Clifford L. Burdick (1894-1992) had a long career as a mining and creationist geologist. Burdick was one of the first modern-day flood geologists since his mentor George McCready Price and Seventh Day Adventist (SDA) creationism influenced his thinking during the 1920s. Burdick's findings have at times caused both amazement and controversy. In 1945 he published one of the first convincing scientific critiques of radiometric dating, "The Radioactive Time Theory and Recent Trends in Methods of Reckoning Geologic Time." In 1946 Burdick published an extensive field report on alleged fossilized human footprints accompanied by casts and photographs at the Paluxy River, Texas. In the late 1960s, he made an extremely important discovery while conducting post-graduate research for a Ph.D. in Geology when he was the first researcher to find "young" fossil pollen in "old" rocks in the Grand Canyon and subsequently published a creationist guidebook called Canyon of Canyons. Burdick was close friends with one of the first people interested in finding Noah's Ark, Captain Benjamin Franklin Allen, who was also SDA and was attracted to sensationalist research. Because of his scientific background and studies, Clifford Burdick was a principal member of the earliest creationist research organizations including the Deluge Geology Society, Footprint Research Committee, Amazing Discoveries, Sacred History Research Expedition (SHRE), Creation Research Society (CRS), and the Noah's Ark-focused Archaeological Research Foundation (ARF).

Chapter 7

1945-1974 Clifford Burdick

Clifford Burdick's life is so fascinating and controversial that a few more thoughts should be shared before diving into his geological assessment of Mount Ararat. Burdick's 1945 paper critiquing radiometric dating had a large impact on *The Genesis Flood* author and Institute of Creation Research (ICR) founder Henry Morris, Ph.D., which convinced Morris that he "no longer had to dabble with the gap theory or some other means of allowing a great age for the earth." Ronald Numbers states this in his book *The Creationists:*

> According to Burdick, radioisotope dating suffered from the same glaring weakness that undermined calculations based on sedimentation: the assumption of uniformity. As corroborating testimony he cited the prewar warning of Watson Davis (1896-1967) in the "Science News Letter" that "the radioactive 'time clock' method of determining the age of the earth may be proved wrong if uranium can be split up in the strange new manner" conceived by physicists—an eventuality subsequently demonstrated in dramatic fashion by the detonation of the first atomic bombs.

Clifford Burdick primarily studied geology, mineralogy, and geochemistry at Milton College, the University of Wisconsin, and finished his Ph.D. dissertation at the University of Arizona, which involved a geologic description of a mountain chain in Arizona. Burdick's Ph.D. dissertation had taken several years to conduct. Burdick only failed his oral exams when he was very sick and the Geology Dept. review committee refused to allow it to be rescheduled or a second chance. Otherwise, he would have received a Ph.D. in Geology from the University of Arizona. The reality is that one of the University of Arizona oral committee professors had branded him a creationist and demanded that he be refused a degree. Years later, another one of the professors on his Ph.D. committee admitted that Burdick got a raw deal and confessed that at the time he did not have the courage to defend him when the committee found out Burdick was a creationist. *The Creationists* describes some of the dilemmas with Burdick's accreditation:

> No one epitomized Larry G. Butler's concerns about creation science more than Clifford L. Burdick, the most energetic researcher in the Creation Research Society (CRS) and the most frequent recipient of its funding. And not surprisingly, no one took greater offense at Butler's critique of creationist research. "Larry, I don't feel that we voluntarily seek sensationalism," protested the aging geologist, whose fame rested in large part on his extravagant claims about human and dinosaur tracks found in the same ancient rocks. "If this seems sensational, I feel its only because it's the kind

of evidence that God in his providence has dumped in our laps." Sensationalist or not, Burdick , according to Henry Morris, for a decade did "more research for the Society, at greater personal sacrifice, than anyone else, all of it in areas of critical importance."

By 1960 he had completed enough advanced work to sit for the comprehensive examinations required for a Ph.D. in geology at the University of Arizona. Three days before the scheduled orals a professor on his examining committee discovered an article on flood geology that Burdick had written for an Adventist magazine, "Signs of the Times," and reportedly announced that he could never vote to award a doctorated to the author of such a scientifically heretical work. The news of this discovery panicked Burdick. For years he had carefully concealed his creationist leanings—and his earlier failure at the University of Wisconsin—and he reckoned the odds at a thousand to one that his professors might discover his true thoughts. "I might go thru a dozen more institutions without they [sic] ever getting next to my inner feelings," he later said wistfully.

"I saw the handwriting on the wall; I knew my goose was cooked," he wrote of the traumatic ordeal. "The emotional shock [Burdick was age 66] induced a severe case of acute indigestion, and I was unable to eat hardly anything for the three days prior to the test. The graduate school granted me a postponement until I got back on my feet, but the geology dept. would not O.K. it, even though I was sick. I think they really wanted to take advantage of that opportunity to 'scrub' me. I sensed the air of hostility the moment I entered the examination room. I should have stayed in bed. I 'browned out' several times during the exam, and could not answer even the most simple questions, that I knew as well as my own name. Even at that I was told I passed as far as knowledge of geology went, but I just ran out of gas and could not answer the reasoning questions, and being sick did not make too good an impression."

The committee, no doubt grateful that Burdick's poor performance spared them the embarrassment of passing a student who repudiated the very foundations of historical geology, refused to grant him a second chance, despite repeated appeals and a lawsuit claiming religious discrimination. Burdick's case soon became a case celebre among creationists, incontrovertible proof of the academic prejudice awaiting anyone who dared challenge the dogma of evolution. "Although he had completed his doctoral thesis and his oral examination, he was denied his doctorate," went the much-told story. "Because he was a creationist he was denied his degree and he was no longer welcome at the university."

Geologic Description of Mount Ararat by Clifford L. Burdick

This article presents a geologic survey of the observations made during the 1966 expedition to Mt Ararat sponsored by the Archaeological Research Foundation (ARF) of New York. Eastern Turkey consists of a relatively barren undeveloped area. Tectonically it is very active, and unstable structurally. The region has been folded, faulted, and intruded with basic types of volcanic rock, such as andesite and basalt. Mt. Ararat is 17,000 feet high, and at its greatest height perhaps measured nearer 20,000 feet. Evidently the cover rocks were Paleozoic and Mesozoic limestone, and in places like Mt. Ararat were domed up by rising magma which burst through channels along fault lines.

During the Flood period at least three blankets of basaltic or andesitic lava were extruded over the original Ararat which may have only been about 10,000 to 12,000 feet high originally. Much of the lava is in rounded blocks called pillow lava, having a conchoidal appearance indicating it flowed out from the fractures while under water. After subsidence of the floodwaters, almost the whole northeast side of the mountain blew up forming the Ahora Gulch. Rock fragments and ash from this eruption cover about 100 square miles. Greater Ararat is covered with an ice cap down to the 14,000-foot level. This cap is hundreds of feet thick and divides into 12 "fingers" or glaciers. An analysis of five rock samples is given and also a list of fossils found by Abich.

Mount Ararat is one of the best-known mountains historically, but also one of the least known geologically. For some reason some scientists have shied away from that area, perhaps because of its very Biblical connection. Two German geologists have made geological observations of the Ararat area: Hermann Abich[1], about 1845: and M. Blumenthal[2] some 110 years later. Abich, it appears, was not afraid to mention the Flood and the Ark of Noah in connection with Ararat, but not so with Blumenthal. Geological evidence concerning Mount Ararat is unavailable to American science while geological data for most other parts of the world is quite abundant.

In 1946, an archeological company was organized in California, the Sacred History Research Expedition, with the objective of helping to fill this empty void scientifically by means of archeological, geological, glaciological, and other projects planned. Dr. Kinnaman, the famous American archeologist, was to be a member of the expedition. Col. Koor, the Russian soldier-archeologist, was to lead us to some 20 archeological sites in need of investigation. But perhaps the time was not yet ripe. Twenty long years passed before this study of the Ararat area became reality. In 1966, ten scientists and mountain climbers actually arrived at camp on Mount Ararat to begin this important work.

George Vandeman was chairman of the board of the Archaeological Research Foundation of New York, and a prime mover in the organization. Ralph E. Crawford of Washington; Drs. Calvin and Agatha Thrash of Columbus, Georgia; Wilber Bishop [who was the creator of Little Debbies] of Cleveland, Tennessee, and Sam Martz of Nashville, were directors of the Foundation. Dr. Lawrence Hewitt of Huntsville, Alabama was leader of the expedition [other Archaeological Research Foundation members said that Hewitt as well as Harry “Bud” Crawford viewed themselves as CIA spies attempting to take photos of the Russian nuclear plant across the border], assisted by Harry Crawford of Denver, who had previously scaled the mountain to its peak. Nicholas van Arkel of Holland was in charge of the glaciological work, mapping the ice cap—some 17 square miles in extent. Two Swiss mountaineers ably assisted van Arkel [Alex Staub and Theo Koehler]. Alva Appel of Washington, D.C. and William Dougall of Seattle assisted Mr. Crawford in mountain climbing and recording general observations of interest, (even hoping that one such observation might happen to be some remains of Noah’s Ark, as per rumors that natives from time to time had stumbled on portions of the original wood).

Dr. Hewitt, besides giving leadership to the expedition, made a botanical study of the mountain and gathered and pressed some 150 plants and flower specimens. [Two other individuals in the 1966 expedition stated that this alleged “botanical study” was simply a last-minute attempt to make the four weeks on the mountain look scientific.] Mr. Eryl Cummings of Farmington, New Mexico, assisted me in making geological observations and in gathering rock samples.

