THE MESA BASALT OF THE NORTHWESTERN UNITED STATES

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Probably the most remarkable basalt unit of the stratigraphic record is the late Cenozoic (Pliocene or Pleistocene) Mesa basalt of the northwestern United States. Various lines of evidence show that several occurrences of medium to light gray porous-textured olivine basalt in Oregon, northeastern California, northwestern Nevada and southwestern Idaho apparently are the preserved remnants of a single, regionally extensive lava flow. The thickness of the flow averages only 30 feet and the areal extent must have exceeded 100,000 square miles. It is therefore the world's largest known lava flow representing a single volcanic event of catastrophic magnitude.

Several problems for uniformitarian geology presented by the Mesa basalt are discussed. Widely divergent dates on various portions of the basalt seem to invalidate the potassium-argon dating method.

Because the Mesa basalt and many other late and middle Cenozoic basalts were deposited in a subaerial environment, while pre-cenozoic lava flows were usually submarine, it is suspected that the Mesa basalt and other late and middle Cenozoic basalts flowed after the Noachian Flood. This inference is supported by the observation that pre-cenozoic flood strata (widespread dolostone, bedded chert, black shale, coal and graywacke) are uncommon in the late and middle Cenozoic.

Introduction

The late Cenozoic geologic history of the northwestern United States was rather violent. From innumerable fissures and craters enormous quantities of molten rock and ash spewed forth. The dark, fine grained rock called basalt, which is composed mainly of minerals called feldspars, $(Na,Ca)Al(Si,Al)Si_2O_8$ cooled from molten lava.

The Columbia Plateau in Washington, Oregon, Idaho, and California is built of volcanic material in some places over five thousand feet thick dominated by basalt flows each about 10 to 15 feet thick, with an occasional one of greater thickness.

The most common topographic features of the Columbia Plateau are buttes, mesas and plateaus capped by resistant "rim-rock" (commonly basalt) over less resistant rock (commonly volcanic ash) which is easily eroded by wind and rain.

The Cascade Mountains in Washington, Oregon and California contain a series of volcanoes, the best known of which are Mount Baker, Mount Rainer, Mount St. Helens, Mount Hood, Mount Jefferson, Mount Shasta and Mount Lassen, each over 10,000 feet high.

Recognition of Mesa Basalt

Two professors of geology at the University of Washington in Seattle, Washington, Dr. Harry E. Wheeler and Dr. Howard A. Coombs, have each spent forty years carefully studying the late Cenozoic volcanic rocks of the Northwest. Dr. Wheeler's specialized field is the analysis of the regional patterns of stratified rocks. Dr. Coombs, who was head of the department of geology at the University of Washington, is a specialist in volcanology. Both are recognized world-wide as authorities in their fields.

About ten years ago Wheeler and Coombs noticed that one particular type of Pliocene or Pleistocene basalt was widespread east of the Cascade Mountains in Oregon, California, Idaho and Nevada forming the rim-rock of many of the buttes, mesas and plateaus. This characteristic type of basalt is usually medium to light gray in color and differs from other basalts which are usually black.

Wherever Wheeler and Coombs found this distinctive type of basalt, it was always coarse-textured with visible crystals of olivine, a green mineral, $(Mg,Fe)_2SiO_4$ protruding into many fine pores. (The texture is technically known as *diktytaxitic.)* Upon close inspection of unweathered samples one can distinguish what appears to be a "jumble of minute jackstraws." Wheeler and Coombs have named this peculiar layer of rock the *Mesa basalt* according to the first description made by the University of California Professor J. C. Merriam in northwestern Nevada in 1910.

