off the land at a greatly reduced speed they began to deposit the beds of unsorted till that the geologist calls glacial till because it is unsorted. There were at least five returning tidal flows, each a little less violent than the last and each of these deposited a bed of gravel and a soil surface composed of dark organic mud and plant debris as the water came to a stop and began to ebb slowly. This process can be seen anywhere storm waters recede in a flat area. The bodies of drowned animals would bloat and float high in the water so that they would be stranded too. The topography of the land and the consequent concentration of water through the low spots would produce a great variance in the thickness of the gravel deposits and the number of beds found from one place to another in the same general locality. Such variation of deposits is commonly found in any river system following flood conditions.

Another possibility, which to my knowledge the glaciologists have not suggested, would be to suppose that the previous layers of till and soil were frozen at the time the following glacier slid across them and therefore they were left undisturbed. This, of course is un-natural too. Continental ice does not

ordinarily move except under melting conditions, at least this is so in flat country such as Kansas and the upper Mississippi Valley. Glacial ice can accumulate in place as snow falls and consolidates over a long period of time. This lasts until the ice becomes so thick that it produces a down-grade along the edges and the ice begins to flow under pressure. This happens in Greenland and in Antarctica as most students of the subject know, but this would not save any beds of till that might have been laid down previously. Whenever world climate changed sufficiently for continental ice to retreat for hundreds of miles as the glaciologists believe it did in North America, meltwater would have been produced in tremendous quantities and even if the ice became stagnant and melted in place the meltwater would have reduced the older beds of till in a most drastic fashion.

( This variation in local topography had the same effect upon the oceanic flood processes that I have proposed. That is why we find five layers in one place, two or three in another and none at all in a third, all within a mile or two of each other. )

Third Question: How can we expect much from carbon 14 dating?

My answer is that we cannot mix C14 dating methods with the science of stratigraphy without taking into consideration the possibility that the carbonaceous and other materials have been reworked; that they naturally float higher in moving water and so are carried farther. That streams continually wander back and forth across a river valley but over long stretches of time. Three thousand years ago and more, the Nile ran along the west side of the valley next to the pyramids and the workman unloaded their stones off barges pulled up to the bank. Now the river channel is several miles away on the other side of the valley. In another three or four thousand years it may be back to the west side and undercutting banks containing charcoal or human bones six thousand years old, and re-depositing it along side fresh material.

I recall that Dr. Carlton Coon an anthropologist, while investigating the contents of a cave along the Caspian Sea for prehistoric artifacts, found the charcoal in up-side-down order. Some of the oldest was near the surface and some of the youngest near the bottom of the fill which was over 20 feet deep. It can be understood that if an oceanic flood occurred of great violence it could easily boil in and out of such a cave and mix the contents so that only the upper layers laid down subsequently would be in historic sequence.

As another example of the dangers of mixing C14 dating with stratigraphy, some students of Pleistocene and Recent, have maintained that the mammoth and possibly the woolly rhinoceros survived up until about five to six thousand years ago. They are very vague about their reasons for believing this but it may be that they are depending on C14 dates for charcoal found near the bones. They even maintain that prehistoric man killed off the mammoth and other extinct animals because charcoal has been found with the bones, a sign that they roasted the animal where

they killed it. This could be so; but I would want to know if these particular mammoth bones were found in a river bank and just where the charcoal was found in relation to the bones and in what quantity. Charcoal is seldom found in any quantity around human habitations for two reasons. First, wood usually burns to ashes unless quenched by water. Second, the primitive firekeeper burned every scrap of charcoal to ashes because it was the best fuel he had and because such fuel was precious. Even our early pioneers were careful not to waste charcoal and many families sifted the ashes to save the charcoal./ Of course, early man might have been wasteful of charcoal while attending some "mammoth cookout" during rainy weather.

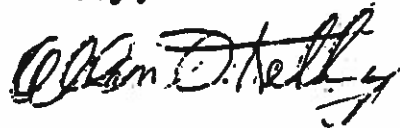
This is certainly a long and rambling letter and I am not sure how you are to correlate it with the previous one but I hope it makes some sense.