Although the Archaeological Research Foundation was the organizational unit, it operated largely on contracts with the United States armed forces, and with the Turkish government. The Turkish military command furnished transportation, as well as an interpreter and a soldier guard. The U. S. military command furnished tents, bedding, supplies and great quantities of food (C Rations). Since the expedition operated largely in a sensitive military zone, some of the scientific data gathered were of a classified nature.

Eastern Turkey is a relatively undeveloped and semi-desert area, lying across a recognized earthquake zone, composed largely of volcanic rock. The people native to that area have to work hard to make a living, and the Turkish government welcomed this scientific expedition gathering data on biology geology, glaciology, soil chemistry and related aspects of the region. Much of our work during the summer of 1966 revolved about the Mount Ararat region, which created general interest because of its historical connection with the Ark of Noah. The Armenians, who have inhabited that area for many centuries, call the mountain, Masis; the Turks call it "Agri Dagh," or painful mountain. The Persians call it Koh-i-Nuh, that is, the "Mountain of Noah."

GEOMORPHOLOGY

The central backbone of Turkey between Ankara and Erzurum is composed of a treeless, barren series of mountain chains of folded and uplifted Paleozoic and Mesozoic limestone. This is the central watershed and the source of the Tigris and Euphrates rivers. This limestone has been intruded in places by volcanic rocks, as at Kayseri (Caesarea), the locale

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[1] Abich. Herman, "Die Besteigung des Ararat im Jahre 1845," *Boitrage z. Kenntuis d. russischen Reiches*. St. Petersburg, 1849.
[2] Blumenthal. M. "Der Vulcan Ararat," Rev. Fac Sc Univ. Istanbul, Series B. Tome XXIII. No 3-4. 1958.
Parrot, F. Reise zum Ararat. Berlin, 1840.

of excavations for Hittite artifacts. The Hittite museum in Ankara is well worth visiting. South of Kayseri is a multi-peaked, snow-capped mountain of some 15,000 feet elevation, known as Erciyes.

From Erzurum, east to the Russian-Iranian border, the landscape consists mainly of volcanic rocks, except for occasional outcrops of limestone. Much of this volcanic rock is on the borderline between basalt and andesite, the samples collected from Persia being the most basic (mafic) as are also the Tendurek mountains southwest of Mount Ararat, and the Hama, Kale and Pamuk mountains to the west.

The swampy plain between Doğubayazit and Ararat is some 4,500 feet above sea level, but on the north and east sides of Ararat the Aras river valley is between 2,500 and 3,000 feet above sea level. Some 50 miles northwest of Mount Ararat along the Aras river is an extensive salt mine with a thickness of some 400 feet. Southeast of Little Ararat near the Iranian border is a deep round hole in the basaltic rock about 100 feet in diameter caused by a meteorite that struck the ground in 1910, drilling a clean round hole deep into the earth.

Greater Ararat is perpetually covered with an ice capping down to the 14,000-foot level in summer. This ice cap is hundreds of feet thick and as it flows down the sides of the mountain, it divides into twelve "fingers" or glaciers, three of which are the Parrot, Abich I and Abich II glaciers, the latter of which tumbles down a vertical precipice thousands of feet into the Ahora Gulch, with a mighty roar that can be heard for miles. Two of our mountain climbers [Alva Appel and Bill Dougall], who were camping in the Gulch, were nearly buried [15 feet away] when 100,000 tons or so of ice and snow came roaring down the Gulch.

The comparatively high snow line is due to the light precipitation and the upward rush of air from the Aras plain. This plain is the veritable breadbasket for both Turkey and Russia. Although the upper and lower zones on the mountain are sterile, the middle zone, from 5,000 to 11,500 feet, is covered with good pasture upon which the Kurdish sheep and goat herders depend.

Mount Ararat is about equidistant from the Black Sea and the Caspian, the Mediterranean and the Persian Gulf. Around Mount Ararat gather many traditions connected with the Deluge. Koor, the Russian soldier-archeologist, lists some 20 such archeological sites, which should be investigated. Both the ice cap and the resulting glaciers move over rough terrain, which breaks them into segments separated by crevasses. Often new falls of snow drift over these crevasses, thus hiding them from view. Climbers sometimes fall into them. In 1965, a 21-year-old Oxford student Christopher Trease tried to climb the mountain alone, and was never again heard from. It was presumed that he fell into a crevasse. In 1970, his Oxford friends searched diligently, but unsuccessfully for some sign of him. Around 1968, an Austrian doctor was separated from his party in a blinding snowstorm on Ararat and was never heard from again. Search parties were unable to find him. It has been thought that he too suffered the same fate. Our mountain climbers never climbed the mountain in less than groups of three tied together with nylon ropes. Even so, two of them actually fell into crevasses, but were pulled free by their companions.

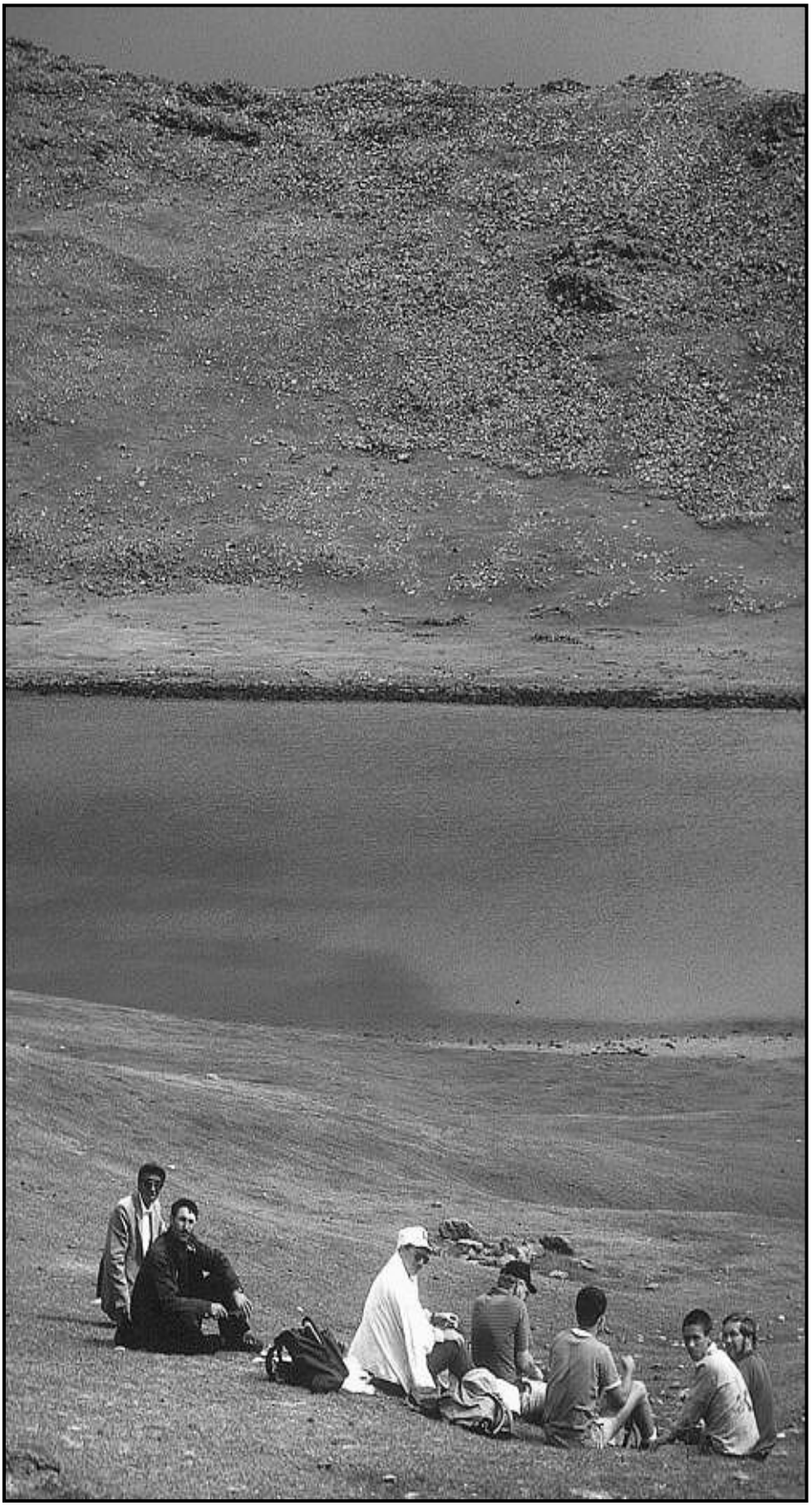
The dangers are many. Storms of wind of 100 miles an hour and temperatures of below zero made life disagreeable for our glaciologists. Also, our geologists were caught out on the mountain in a thunder-storm in pelting sleet and rain, and the ensuing fog made it difficult for them to find their way back to camp late at night, soaking wet, cold and exhausted. Without a good sense of direction and a flashlight, they might have been "victims" of Ararat.

Traditional places include the Garden of Eden in the valley of the Aras river; Marand is the burial place of Noah's wife; at Ahora (Arghuri) was the spot where Noah planted his first vineyard. Incidentally, we noticed this summer that a vineyard is still located there. The monastery of St. Jacob was also situated here until both it and the village of Ahora were destroyed in 1840 by an earthquake and resulting avalanche, which came thundering down Ahora Gulch [water, morainal material, ice, and mudflows wiped out the town of Ahora or Arghuri]. James Bryce, the British statesman, author, and later ambassador to Washington once climbed Mount Ararat and he wrote of his experiences in a book, *Transcaucasia and Ararat*.