After recognizing the vast distribution, the thickness which averages only 30 feet, and the singular stratigraphic occurrence in any locality of the *Mesa basalt*, Wheeler and Coombs asked,

> Could this layer of "jackstraw" rock, vestiges of which were scattered over parts of four states, conceivably be the remains of a single sheet? Could such a sheet have been laid down during one enormous volcanic eruption? After initially dismissing the idea as preposterous, we later evaluated it as belonging somewhere between the improbable and the impossible. A number of lava flows had been known to travel tens of miles from their sources. J. W. Bingham and M. J. Grolier of the U. S. Geological Survey recently showed that one flow of the Columbia River Basalt succession covered at least 20,000 square miles of southeastern Washington and northeastern Oregon. However, to assign the *Mesa basalt* layer to a solitary

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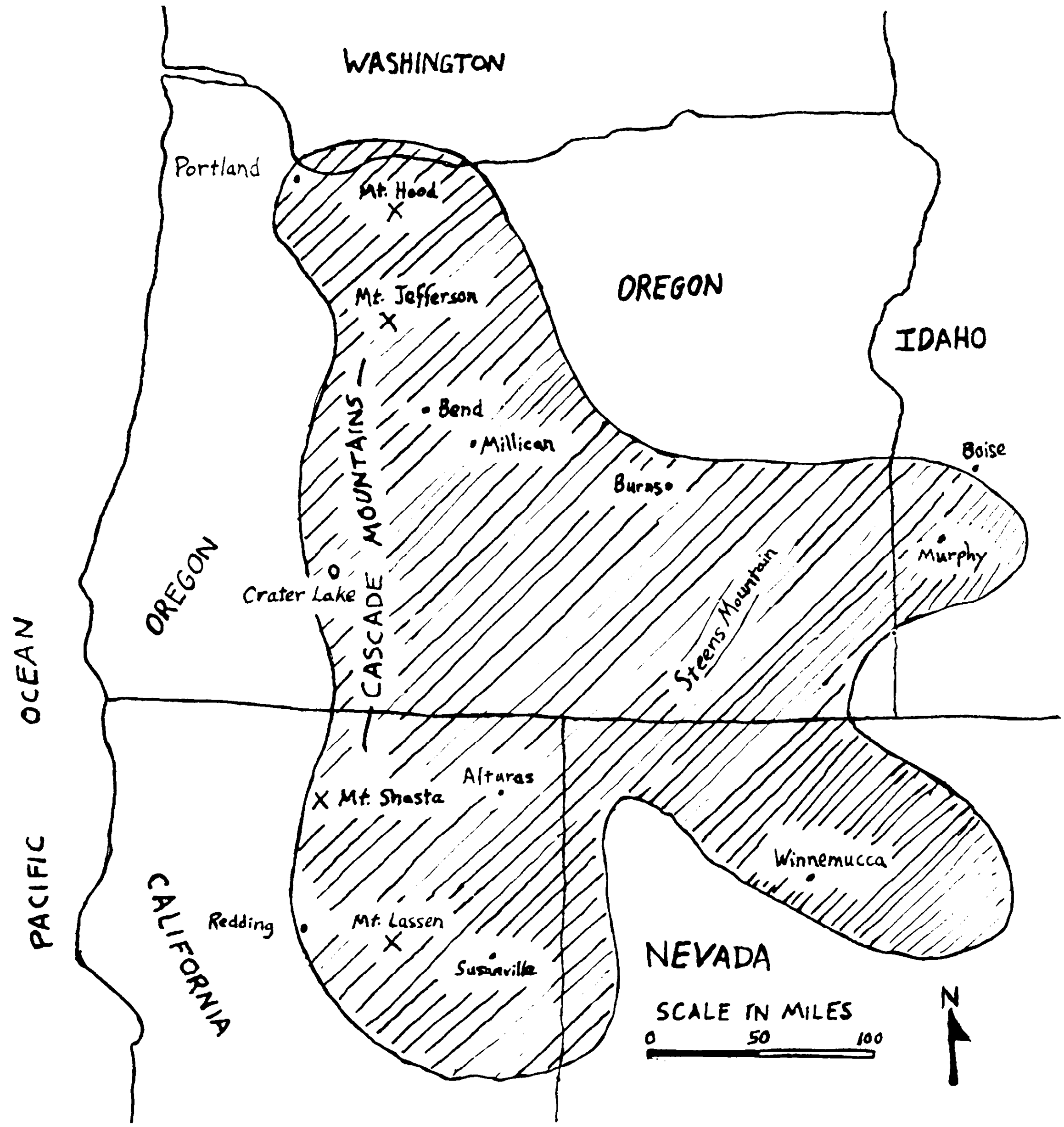