In looking thru my list, I see that I sent you a copy of METEORITIC COLLISION, A DYNAMIC FORCE IN EARTH HISTORY in 1963. This contained two papers having to do with the same subjects as above but in much greater detail. You might refer to it or I can send you another if you have lost it among the great volume of such stuff as you must receive.

I am about ready to look for a publisher for my new book on Continental Drift, mentioned above, but I am afraid I will have to go to private publication sooner or later. It takes a Big Name or connection with a Big Institution to get to first base with any new idea. Nobody pays any attention to the logic or the sound scientific basis behind the work of a lonee. Besides, it is too short for a book and too long for a magazine article.

If there is anything further that I can do please feel free to call upon me for this is what I like to do best and since retired, have plenty of time.

Sincerely,



Allan O. Kelly

Post Office Box 1065  
Carlsbad, California 92008  
Phone: 438-0668

Sept. 4, 1982.

Meteorite Recovery El Paso  
Donald Rathbun M.D.  
El Paso, Texas

Dear Dr. Rathbun:

Thank you for your kind letter and the clipping out of ASTRO NEWS....their writeup of Aherns and O'Keefe's paper given at Houston last March. I hope the reporting is not correct because I doubt that O'Keefe would write such stuff but in any event, they are 29 years late because the demise of the dinosaurs by impact oceanic flood was proposed in TARGET:EARTH in 1953. (See pages 219, 220-221)

I have listened to Aherns at Society meetings but never met him personally, however, I have met O'Keefe there and carried on letter exchanges with him on Mars and the Moon on various occasions. He is well acquainted with T:E and my more recent work and he should have been willing to give credit where credit is due.

If you will turn to the above pages in T:E you will find that the great French catastrophist and geologist, Baron Georges Cuvier, had seen the physical evidence of oceanic flood in the gravel deposits and the extinction of animals and described what he saw but did not have an explanation, a source of power for such a cataclysmic event. He had no knowledge of gigantic asteroidal impact or he would have certainly seen the connection. All I did was to recognize that source of power and put it together in a manuscript. Then Dacheille came into the picture and added his knowledge of chemistry and math.

One of the greatest faults in the teaching of geology, it seems to me, is the general lack of field study. The colleges turn out academics who have little or no ability to read the records in the rocks. They are obsessed with learning the jargon and the names of everything. They are sent out into the field to map a small area and name each formation as they have learned it in the class room. They go right by mountains of boulder gravel in impossible places and call it Pleistocene gravel, never seeing the anomalies.

Did the science reporter really get it right when he quoted them as proposing a 7 mile diameter asteroid at 25 mps, striking in a 4 mile depth of ocean, "making a cavity containing superheated water (steam?) and vaporizing the rock in a basin 25 miles wide and 20 miles deep, making a 30 mile steam bubble extending 25 miles up into the atmosphere." Did they really say this? That such an impact would make an ocean wave 3 miles high over-running the land....all this without producing any huge deposits of gravel. A little later, where you marked the margin, they are "troubled by the lack of evidence.

The lack of evidence of such flood gravels I can understand because they are not mentioned in the text books and its evident that these two eminent scientists are depending for their information on the geology text books and the text book authors of today, got their information from the text books of yester-year and those, to others before them and so altogether....few of them have remembered to read Cuvier, Sedgwick, William Smith or Murchinson.

Catastrophism went out of style in the early 1800's because it supported the Bible Deluge and they can't serve two masters.

I am returning a copy of the clippings you sent to me with some notations of my own and in reading it again you will see how often they make assumptions....assumptions that other scientists are right, in some speculation, and assumptions in programing their computer models.

I am just a layman. I make no assumptions. I just go out into the fields, the rivers and the mountains and take pictures of the vast deposits of boulder gravel and on down the scale to huge sand hills and sand dunes of the deserts of the world and ask myself... what else but oceanic flood could ever have produced these vast deposits of recent origin and.....what else but cosmic collision could ever have produced such oceanic floods.

I look for the evidence first and the assumptions come later.