> I know of nothing so sublime as the general aspect of this huge yet graceful mass seen from the surrounding plains: no view which fills the beholder with a profounder sense of grandeur and space than that which is unfolded, when, on climbing its lofty side he sees the far-reaching slopes beneath, and the boundless waste of mountains beyond, spread out under his eye. Its very simplicity of both form and color increases its majesty. All lines lead straight up to the towering, snowy summit. There can be but few places in the world where so lofty a peak soars so suddenly from a plain so low, and consequently few views equally grand. The mountain raises itself solitary and solemn out of a wide sea-like plain.

STRUCTURE

The structural trends of eastern Turkey are in a northwest, southeast direction, such as the Aras river flowage, and the "lining-up" of the triple volcanic peaks, Alagoz, on the Russian side of the Aras river, and Greater Ararat and Lesser Ararat, in Turkey. These triple peaks are in a line, because that is the direction of strike of the elongated fault in the basement complex up through which the molten magma flowed.



Tendurek mountain crater lake
Courtesy of Doris Bowers 1986

If the fractures are shallow, as in the August 19, 1966 quake, no lava is emitted, but when the fault extends many miles deep, it taps the area where the temperature exceeds the melting point of basalt, about 1,200 degrees Centigrade. The fault or fracture relieves the surface pressure, and the hydrostatic pressure forces the liquid magma to the surface, much as oil is blown out when an oil gusher is drilled.

The Tendurek mountains to the west and southwest of Ararat are also volcanic extrusions along faults parallel to the Alagoz-Ararat fault and are part of the complex fault system which winds and twists in a generally north-south lineament through the Dead Sea in Palestine and across the Red Sea into eastern Africa, comprising what is known as the East African Rift. This fault or rift is signalized by volcanism and block-faulting, indicating tension faults.

The Dead Sea, about 1,300 feet below sea level and the deepest land depression on earth, is a graben, or fault-block, that has dropped down when the tension drew the crust apart. I followed the most recent fault for some 50 miles from Varto, the epicenter of the August 19 quake, to a point between Erzurum and Ararat. This most recent faulting, which caused the severe earthquake, which wrecked the city of Varto and caused some 2,000 deaths, was minor in displacement as compared with the scars left by the earlier faulting which took place presumably at or soon after the Flood Period. The recent rift caused a displacement of mere feet, while the "original" fracture zone was probably miles wide in places, and furnished a channel-way up through which flowed mountains of magma. This may have taken place at the time of the volcanism, which formed the Alagoz-Ararat mountain chain.

Apparently the Paleozoic-Mesozoic limestone complex, which covered parts of the region, was severely deformed, compressed, folded, and in places like the Ararat area domed up when the rising magma burst through. This doming effect is most evident when one views the same limestone formation on all sides of Mount Ararat. The beds dip away from the mountain on the

Turkish, the Russian, and the Persian (Iranian) sides.

There were several eras of volcanic events. Professor Nazmi Oruc of Atatürk University at Erzurum told me that his soil sample study from well drillings in the Aras valley showed at least three periods of volcanism, the layers of lava being interbedded with sediments.

West-southwest of Ararat and west of Diyadin occurs a thick bed of basalt overlaid with limestone, apparently conformable. A river flows through the limestone, and the latter has been folded into an anticline, which has fractured along the axis. This fracture has permitted ground water to penetrate down to the limestone-lava contact.

The lava was apparently not very cool when the limestone was laid down, for it heated the water to the boiling paint, and the steam pressure has forced steady geysers to shoot from the surface. This water flows down the sides of the geyserite or tufa and is caught in pools similar to the hot water pools in Yellowstone Park. Some of these pools are just the right temperature for bathing, and are usually put to such use. This hot springs tufa is varicolored like that in Yellowstone. Local Turkish authorities hope eventually to make a park or national monument of this hot springs-geyser area.

The orogeny of the hot springs bespeaks fast tectonic activity, cataclysmic action, and does not fit long-ages geology. Seemingly, basaltic extrusion was quickly followed by deposition of limestone before the hot lava cooled. If this limestone, designated Cretaceous, was laid down some hundred million years ago, surely the lava would have lost its heat long ago, for the limestone covering the basalt is not very thick. In fact one wonders how it could have retained its heat this long even if the rock was formed at the time of the Flood! The Genesis record tells us that, early in Creation week, the whole earth was covered with water similar to the flooding by the Deluge: the difference being that the whole earth was originally almost a perfect globe, without mountains and ocean basins. There was less water then to cover the earth than now. Then, the record tells us, the Creator formed the ocean basins, and dry land by diastrophism or uplift. The water ran off the land into the basins; as most geologists agree that the ocean basins existed from earliest times. We are not informed how high the continental cratons or mountains were, but presumably not as high as now. Genesis mentions rivers; among them is the Euphrates, which rises not too far from Mount Ararat. A river drainage system needs high land for its source.

Evidence gathered at Mount Ararat indicates that the original mountain was much lower than the present one and was of different composition or at least of different texture and different color. The metrological differences will be discussed later, but the original Mount Ararat apparently was not more than from 10,000 to 12,000 feet in height. The present peak is about 17,000 feet, and at its greatest height perhaps measured nearer 20,000 feet. Erosion has worn it down.

During the Flood period—in the broad sense—at least three blankets of basaltic or andesitic lava were extruded over the first Ararat. Volcanic eruptions have taken place periodically ever since, but with subsiding activity. More recent flows have been extruded from cracks lower down on the mountain as each succeeding extrusion had less force than the preceding one.

Ararat is known as a *shield* type of volcano. This section would not be complete without mentioning what was perhaps the most violent eruption associated with Ararat. This did not occur in 1840 as some have surmised; it was infinitely more terrific. Very likely some time after the floodwaters had subsided, almost the whole northeast side of the mountain blew up. A long deep gash was opened in the mountain, known now as the Ahora Gulch. This is many miles long and thousands of feet deep and wide, and a conservative estimate would be that from one to two cubic miles of rock debris and volcanic ash was blown from the mountain.

Large surface fragments were hurled miles away down toward the lower slopes of the northeast side, where they are yet visible. Lighter volcanic ash was blown into the upper atmosphere and settled down as light-colored whitish tuff on the east and northeast sides of the mountain. This ash covered some 100 square miles of surface to a thickness of from hundreds of feet near the mountain to a few feet, ten miles away. Thus, a sloping pediment of some 3-5 degrees was formed, which is similar to those seen in the desert Southwest in Arizona. As a result, varied rock specimens of the whole Ararat area are found in the Ahora Gulch.

This is the type of volcanic eruption that buried Pompei and Herculaneum. Presumably Noah and his family had left the area by that time. The original Ararat had been deeply blanketed before that, and the only part of the original Ararat now exposed is that at the head of the Ahora Gulch where the giant explosion opened it up.

Little Ararat and other parasite cones are of more recent origin for Little Ararat is smoother and less gullied and eroded than Greater Ararat. The only forests in the whole area are located on the eastern [and northern] slopes of Little Ararat.

STRATIGRAPHY

Abich and others in the past have done stratigraphic studies in the limestone formations of eastern Turkey. They identified index fossils and others belonging to late Paleozoic, mainly Permian; also Triassic, Jurassic and Cretaceous of the Mesozoic, besides some of the early Tertiary. The following are Abich's classifications, taken from the Doğubayazit-Igdir area:

Devonian, gray limestone:	*Atrypa reticularis* Atrypa aspera Spiriferseminai
Mississippian, dense limestone:	*Productus auritus* Dalamella michellini
Pennsylvanian, dark limestone:	*Fusulina verneuili* Productus intermedius Fusulinella lenicularis

Collection of fossils found by explorers 1984
Courtesy of Doris Bowers

Permian, limestone, shale:	Goniatities albichianus Reticularia Spirigera Zaphrentis lepticonica

Triassic, limestone, dolomite:	*Xenodiscus-Arten* Pseudomonotis-Arten Paratirolites-Arten Goniatites abichianus
Jurassic: (Ammonites)	*Soninia sowerbyi* Lytoceras mediternaeum Sphaeroceras bullatum
Cretaceous:	Mortoniceras texanum Parapachydiscus neubergeri Cyclasteraturicus
Eocene:	Discocyclina archiaeri Nummulites irregularis Asterodiscus
Oligocene:	Nummulites incrassatus
Plincene:	*Planorbis* Clupea lanceoplata Cardium protractum Tapes greganus Orbicella defancei

These fossils are all invertebrates.

PETROLOGY

As already mentioned, eastern Turkey lithologically consists mainly of two types of rock, Paleozoic and Mesozoic limestone intruded by volcanic rock, much of it being an andesitic-basaltic complex on the borderline between andesite and basalt. For that reason it is not practicable to map off certain parts of the mountain as basaltic and other parts as andesitic, since composition varies from place to place, not permitting a mapable unit.

The central highlands of Turkey consist in large part of a whitish limestone interspersed with volcanic rocks. The eastern part of the country is mainly volcanic, interspersed with limestone. Many of the faults cutting through the mountain of Ararat have been filled with a red intrusive rock that resembles a sandstone, but strangely enough is of essentially the same composition as the black and gray basalt and andesite, the difference being that the black magnetite has been oxidized to a red geothite. Following is a typical mineralogical composition:

Sample No. 1
augite 3% rimmed with geothite
hypersthene 5% rimed with geothite
andesine (55) 52%
glass 40% partly devitrified
magnetite trace

The augite is a triclinic pyroxene, while hypersthene is orthorhombic in crystal structure. These pyroxenes are more typical of basalt than andesite, but the plagioclase is andesine, from which the rock *andesite* gets its name. The high percentage of glass indicates that the rock was quickly "frozen" or cooled, so that solidification took place quickly, too fast for crystals to form.

Sample No. 2 was a gray-black rock taken from the 12,000-foot level to the north of the Ahora Gulch. The mineral composition is strangely like sample No. 1, although macroscopically it does not much resemble it.

Sample No. 2
augite 1%
hypersthene 10%
andesine (43) 87%
magnetite 1%
apatite trace
(Apatite is a phosphorus oxide)

As alluded to in the section on Structure, the Ahora Gulch exposes the inner core of the original mountain which is distinct in color and texture from the volcanic rock. It is coarse-grained porphyry with a light buff color and much pyrite. This indicates a deep-seated intrusive that cooled slowly, permitting the coarse phenocrysts to form first. Then the whole mass was uplifted through the cover-rock, allowing the remainder of the magma to cool more quickly and form fine-grained crystals and glass. This inner core may represent the original mountain dating from Creation.

Sample No. 3 was collected from several places in the Ahora Gulch.

Sample No. 3 Andesite porphyry
bastite 5% (replaces a pyroxene)
glass trace (inclusions in plagioclase)
hypersthene trace (poikolitic inclusions in plagioclase)
andesine 50 94%
sphene trace
leucoxene trace
apatite trace

Sample No. 4 is also a sample from the Ahora Gulch from the inner core of the mountain. Its mineralogy is similar.

Sample No. 4
augae 4%
hypersphene 10%
andesine (55) 30% (rims are andesine 50)
magnetite 2%
glass 53%
apatite trace

Sample No 5 is also from the same source as the two previous, but the rock is a basalt rather than an andesite, because the plagioclase is more basic-labradorite.

Sample No. 5 Basalt-porphyry
augite 1%
hypersthene 3%
labradorite 35%
glass 56%
hematite 5%

These samples are typical, and it would not be necessary to give details on more samples.

GENERALIZED STRATIGRAPHY FOR EASTERN ANATOLIA

Basement – The outcrops of the basement are similar and usually metamorphosed. Here are some of the outstanding plutons in this region: 1) Bitlis massif 2) Ozalp massif 3) Golesor massif 4) Diyadin massif 5) Movasor massif 6) Tirman massif. These are granitic or granitoid in mineral composition, and more or less metamorphosed. At least three metamorphic facies are evident: a) garnet-schist (katazone); b) amphibolite, biotite, muscovite, epidote-schist and gneiss, (mesozone); c) chlorite, actinolite, sericite, and epidote-schists (epizone).

The schists often interfinger with crystalline limestone. There are many varieties of gneiss, such as plagioclase-gneiss, amphibolite-biotite gneiss. Gradations appear between igneous and metamorphic rocks. There is nothing to

indicate the age of these plutonic and metamorphic rocks except that they appear to be the oldest rocks that outcrop. They may belong to the Precambrian or Paleozoic.

Many varieties of limestone exist, mostly altered to some extent. They may be laminated, cross-bedded, foliated, partially crystallized, fine or coarse-textured, cherty or marly. Often they contain hydrocarbons. No fossils have been found in the crystalline limestones, but the unmetamophosed limestone contain Fusulina in places.

Near Ozalp green mica-schists underlie white, grey and black thinly-foliated calc-schists. The gneiss exposed to the west of Diyadin contains bands rich in garnet, rutile, and zircon. Some of the metamorphic rocks measure up to 1000 meters in thickness.

Devonian – The reddish schist-sandstone series at the base of the Permian limestone, which occurs near the Permian border around Aybey Mountain, south of Little Ararat near the Persian border, passes down into limestone, in which have been found some brachiopods of possible Devonian age. Alternating layers of limestone and schist occur in the neighborhood of Dumbat (P. Bonnet).[3] Also Hermann Abich reported the occurrence of fossiliferous Devonian rocks north of Mt. Maku in Persia.[4]

Permo-Carboniferous – Many fossils of unquestioned Permo-Carboniferous age have been found in this region. The following invertebrates were found in two small hills at Ciftlik village in Baskey district, east of Igdir, occurring in black to red limestone and yellowish argillaceous schists: Caninia cylindrical SCOULER; Zaphrentis sp.; Syringopera sp.; Athyris sp.; and Fenestella sp.

H. Abich found specimens of Zaphrentis near there but on the Russian side of the border, near Khorvirat. At Mount Aybey again there are abundant Fusulinidae and some Gastropods (Bellerophon) on the altered faces of the gently folded dark-greyish-blue Permo-Carboniferous limestones. S. Erk[5] identified the following Permo-Carboniferous fauna: Schwagerina multiseptata (Schelwein); Schwagerina sp.; Schubertella sp.; Stafella sp.; Ammodiscus sp.; Cancellina primigena (Hayden); Reichelina minuta ERK; Ozavainella sp.; Pachyploia sp.; Cribrogenerina sp.; Lenticulina sp.; and Cymnocodium tenellum PIA. Fusulinidae are abundant in the limestones at Kalus, northwest of Doğubayazit, indicating a Permian age. The color is typically black.

Mesozoic – The Triassic, Jurassic, and Lower Cretaceous rocks have been missing in this area, the only Mesozoic rocks being those from the Upper Cretaceous. These rocks are often associated with Lower Tertiary rocks and also ophiolites as a complex, and extend over wide areas. J.H. Maxson[6] referred to this as the "Hakkari complex," and E. Altinli pointed out that this complex forms the most important upthrust of southeast Anatolia.[7]

This complex consists of pink limestones and conglomerates resembling the "wildflysch" of the Alps. The whole rests unconformably on Permian limestones. Red and grey limestones with serpentine form breccias. Radiolarian beds and siliceous chert occur in the vicinity of the extrusions. Some limestone masses have been hydrothermally metamorphosed and their colors changed to yellow and brown. The pink limestones are silicified and impregnated with iron oxides wherever they are in contact with large ophiolite bodies. The Upper Cretaceous occurring south of Guzeldere is multicolored with alternating beds of grey limestone and marl, with the following microfauna: Globigerina asper (EHRENBERG); Globigerina bulloides; Globigerina cretacea (d'ORBIGNY); Globigerina (BRADY); Globorotalia of. Crassata (CUSHMAN); Globortruncana rugosa MARIE; Pseudotextularia elegans RZEHAK; Praelveolina dordonica; Omphalocyclus macroporus LMK; Siderolites vidali DOUV.

North of Lake Van the Upper Crataceous series extends to the south from Mount Samkar. It consists mainly of bedded green sandstones, but passes down into grey sandy limestones and greenish-blue marly limestones. These

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[3] Bonnet, *Description Geologique de la Transcauscaise*, Meridionale Mem. Soc. Geol. France. Nouv. Serie T. XXV Mem. #53, 1947.

[4] Abich, Hernan, 1859 *Vergleichende Geologische*, Grundzuge der Kaukasischen Gebirge mem. Acad. Imp. Ser B, Sc. Math. Et. Phys., Bd. VII, St. Petersbourg.

[5] S. Erk, *TURKIYE Jeologi Haritas*, Mineral Research Exploration Institute Ankara, 1964.

[6] J H. Maxson, 1937, Reconnaisance of the petroleum possibilities of the Van District, M.T.A. Rep. #682, Ankara, Turkey.

[7] Altinli I.E., Geology of Southern Hakkari Rev., Fac. Se. Univ. 1st serie B. tome XIX fasc. I.

limestones dip into the waters of Lake Van. This series also contains a sill of olivine basalt about 100 meters thick. The total thickness of the upper Cretaceous series is about 600 meters.

THE TERTIARY

Paleocene – This series is mainly seen in the regions east of Lake Van. They consist of: grey and multi-colored shales (100 meters); soft and red limestones with calcite (veins 50-60 meters); multicolored marls with limestone intercalations (150-200 meters). These formations were identified with the following fossils: Globorotalia crassata group; and Globigerina triloculinoides PLUMMER.

Eocene – Rocks of this age are also to be found in the Lake Van area, represented by white limestones eastwards to Ozalp, and at Sosam village east of Van green-grey marls and sandstones underlie the limestones. They are from 200-300 meters thick and contain the following fossils: Assilina granulosa d'ARCHIAC; Nummulites atacicus LEYMERIE; Nummulites irregularis DESHAYES. In the Mus area are found red and green shales, marls, and sandstones with thick conglomerate bands, and these fossils: Globorotalia wilcoxensis CUSHMAN AND PONTON; Globigerina trilocularis d'ORBIGNY; Laffittenia sp.; Quinqueloculina sp.; Eorupertia sp.; Cibicides sp.; Orbitoides sp. In other areas from Doğubayazit to Sirvan and the Zap river occur other Eocene microfossils: Nummulites of . uroniensis A.HEIM; Nummulites striatus BRUG; Assilina mamillata d'ARCH; Discocyclina douvillei SCHLUMB; Corallina cossmanni SHCLUMB. At Yukaribernuaz the following fauna was found: Nummulites millecaput BOUBEE; Nummulites aturicus JOLY AND LEYM; Nummulites oroniensis; Discocyclina sella d'ARCH; Operculina pyramidum SCHWAGER; and Porosoma sp. Northeast and east of Doğubayazit occur greenish marls and siltstones and thin-bedded limestone intercalations and cream or white Nummulitic limestone, from which were found: Nummulities contortus DESH; Nummulites striatus BRUG; and Discocyclina sp. etc.