Very truly,



P.S. About the Delgrango meteorite: I do not collect meteorites. All I have is a few small pieces the size of a penny that I picked up around the Arizona Crater, some tektites and the one from the Delgrango Crater. It is only the size of a half walnut shell, an iron and I had one side polished to show as a specimen, so I do not wish to trade it or sell it.

# The Changing Level of the Sea

*Glacial cycles and the slow sinking of the ocean floor have caused sea level to fluctuate from epoch to epoch. The last great upsurge apparently culminated in the deluge described in the Old Testament*

by Rhodes W. Fairbridge

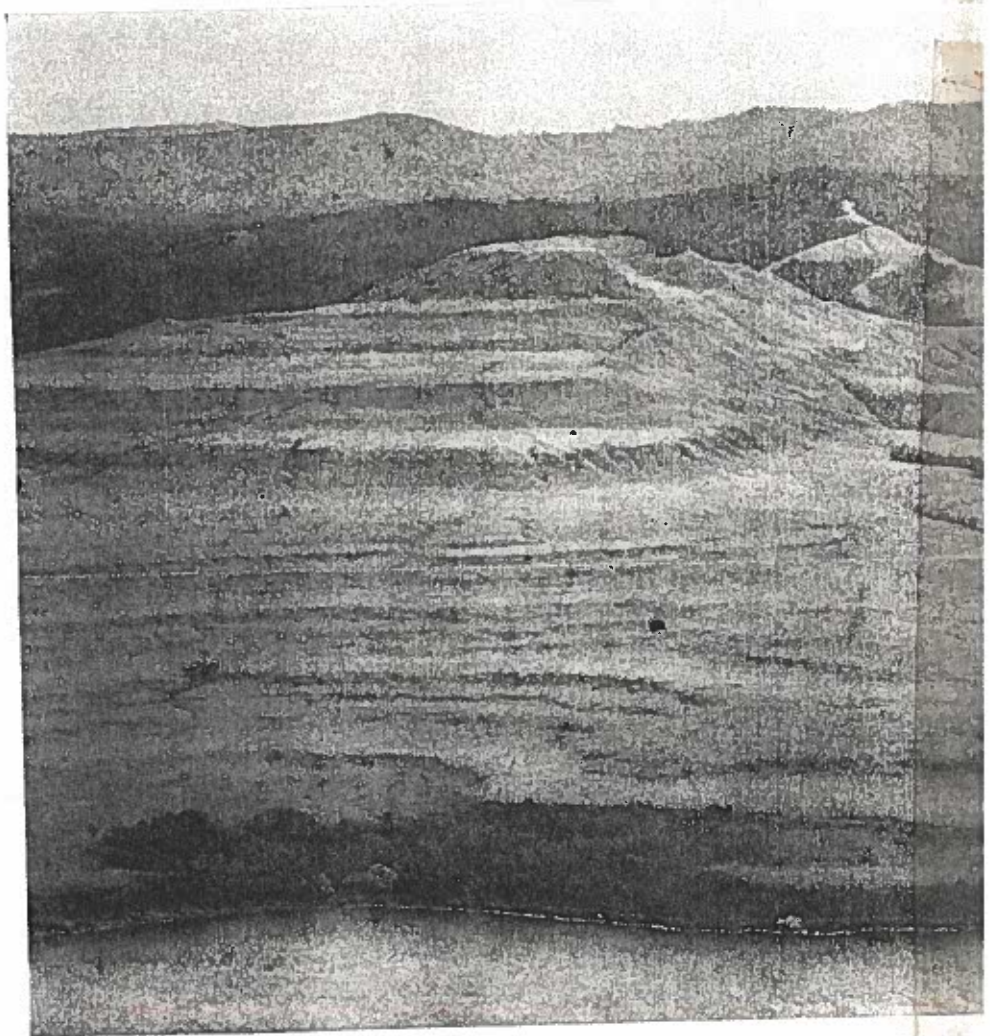
A deluge such as that described in the Book of Genesis occurs in the legends and folklore of almost every ancient people. The Greeks told how Deucalion, son of Prometheus, was forewarned by his father and thus survived the flood wrought by Zeus to destroy mankind. Babylonian scripture related how the city was founded on the site where the god Ea conquered the floodwaters gushing from the mouth of the nether world, which he sealed with a giant stone. The magnificent bas-reliefs of the Cambodian temple of Angkor Vat illustrate the Hindu legend that relates how Manu, one of the 14 progenitors of mankind, was saved from the deluge by a fish whose life he had spared.