Oligocene – One outcrop of this age outcrops in a narrow zone near the village of Hamurkesen, northeast of Karakose. There are alternating beds of dark grey sandstone and conglomerates. Oligocene outcrops are also situated north of Mus, consisting of grey marl, sandstone, and impure limestone, with these fossils: Nummulites intermedius d'ARCH; Nummulites fichteli MICHELOTTI; Operculina alpine H. Douv; Lepidocyclina dilatata (MICH); Globigerina bulloides d'ORB; and Operculina sp.

Miocene – This information is composed in part of grey, sandy limestones, overlying Permian limestone. In places the Permian is overlain by a greenish marl and creamy limestone. South of Horosan there is an assemblage of multicolored marl, siltstone and fine-grained sandstone. The facies near Doğubayazit consists of alternations of limestone, overlying Upper Cretaceous. There are both fresh water fossils and marine fossils. Oysters and Echinoids have been found near Korzut: Lepidocyclina dilate MICHELOTTI; Nephrolepidina margimata MICHELOTTI; Amphilepidina sp.; Operculina complanata; Isastrea turbinate DUNCAN; Astrocoenia; Ostrea squarrosa; Echinolampas acuminatus; Chlamys; Sponge spicules; Bryozoa; Crinoids; Brachiopods; Gastropods; Ostracods; and Algae.

Pliocene – Typical exposures can be seen at Hinia, Bulanik, west of Igdir, and near the southern escarpment of the Carpanak peninsula. These rocks consist of thick-bedded conglomerates with flat pebbles in yellowish sandstone. The pebbles weather easily, possibly indicating crushing with great overburden when the material was yet soft. There are also greenish-brown marls in alternations with conglomerates.

QUARTERNARY

Alluvium – Large areas of alluvium occur in the valleys and axial depressions.

Terraces – Terraces are common along the rivers, where alluvium has been deposited during times of high water. Terraces occur along the Aras River. Around the shores of Lake Van are remnants of terraces at 10, 20, 30, 45, and 60 meters above the lake, indicating stages in the recession of flood waters, during the drying up process.

Talus Cones – On the flanks of the Bitlis massif occur talus cones, which coalesce into aprons. Important occurrences are south of Doğubayazit and along the northern flanks of Ararat.

Karst Topography – Karst features are found especially in Permian, Eocene and Miocene limestones.

Glaciation – The mountain glaciers are dwindling remnants of Quarternary glaciation, and the topographical effects are to be seen in U-shaped valleys, moraines, cirques, some occupied by glacial lakes. The largest glacier or snowcap in Turkey covers the top of Mount Ararat, occupying some seventeen square miles in extent according to the recent

measurements of glaciologist Nicholas van Arkel. This ice cap divides into eleven finger glaciers following the canyons down the mountainside.

Travertine – There are many warm springs emitting carbon dioxide and hydrogen sulfide. The largest deposit of travertine deposited from these hot springs is at Edrimet, one north of Hinis Creek, issuing from Mermer Mountains. Another notable deposit of travertine occurs west of Diyadin. This overlies a large outcrop of basalt, which evidently furnished the heat for the hot water.

Lakes – There are more than 29 lakes in the general area of Ararat, the largest being Lake Van, actually the largest in Turkey. Some are dammed by lava flows, some by differential erosion, some by ponding along stream courses, some in craters, two cirques, one by artificial damming, two occupying structural depressions, such as synclines.

PLUTONIC AND METAMORPHIC ROCKS

Intrusive rocks from plutons are indeed scarce in the Ararat area. One occurs southwest of Kıpal, one 40 km south of Karayazi and one between Diyadine and Tashcay. In the first place occurs leucocratic, holocrystalline granite. In the other locations occur both granite and diorite which have metamorphosed marble.

Ultrabasic Rocks – Ophiolites of Upper Cretaceous age are related to magmatic activity. They occur more frequently along intensely folded zones of intrusion. The periodotites are serpentinized. Submarine basaltic intrusions occur, such as diabase and spilite. Large laccoliths occur with various compositions. Red and green pillow lavas occur in a greenstone mass south of Catak. These submarine pillow lavas were ejected under water, forming the conchoidal fractures peculiar to that type of rock. The age of inundantion is uncertain but might be related to the Flood.

Volcanic Rocks – Basalt, andesite and pyroclastics have extensive outcrops north of Lake Van and around the Ararat region. Volcanic activity apparently took place at repeated intervals during the Cenozoic Era and right up to almost historic times. Discrimination between basalt and andesite is often difficult in the field, for one borders on the other. For that reason differentiation is also difficult even in thin sections.

Plateau basalts form extensive sheets in many places. Volcanic cones and cinder cones are aligned along fissures treading in four points of the compass, north-south, east-west, southwest-northeast, and northwest-southeast. The Ahora Gulch fracture through the Greater Ararat lines up in a northeast-southwest direction, while the axis of the Ararat-Tendürek-Süphan-Nemrut lineament has the same trend. When it is realized that the Ahora Gulch and its SE counterpart that cuts through the mountain is aligned along this lineament, this helps to explain the existence of the Ahora Gorge. The mountain grew from extrusions up through this old fracture, and the explosive phase naturally followed the same fracture system. There are fractures in other directions through which flowed later lavas on the side of the mountain; and many of these fractures are filled with red dikes, indicating oxidation of black iron to red.

In many places the volcanics are in the form of tuffs and ignimbrites with basalt interbedding. The tuff may be black, grey, sandy, pumaceous, or even white, as on the east slope of Mount Ararat. Basaltic sheets cover extensive areas, and are scoriaceous, that is vesicular, indicating rapid ascension from deeper levels where pressure was greater and the gases were formed when the pressure was released on coming to the surface. Much of the basalt weathers spheroidally, suggesting underwater extrusion.

Tendürek volcano has two cones, each with a crater. The eastern cone is known as Hell Mountain; the western one is Gulizar Tepesi. The main body is andesitic, grey in color, while the basalt that flowed through the radial fractures in the sides of the cone is black, with a basaltic capping. Around its base are cinder cones, spatter cones, scoria mounds, and through the fissures pyromagma was ejected. The upper part of the cone was destroyed by explosion, with the expulsion of much ash. The main body of the eastern cone is andesitic, grey in color, while the basalt that flowed through the radial fractures in the sides of the cone is black. Around its base are cinder cones, spatter cones, scoria mounds, and through the fissures pyromagma was ejected. The upper part of the cone was destroyed by explosion, with the expulsion of much ash. During historic times the volcano erupted pumice. An oval lake occupies the crater 150 meters by 75 meters. The hot springs around Tendürek are related to the volcanism. One lava flow is scarcely distinguishable from another. The type is common, that is, lava with blocky surfaces.

Greater Ararat is a compound volcano, comprising two strato-volcanoes. Greater Ararat ejected much more lava than Little Ararat. Lava was ejected from the central cone as well as two notable cones on the flanks at 3,300 and 3,800 meters elevation. The mountain has no visible typical crater with ice top, although there is a crater lake on the northwest side of Kıp Göl. The flank volcanoes are known as parasitic and are aligned along radial fissures in the sides of the mountain.

Little Ararat is lined up southeast of Greater Ararat and has a separate central magma pipe. Around this pipe, lavas, breccias, and tuffs accumulated to form a strato-volcano. The main crater of Little Ararat ejected hypersthene-rich andesitic lava, while the flank eruptions were of basalt with olivine and andesine. The last eruptions were very recent.

Suphan is a strato-volcano built up mainly of andesite and obsidian, the obsidian indicating quick cooling as under water. The main cone is mostly grey hornblende-rich coarse-textured andesite. The concavity of the caldera has been

preserved. Tongues of viscous andesitic lava with convex surfaces crept down the slopes, forming heaps of volcanic breccia. The basaltic phase came to an end with an ignimbritic eruption.

Nemrut is a young shield volcano. Its crater is filled with lakes. Olivene basalts and andesitic lava ejected from the same vent are interbedded with tuffs. Twenty separate flows have been counted. Welded tuffs were deposited in and filled the old Bitlis valley, suggesting that Nemrut grew with strong explosive activity, same as the Ahora Gulch on Ararat. There was Pelean activity and katmaian nuees ardentes. The main body is composed of grey-hornblende andesite but covered with pumice. Pelean ash showers falling into floodwaters became agglutinated. Explosions, which form calderas, are a sign of old age.

Basaltic pyroclastics are less common than andesitic types and preceded the flows. The tuff and breccia exposed along the Doğubayazit road overlie andesites and underlie recent basalts of Mount Ararat. Therefore the explosive type of volcanic eruption on Mount Ararat was neither the earliest nor the latest events in volcanic activity.

TECTONIC HISTORY

Almost continual magmatic and volcanic activity with regional and dynamic metamorphism has resulted in a complex structural framework. The Bitlis mountain system is the backbone of that part of East Anatolia to the west of Lake Van. Its eastern slope was deflected to the northeast, possibly by pressure from the Arabian shield. There is believed to be a northwesterly directed overthrust. The Ozalp mountain system covers a limited area. The Sarigold range is larger and is covered by volcanics. An overthrust near the Tirman mountains is directed southward.

The Diyadin mountain range has conspicuous depressions. Its range is covered with fossiliferous Permian strata. It is possible that folding took place during older orogenic phases. These ranges are of anticlinal type and the valleys represent synclines. The throughs were perhaps folded during Alpine orogeny, in Tertiary time.

Folds – Secondary undulations on the limbs of major folds are common; in places these folds are overturned. Isoclinal folds are due to tight folding. These are drag folds along fault planes. North of Catak along the road are intricate crenulations, accompanied by faults and shears. Difference in competence between limestone and shale produced disharmonic folding. Intense volcanic activity during the Upper Cretaceous led to confused structures. Crenulate folding is quite common in the ophiolite and limestone areas. Foliation had developed in soft rocks that they often resemble schists.

Overthrusts – There appear too many large overthrusts and imbricated structures in the area, many occurring along old dislocations in the Cretaceous ophiolite zones, North of Sirvan, Upper Cretaceous formations are thrust over Lower-Middle Miocene beds. Near Gercus appears a window eroded through the Upper Cretaceous in which middle and lower Miocene conglomerates are revealed. At Binik Upper Cretaceous Paleocene is thrust over Miocene marl so that the age of the thrust is post-Miocene. South of Buyuktuzla Miocene passes under Upper Cretaceous indicating the evidence of a thrust although the evidence seems to be more fossil inversion. The direction of thrusting is southward.

North of Narh, crystalline schists are thrust over volcanic Upper Cretaceous. Most of these overthrusts are directed southward, but south of Narh Upper Cretaceous is thrust over Miocene in a northward direction. At Gelye Creek upper Cretaceous formations have been dragged over Permian in an easterly direction. At Mount Capala Permian is thrust over Eocene, while Istindar Permian is thrust over Upper Cretaceous. Also along Arpit Creek west of Gevas, Permian limestone is thrust over the Cretaceous formations. The displacement is more than 10 kms.

North and West of Karacahasan village, south of Karayazi the Upper Cretaceous is thrust over Miocene sandstone. Near Doğubayazit there is an imbricate structure, extending from the frontier station past Kalus knoll to the Persian frontier, the thrust being directed to the northeast. At Kalus the Fusulina limestone is thrust over the Eocene limestone. West of Ihea Upper Cretaceous is thrust over Eocene marl in the north and Eocene limestone in the south.

Faults – Most of the faults in the area are younger than Lower Middle Miocene and younger than the overthrusts. One fault is of recent age, post-dating the basaltic flows. There are numerous shears and joints. Near Doğubayazit lithologic discontinuities suggest the existence of east-west trending faults. One appears at Milladric and appears to be a strike-slip fault extending to the north of the district. These longitudinal faults have the same trend as that of the major

Hasankale fault. The marine beds of Oligocene age at Tuzluca are bounded by two faults. Miocene limestone at Kahnispi, northwest of Patnos, exhibits a high-angle normal fault in the west. Near the high pastures of Urik the Bitlis range is blockfaulted.

PALEOGRAPHY

The presence of greywackes in the Ararat range suggests the former existence of a eugeosyncline, in which the rapid subsidence and sedimentation prevailed and shale and marine limestone were deposited. Permian sandstone, shale and marine limestone were deposited. The age of the intrusive granites and diorites is uncertain. The red beds are primary in origin and were formed in a warm and humid climate, quite different from that at present. White and black sandstones, greywackes, chloritic, micaceous, and silty shales were deposited.

Greenstones[8] are the manifestations of initial magmatism and are characteristic of the eugeosyncline. They existed along fault planes. After the greenstones, basic submarine extrusions and andesites formed pillow lavas. During later times lagoonal and terrestraial environments prevailed due to the dry climate. Periodic andesitic and basaltic lavas were ejected along faults related to earlier orogeny. During the Miocene the most important volcanic lineanment was formed, that is, the Ararat-Süphan-Nemrut axis. Basaltic flows reached the waters, forming pillow lavas.

MINERAL DEPOSITS

The metalliferous and fuel deposits are few and far between in Eastern Anatolia; but non-metalliferous deposits are most important.

Iron – Hematite and specular iron ore occur at Kavakalti, south of Mukus. They occur in crystalline schists in limestone intercalations.

Chromite – Some chromite fragments have been found in Pleistocene pebbles at Sehbag, near Van.

Copper – Malachite has been found in Upper Cretaceous sediments and andesites northeast of Sirvan between Akcazer road and Hizne Creek. There are many old workings. The pyrite and auriferous chalcopyrite are related to submarine extrusions, as noted in the inner core of Mount Ararat at the head of Ahora Gulch.

Magnesite – Magnesite occurs in serpentine in the form of veinlets and small lenses.

Sulphur – Small amounts of sulphur have been precipitated in springs emitting hydrogen sulphide. Specks of orpiment have also been found.

Oil – The most important oil seepage in Turkey occurs through a dislocation zone in the Upper Cretaceous along the Neft Stream near Korzut Village. The seepage is through a breccia zone in a fault plane striking S45 degrees East. It is believed that the oil originates in the underlying Permian limestones. The oil can be used directly in engines without any processing. From a well near the oil occurrence carbon dioxide gas is emitted, and oil patches can be seen in the water. However, no really good oil structures have been noted in this district.

Lignite – At Palatks Creek, near Eleskirt, lignite occurs under marls and tuffs. It is extracted by driving tunnels. The formations south of Horasan contain thin lignites, At Sahmanis coarse and fine detrital contain thin lignite seams varying in thickness from a few centimeters to 1.10 meters.

Salt – Salt has been mined at Tuzluca since ancient times. The salt occurs in Oligocene marls. There is little trouble from water in the mine, and drifts have been driven along the seams of salt, which are imbedded with shaly seams. At

[8] Igneous, not metamorphic facies.

Akuzla and Kirmizituzla salt occurs in Miocene beds along the axis of a basin. Near there is a big outcrop of gypsum, indicating a drying up of arms of the sea. It is possible to get salt from five locations southwest of Sirvan.

Soda – Lake Van is rich in soda, and investigations are under way as to the economic possibility of its extraction.

Gypsum – There are gypsum beds at Canik and at Ruscan village, north of Aktuzla and Kirmizituzla, only the first being worked.

Cement – A study is being mad of the possibility of making cement from Tertiary rocks.

In conclusion, the following experience is worth of note. A man brought a fossil breadfruit, or closely allied to it, for our inspection. This fruit suggests a warmer climate in the past. There is ample evidence from both the Arctic and Antarctic that the climate was warmer at one time.

Abich reported that in the earthquake of 1840 an avalanche of mud and water came down Ahora Gulch burying not only Ahora and St. James monastery, but covering the valley glacier to such a depth that it insulated and preserved the ice from melting to any great extent until the present. The writer noted the same situation on the Parrot glacier on the northwest side of the mountain, where the lower end of the glacier is covered deep with talus and volcanic debris. In summer where the cover is thin and toward the terminal moraine the ice melts and lets the cover rock drop into the canyon. This is also true of the Ahora glacier. In the bottom end of the Parrot glacier the melting water carries the smaller fragments downstream, but boulders weighing tons are still perched up on ice necks many feet above the glacial floor. Eventually this neck will melt and the rock will roll down hill.

The largest stream flowing down the mountain of Ararat comes down the Ahora Gulch and joins the Aras River. One wonders why there are not more streams, until it is realized that the surface of Ararat is very rough and porous and the youthful morphology of the mountain explains why fine sediment has not yet filled the interstices. For that reason the water from the melting snow sinks deep into the rock cover and may come to the surface down in the valley as springs or artesian wells. Jacob's Well, in Ahora Gulch, where ARF camp was made, is fed by seepage down the mountainside in an aquifer of tuff sandwiched between lava flows. Other exposures also show beds of tuff covered with lava flows, indicating that the volcanic explosion was not the final tectonic event on Ararat.

On the north side of Ahora Gulch the strata dip about 10 degrees to the northwest, while across the canyon the black rocks dip about the same amount to the southeast, perhaps indicating that at the time of explosive eruption subterranean forces domed up the mountain as the explosion took place, forming an anticline of the remaining beds. Up through this fracture evidently flowed the later lava flows that built up the mountain to its full height, for the layers at the top dip parallel to those on the southeast side of the Ahora Gulch. Furthermore there is evidence that the black volcanics on the southeast side of Ahora Gulch are later than the original core of the mountain, for the bottom layers on the left going up the canyon are a volcanic breccia, indicating that they were formed from broken up previous volcanic flows, while the original core seems undisturbed except for the tilting.

The sunken ring or moat around the mountain calls for an explanation. Ararat apparently followed the same pattern as other volcanoes. As it grew it domed the surrounding rock strata to make room for the rising magma. After the volcano reached its ultimate height and maturity, it gradually reached the old age phase, and the lava began to drop back down the lava conduits into the bowels of the earth forming what is known as a caldera. As the molten magma drained back into the lower crust, it left a void or hollow, and the weight of the cover rocks caused the crust to collapse and fill the voids, thus leaving a sunken ring around the mountain, now occupied by poorly drained swampland.

Instead of Ararat forming a drainage pattern radiating from the mountain, the watershed drainage flows to the Aras and Tigris and Euphrates apparently as if it did not know that Ararat existed, thus suggesting a more recent birthday for Ararat. The original drainage system may have been established from the days of Creation. Everything about Ararat suggests youth.

It has been brought out before that the bursting forth of Ararat domed the surrounding rocks such as in Ahora Gulch and the limestones surrounding Ararat, but our investigations on the shoulders of Ararat near the Ahora Gulch showed a strange tectonic phenomenon—underthrusting—that is the upwelling magma pushed the deeper rocks aside as it made room for the rising magma, while the surface rock cover was more stationary. This was deduced from "S" bends or folds in the rock exposures.