Such agreement among the legends of so many peoples living in distant parts of the world has caused scholars in modern times to wonder whether mankind did in truth experience the world-wide catastrophe of a deluge. The evidence of legends cannot be accepted as proof of geological events. But it can be argued in reverse that geology might produce evidence of events that could have inspired the legends. The seacoast was the home of many primitive peoples and the site of many early centers of civilization. A major and relatively quick rise in the sea level—say a few feet in a decade—could have had profound effects upon the way of life and the imagination of those who experienced it. If the sea level had continued to rise generation after generation, even with intervals of retreat, floods would surely have become incorporated in legends the world over. A major swing in climate, bringing increased rainfall and the thawing of mountain snows, could have caused calamitous river floods throughout an entire climatic zone of the earth and could have made a similar imprint upon hu-

man memory. If the two kinds of flood had occurred together, they could easily have been recorded as a deluge.

A century ago it would have been difficult to persuade geologists to entertain such a possibility. In their effort to establish natural causes for the grand-

scale workings of nature they spurned the Scriptural concept of catastrophe. Under the leadership of the Scottish pioneers James Hutton and Charles Lyell they advanced the principle of uniformity, which held that the events of the past could be explained in the light of



COASTAL TERRACES reflect the sea levels of the past. This terrace, on the coast of New Guinea near Finschhafen, was formed partly by the higher sea-levels of warm interglacial

processes at work in the present. This point of view especially cherished the constancy of the sea level. After all, the sea covers from 70 to 75 per cent of the earth's surface. The level of the sea represents the simplest basic shape of the earth. That shape is close to a spheroid, but exhibits slight departures, and is known to the geodesists as the geoid.