Cataclysmic Flood Geology – Mount Ararat is easily associated with the Ark of Noah and the Flood in the thoughts of many people. Often the question is asked: what evidences, if any, are found around the mountain to substantiate the flood concept? The answer would be that, if the flood was world-wide as we believe ample evidence indicates, then we should find such evidences not only around Mount Ararat but most anywhere. However, since this paper is an outline in brief of some of the main points of the geology of the Ararat area, I will attempt to point out a few evidences of the flood, which were identified in the summer of 1966.

Possible "Pillow Lava" on Mount Ararat at about 14,000 feet. Notice the sun gleaming off the smooth surfaces and the density of the lava 1984

Courtesy of Doris Bowers

One such evidence has been described concerning the geysers and hot springs west of Diyadin. (See section on Structure.) In time past, these geysers were apparently much more active, as volcanic activity was greater in times past. Some lava was perhaps poured out under water while the flood was at its height, for stresses were built up in the crust of the earth, as it was out of isostatic balance due to the shifting of sediments from one place to another. The Hawaiian Islands were built up from the bottom of the ocean, some 11,000 feet deep, by volcanic extrusion. When lava is extruded under water it is cooled quickly and solidifies so rapidly that crystals often have no time to form, like obsidian; or when very small crystals are formed, much of the basalt and andesite composing upper Ararat was of this type. The lava is often found in rounded blocks called pillow lava because they are of pillow-like appearance having conchoidal fractures. Much of the basalt on Ararat had semicircular fractures, typical of underwater extrusion. When did the waters reach the 11,000-foot level on Mount Ararat? There is the puzzle of the upturned limestone beds surrounding Mount Ararat, on the Turkish, Russian and Persian sides. Near the city of Doğubayazit these limestone formations, some 1,000 feet in thickness, are tilted from as much as 45 degrees with respect to the horizontal to almost vertical. The true cause is apparent, although others have not apparently sensed it. The strata dip away from Mount Ararat on every side just as the surface dirt crust does when a seedling bursts up through. Evidently Mount Ararat burst up through the limestone beds to form a near 20,000-foot peak or series of them; and, thus provided shelter for the Ark from the tempestuous storm as the waters began to recede. The Genesis account says that strong winds blew to dry up the floodwaters. If the standard geologic column is right, then these limestone formations were laid down some 100,000,000 years before Mount Ararat came into existence, at a time when the greatest land inundation from the sea took place. For that reason, I wonder if perhaps the Cretaceous period and the Flood may not be synonymous? And, carrying the comparison a bit further, would that not place Creation week way back in the Precambrian? We, of course, have presented our reasons for not accepting the validity of orthodox time scales, such as 100,000,000 years in earlier issues of Creation Research Society publications. According to Genesis geology, we could scarcely visualize a universal deluge between Creation and the Flood, for the Euphrates valley, we believe, was the cradle of civilization. Limestone is precipitated under water; therefore, such sedimentary rock must have been laid down during the inundation of the earth by the flood waters—the early part perhaps—since Mount Ararat was apparently elevated to its full height during the latter period of the flood, to provide the above-mentioned haven for the ark. There are small peaks on the top of Greater Ararat, which might well have provided that haven.

This may not sound so much like fanciful speculation when one reads some recent findings of the Lament Geological Observatory at Columbia University. The New York Times News Service for Jan. 3, 1967, reported:

> The findings also concern a layer of sediment 1,000 feet thick beneath the floor of the Atlantic. It apparently has lain undisturbed for 70 million years. The layer across the Atlantic floor appears to be a relic of a cataclysmic occurrence at the end of the Cretaceous period, 70 million years. During the Cretaceous, oceans covered much of the present-day continents. Toward the end of the period the land rose out of the sea (or the seas subsided). Water cascading off the land carried sediment that was laid down in the deep basins. This may account for the deep buried layer.

If we but substitute the word "Flood" for "Cretaceous" in the above statement, the Lamont Geological Observatory has given a very graphic, and presumably accurate, picture of just what happened at the close of the flood period. We can detect fracture patterns running across the ocean bottoms, which may have been deepened to make room for the floodwaters "cascading" off the continents. Greater deepening of the ocean basins was probably compensated for by a corresponding rise in the height of the continental blocks. Findings of ocean floor research are described in the December 2, 1966 issue of *Science*.

As the waters further subsided, isolated epeiric-seas were formed by arms of land cutting off small bodies of water from the ocean. As the winds of hurricane force dried up these in land seas, salt was precipitated. I examined one such salt mine a few miles northwest of Mount Ararat. The salt was laid down in layers exactly as the limestone and sandstone and shale were, interbedded with thin layers of silt and dust.

After the salt was precipitated, the wind evidently blew dust over the salt layer, then a stronger gale may have caused a tidal wave to bring in a fresh flooding of the basin. Then, as the winds died down, evaporating water again precipitated a new layer of salt. I counted as many as fifteen to twenty such layers in one place. Such surges of water can be attested to by two mountaineers in the expedition [Bill Dougall and Alva Appel]. They were camping somewhat below the bottom end at the glacier that flows down the bottom of the Ahora Gulch. A terrific roar from above rudely awakened them when the glacier above the Gulch broke loose, and some 100,000 tons of ice and rock came cascading down almost to where the men were camping. Needless to say they hastily moved their camp to safer ground. The top of Mount Ararat, down to about the 14,000 feet level, is permanently ice-capped. This means the cap is a static entity: as the snow continues to fall, the ice-cap builds up. As a consequence of this buildup, ice "flows" outward as a *Rheid*, that is, a material that under continued pressure flows like a viscous fluid. As the Ararat ice cap flows outward in all directions it divides into about a dozen fingers or glaciers flowing down various canyons. As is typical of all glaciers, the Ararat glaciers are eroding agents, carrying tremendous quantities of rock debris from higher to lower levels. This means that each year the total height of Ararat is a little bit lower than the previous year. If we knew the annual rate of erosion, we might be in a position to estimate the altitude of Ararat at the time of the Flood.

Scientists from the United States Geological Survey have found that glaciers in Alaska have no fixed rate of advance: that sudden surges cause what they call "catastrophic advances," at speeds from 10 to 100 times the normal rate. The normal now is usually stated as from one to two feet per day. "The cause of these surges is not completely understood," said Dr. Mark F. Meier, research geologist at the U.S. Geological Survey office, Tacoma, Washington.

Summary

Eastern Turkey consists of a relatively barren, undeveloped area quite without tree cover. Tectonically, it is very active, and unstable structurally. The region has been folded, faulted, and intruded with basic types of volcanic rock such as andesite and basalt.

Previously the cover racks had been Paleozoic and Mesozoic limestone, but these have been eroded, folded and faulted by frequent orogenic activity, forming volcanic mountains, among which are the Tendurek range, and also the Alagoz-Ararat system. These mountains are found along fault lines, which provided channels through which molten magmas hewed from deep zones in the earth's crust, or upper mantle, where the temperature is well above that of the melting point at basalt, about 1,200 degrees Centigrade at one atmosphere pressure. (At depth, the hydrostatic pressure greatly raises the melting point of rock.)

On the north and east of Ararat lies the Aras River fault block, at about 2,500 feet to 3,000 feet elevation as compared with the Doğubayazit (southwest) side of Ararat at about 5,000 feet. The rim of Ararat around the mountain forms a depression ring or "moat" of marshy land, not well drained. Perhaps a “collapse cauldron” caused this. That is, after a volcano attains its greatest height of activity, the magma settles back into the "bowels of the earth." Leaving an empty void, which recedes to lower levels, like the terrain around Long Beach California, after Signal Hill was drained of oil. The original core of Ararat was andesitic and basalt porphyry. During and since the flood period, the total height was raised thousands of feet by successive cycles of volcanic extrusion. The Mount Ararat region contains abundant evidences of cataclysmic geologic activity, as well as signs of the complete inundation of Mount Ararat and the whole area by floodwaters.

Photo showing sedimentary layers and alleged fossils on Mount Ararat. Photo taken from the west rim of the Ahora Gorge at the top near the edge of the Cehennem Dere looking almost directly south. If you were to raise the camera you would be looking right at the peak. You may see the top of the Ahora Gorge from Ark Rock but only the portion above the Cehennem Dere and up to the east peak (therefore – not much). You cannot see the Cehennem Dere from Ark Rock – there is a "ridge" of glacier between the two above the north canyon.

Addendum by Rex Geissler

The issue of fossils on Mount Ararat has been a hotly debated topic. Note that the fossils listed by Dr. Abich in the preceding article and those found by the recent researchers including myself were not found on the heights of Mount Ararat but in the nearby Doğubeyazit and Igdir areas across the valley floor of Ararat. In fact, most of the explorers in this book have found many fossils near Doğubeyazit. However, in regard to fossils on Ararat, no fossil evidence has ever been verified scientifically although there are a few people who claim to have found them. Ahmet Arslan, who has climbed Agri Dagh about sixty times, told Geissler that he had personally found hundreds of fossils on Mount Ararat, a number of which are currently in his Virginia home, but this has not been verified.

Dick Bright reported that Keban Holding Company's Nurettin Ergucu (Chairman of the Board), Cavit Kiliccote (President), and Muammer Coskun (member of Board of Directors), who personally knew the Turkish Ministers of the Interior and Defense, told him of fossil evidence such as sea horses, seashells, and other fossils of ocean origin which have been found as high as 14,000 feet on Ararat.[9] In 1969, when he was 73 years old and near the summit of Ararat, John Libi claimed that he found a layer of water-borne fossils.

Elfred Lee put together a 360-degree view of the 1969 SEARCH team photo map of the Parrot Glacier and Navarra ice cap areas. Lee included a 1960s photo taken by ARF and SEARCH climber Harry “Bud” Crawford of alleged fish and seashell fossils found near Ark Rock or possibly the western rim of the Ahora Gorge. Bud Crawford and the other members of the 1967 ARF team could see the fish and seashell fossils with the naked eye just a few feet away but could not get across the crevasse to take close up photos because they did not have rope with them at the time.

> We were searching along the northern edge of the Ahora Gorge and there is absolutely no passageway between the Ahora Gorge and the Parrot Glacier. That’s when I found the fossil layer and the actual fusion line between the old and new mountains. The fossil layer was at 14,800 feet. It was a sedimentary layer between 18 and 20 inches thick and looked like seashell fossils. It was in a spot that I couldn’t get over to without rope. Because of all things [going on] I didn’t have a rope that day. And I, climbing with an inexperienced boy and if I was left dangling, I’m sure he would have left me to dangle for awhile.

Although the photo above is not close enough to make a positive identification and more research is absolutely required, it could be a sedimentation layer and possibly contain some fossils.

Ray Anderson stated the following to Geissler, “On my first trip to the mountain with Dr.Hewitt, I remember him pointing out a couple of plant fossils just below the snow and ice on the east side of the Ahora Gorge. Botany studies on the mountain was a passion with him and he would stop constantly looking for any thing that resembled plant life. He mentioned that on some of his previous trips on the mountain he had seen other plant fossils as well as a fish fossil up near the edge of the glacier.”

Petroleum expert Scott Van Dyke told Geissler the following: “We only saw shale during our climb in 1983. It was on the northeastern side of the mountain, above 10,000 feet. We did not see any other sedimentary layers.”

A statement below backed up Lee's recollection along with the same photo below (and another photo showing a rock sea-salt crystal supposedly from the 14,000-foot level on Mount Ararat was also shown in the 1993 movie *The Incredible Discovery of Noah’s Ark*) in Nathan Meyer's book, *Noah’s Ark Pitched and Parked.* The book *Noah’s Ark-Opposing Viewpoints* stated, “There are also cube-shaped salt clusters, as big as grapefruit, which Harry “Bud” Crawford found on Mount Ararat 7,000 feet high and several hundred feet in the mountain and there was a sedimentary layer of limestone at 14,200 near Ark Rock.” However, no evidence of this has ever been validated. And one should remember that the SEARCH President (Ralph Crawford who was the father of climber Bud Crawford) tended to spin the story to make it sound good which gave rise to so much interest in SEARCH. Also, many of the SEARCH Foundation expeditions discussed in the quote were really the Archaeological Research Foundation (ARF) expeditions in 1960, 1962, 1964, 1966, and 1968, before the SEARCH spin-off took much information from ARF and started their own group.

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[9] Richard C. Bright, *The Ark, A Reality?* (Guilderland, New York: Ranger, 1988), p.338.

In order to understand the creationist background of geologist Clifford Burdick, the following is part of an interview done by Gerald B. Heyes in the July 1987 edition of *Science for the Layman*.

One of the first modern-day Flood geologists, Clifford Burdick's findings have at times caused controversy and amazement. In 1945 he published one of the first scientific critiques of radiometric dating, and among his many important discoveries he found 'young' fossil pollen in supposedly 'old' rock in the Grand Canyon. Burdick has authored more than 50 published papers.

Heyes: Dr. Burdick, how did you become a creationist?

Burdick: As a science teacher I taught the evolutionary point of view—as I had been instructed. Eventually, I met up with the well-known biblical geologist of early this century, George McCready Price. Our friendship lasted until he died in 1962. He gave me lots of material to read and helped me see the creationist position and that evolutionists were not reasoning logically.

George was really the pioneer creationist who startled the world after the famous Scopes Trial of 1925. You see, most people were convinced that the evolutionists had proved their case in that trial, but George got many of them on the creationist side. It took two or three years to get evolutionary thinking out of my system. I give him the credit.

Heyes: What was the state of the creationist movement at that time?

Burdick: Rather fragmentary. They were just beginning, mainly through Price's work, to show the fallacies of the evolutionists. In my opinion Price was a little weak on some aspects of geology, such as the Ice Age, and a good segment of the budding creationist movement still straddled the fence. Some believed in a short biblical age; others believe the Gap Theory—that the world was destroyed and remade before the time for Adam and Eve.

Heyes: How did support for creation grow through all this?

Burdick: After the Scopes Trial, in Tennessee, everybody seemed to feel evolution was proved. It took someone like Price to pop the balloon. He got geologists like Byron Nelson and myself interested, as well as biologists such as Frank Marsh and Harold Clark. Each of us in turn became a stronger advocate of the creation position. There were others too, like Ben Allen, who actively backed early projects such as the search for Noah's Ark on Mount Ararat.

Heyes: What was your involvement in the search for Noah's Ark?

Burdick: Well, first off you have to realize the impact of a bona fide sighting of such an Ark fitting the biblical description if it were found at that location. While it might not prove the biblical Flood account, it would satisfy one of the main predictions of a literal global flood model. Ararat is so high—17,000 feet [5165 metres]—that only a catastrophic worldwide flood would allow a boat to rest there. I got involved in the search after speaking with Benjamin Allen. Eryl Cummings and others had reported that a Russian military group had sighted the Ark, and others broadcast this over the radio. Some of this group had come to the United States because of the Bolshevik Revolution. I remember meeting one of them, an accomplished archaeologist [probably Colonel Alexander Koor]. We had a difficult time raising funds for the project. We tried to reach Ararat in 1946, but didn't get there. But we went 20 years later when a man by the name of Ralph E. Crawford raised the money. I have made several expeditions since, and even filed a geological report of the area with the U.S. and Turkish Governments.

Heyes: What is the status of the search for Noah's Ark so far?

Burdick: Many other scientists and myself were involved in a documentary movie called *In Search of Noah's Ark*. Nobody has yet fully documented finding the Ark, though I was involved in analyzing salt crystals and some petrified wood from the area. The *Arizona Daily Star* in Tucson did a write-up in February, 1979, about my work with the crystals, and some of this news got on television.

A Frenchman [Ferdinand Navarra] found hard wood embedded in ice and brought it to New York, but I really can't say whether it is like the wood of that area. Some think it may be related to a railroad the Russians built in the early 1900s.

The project is now being run mostly by geologist John Morris of the Institute for Creation Research—the son of ICR president, Dr. Henry Morris. I introduced John to the area in 1971 while lecturing on a Middle East tour with the Bible-Science Association. We spend several days together, and I passed on lots of data about Mount Ararat to him…Nothing conclusive can be said, bu the area is covered by a huge glacier, and exceptionally warm summers are needed to melt the ice-cap. These summers cycle about every 15 years.

Heyes: You have been credited with publishing one of the first convincing scientific critiques of radiometric dating [1945]. Where did you get the data to write this article?

Burdick: The data were all there in the literature of the field, but were not really what the layman would see. Of course, I had experience as a mining geologist. One time I discovered one of the largest copper sites in the North American continent, and did they ever mine it! So I was able to gather data from my reading and research, which evolutionary geologists either passed over or called "anomalous."

Of course, that's a fraction of the information you can gather today. What is interesting about this radiometric dating is that Willard Libby, the Nobel Prize winner who invented the carbon-14 method, assumed an equilibrium condition between the production of carbon-14 and its disintegration. It was a critical assumption. Well, we found that the system has not yet reached a steady state, which means the earth cannot be more than thousands of years old, because it only takes about 30,000 years to reach equilibrium based on the half-life of carbon-14.

Heyes: Could you tell us about your work in the Grand Canyon and with fossils?

Burdick: Over the years I made many trips to the Grand Canyon, lecturing and leading tour groups. I found many evidences for creation, which contradicted the geologic column. The kind of sorting, sedimentation and cyclic depositions found in the canyon walls speak of receding floodwaters on a massive scale. Another point concerning the canyon is that some rare fossils even of jellyfish and vertebrates have been reported in Precambrian formations. These are way out of order if you accept evolutionary chronology…In 1974 I published a creationist guidebook of the canyon called *Canyon of Canyons*, which is not full of the standard evolutionary explanations. The Grand Canyon was once "Exhibit A" for evolutionists, but it is now "Exhibit A" for creationists. I found "young" fossil spores and pollen in "old" rocks…We found no graded evolutionary series of simple to complex plant pollen and spore types. In fact, we found the same types from top to bottom…I developed a new method so that spores and pollen were more readily separated and more easily seen and photographed under the microscope. Some tried to duplicate my work, and could not, because they used the old methods of separation, and told me that my work which they originally liked so well suddenly was now sloppy.

Heyes: What changes have you seen take place in creationism since the early days?

Burdick: We have a lot more outstanding scientists and better data now. More information is coming from geology, paleontology and the like. Gentry's work with radiohaloes from short-lived isotopes, and Barnes' work with the earth's magnetic field decay… Biologists such as William Tinkle, Walter Lammerts and Frank Marsh have demonstrated experimental limits to genetic variability of the different kinds of plants and animals. I've been in this work over 40 years and have made findings in field geology, which have punctured many of the main theses of the geologic age column.

Most notable was the information from my work at Antelope Springs in northern Utah. I went up there in August 1968 with William Mesiter. A couple of months before, he had found a human sandal print with several trilobites right inside the human print in shale. I found a couple of child's footprints at the same location. Other geologists, including Dr. Melvin Cook of the University of Utah, corroborated the finds.