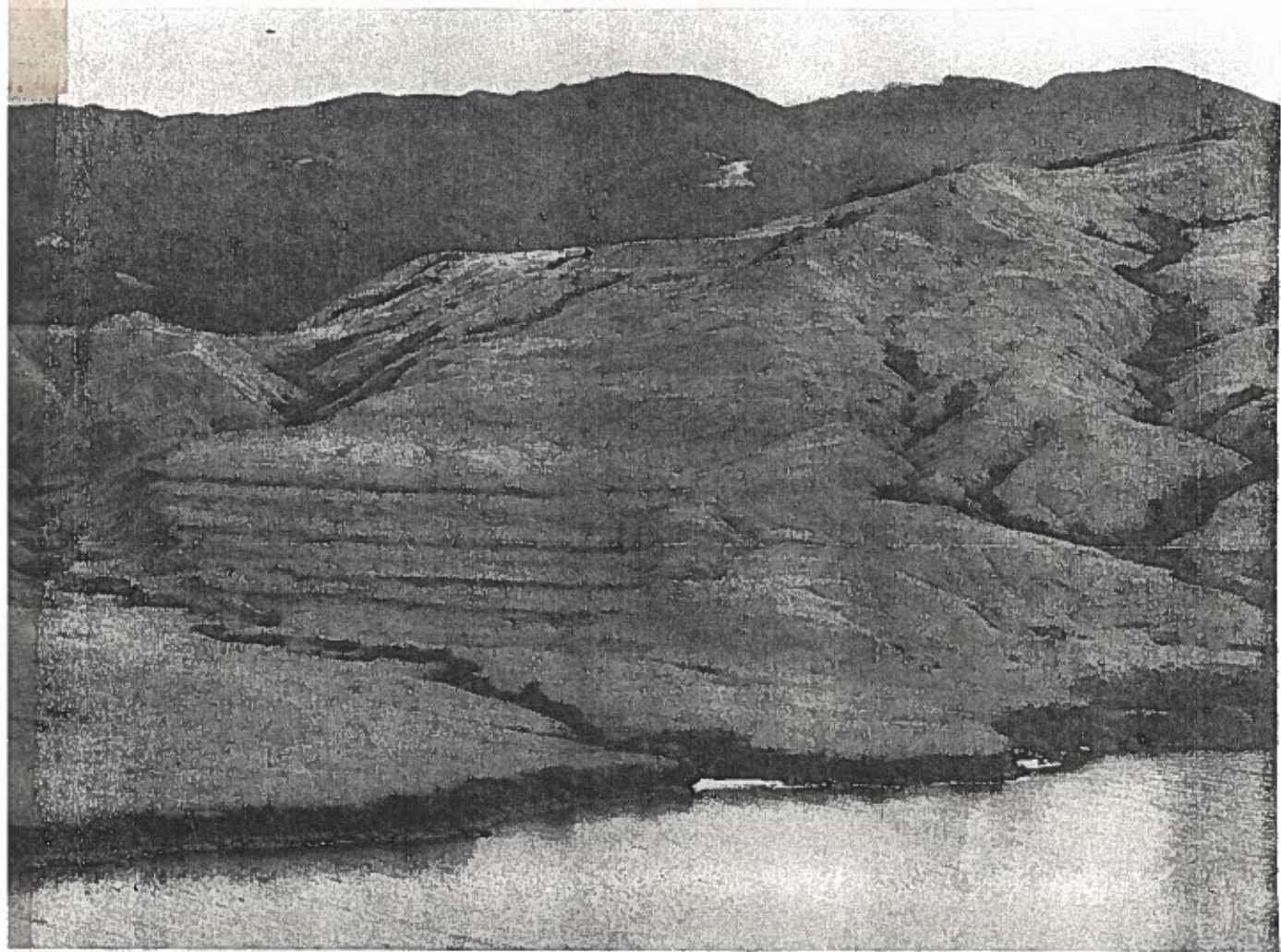
Yet the founders of modern geology were also the observant fieldworkers who first recognized the traces of the ice age. Soon geologists found evidence for several ice ages in the lengthening span of geologic time. By the turn of the century they were finding ice ages at every stage of the geologic history, in keeping with the philosophy of uniformity. Careful re-examination of the evidence in recent years, however, has rejected many of these ice ages; formations once identified as glacial moraines have been reinterpreted as beds laid down by mudflows, submarine landslides and turbidity currents: avalanches of turbid water that carry silt, sand and gravel out over

the deep-ocean floor. But from all the data four great ice ages remain: the Late Pre-Cambrian (600 to 700 million years ago); the Siluro-Devonian of South America (350 to 450 million years ago); the Late Paleozoic of the Southern Hemisphere (200 to 300 million years ago); and the Quaternary (from 500,000 years ago to the present).

During these periods an immense portion of the earth's total supply of water was locked up in ice sheets on the continents. That they held enough of the total to substantially affect the sea level may be judged by the volume of the world's present glaciers. The icecaps of Greenland and Antarctica, the remnants of the waning Quaternary ice age, would raise the sea level by some 300 feet if they were to undergo a sudden thaw.

It remains to be shown, however, that the melting of glaciers could alone cause major changes in the sea level. From other information about the earth and its structure it is clear that the transfer of

such an immense burden from the continents to the sea must set further changes in motion. Over the span of geologic time the earth's outer crust may be regarded as a tough skin enclosing a more plastic interior mantle and core. The melting of a continental ice sheet 9,000 to 10,000 feet thick—the thickness of the antarctic icecap—would cause the continent to rise, as Scandinavia and certain parts of North America are rising even today. This rise is compensated by the sinking of parts of the ocean floor. Certain regions of the sea bottom are sinking now. Although the details of this isostatic mechanism are not fully understood, the continents may be pictured as blocks of lighter material floating in a viscous substratum. The shift of the burden of ice from the continents to the sea would be compensated by a slow lateral movement of the rock under the roots of the continents, buoying the continental blocks upward. Thus the sea level does not depend solely upon the amount of water in the sea; it also depends upon



periods and partly by the interrupted uplift of the land, which lies in one of the earth's most unstable volcanic belts. The old-

est terraces are the highest; each contains fossil plants and shells that indicate the date and temperature of the ancient shore.

These terraces are 11,000 — years old, not millions of years