Figure 1. The world's largest known lava flow. The area of this lava flow is shaded on the map. It covered an estimated 100,000 square miles in Oregon, Idaho, California and Nevada.

eruptive event (even if two or three outbursts in rapid succession were assumed) would be equivalent to saying that the flow was so gigantic that portions of it had to come to rest, cooled, and solidified no less than a few hundred miles from the place of eruption. How could any one outpouring of molten rock traverse such a distance before cooling?[1]

Subsequent mapping by Wheeler and Coombs has shown the extremely vast distribution of the *Mesa basalt* (See Figure 1).

Although some of the earlier correlations tentatively proposed in the literature suggested a possible original continuity of *Mesa basalt* considerably in excess of 100 miles, there was no appreciation of the total sweep of the erosionally reduced remnants our everwidening search has uncovered during the last five years. Our recently completed geologic mapping in Oregon reveals at least two areas, each with continuous exposures for more than 100 linear miles. In central Oregon, the *Mesa* sheet may be kept either

> under-foot or in virtually continuous view for 150 miles from southwestern Wasco County on the east slope of the Cascades to Wright's Point Mesa southeast of Burns in north-central Harney County. *Mesa basalt* exposures are equally continuous from near the southeastern base of Mount Shasta in Siskyou County, California, for a distance of 90 miles southeast across the low crest of the southern Cascades to Susanville in Lassen County. If one will allow five erosional separations of present flow remnants (in which the two largest gaps are only ten and twelve miles), a minimum lateral extent of 250 miles is clearly evident. . . . We are now convinced that what we see of the *Mesa basalt* layer today is only a modest fraction of the original sheet of lava. The major portion of the sheet has been eroded away. The remnants are distributed from near Portland, Oregon, southeasterly to beyond Winnemucca, Nevada, a distance of more than 450 miles. In the northeast-southwesterly direction they occur from near Murphy in the Snake River Valley (south of Boise), Idaho, to near Redding in the northern Sacramento Valley of California. The minimum region encompassed is conservatively estimated at 100,000 square miles.[2]

Near Portland, Oregon, the *Mesa basalt* is over 60 feet thick; in central Oregon near Bend about 35 feet; in Modoc County, California, about 29 feet; in southern Lassen County, California, about 22 feet; near Winnemucca, Nevada, a little over 10 feet; in western Idaho about 16 feet thick. The regional thickness gradation of the *Mesa basalt* from thickest in the northwestern most portion (near Portland, Oregon) to thinnest in the southeastern most portion of the sheet (near Winnemucca, Nevada) suggests that the fissure which fed the lava layer was located to the northwest of the entire sheet.

To support their interpretation of the *Mesa basalt* as a single, vast basalt flow, Wheeler and Coombs have also noted similarities in chemical composition, resemblances among volcanic structures, and regionally associated stratigraphic relationships. After mentioning several physically associated characteristics of the *Mesa basalt*, Wheeler and Coombs correctly claim, ". . . these are immediately recognized as the diagnostic physical criteria for the identity, original continuity, and genetic unity of any lithostratigraphic unit (sedimentary or volcanic) . . ."[3]

Many geologists today use fossils or radiometric methods to demonstrate stratigraphic equivalence of layered rocks in separate localities and have relatively ignored the most conclusive method, that of physical stratigraphic similarity. This incredible oversight by geologists during the last 60 years is one of the main reasons why the vast distribution of the *Mesa basalt* has only been recently appreciated.

Special Problems Presented by Mesa Basalt

Since the entire sheet of *Mesa basalt* cooled from a lake of molten lava at roughly the same moment, it is a convenient time datum to check the accuracy of potassium-argon dating. Two U. S. Geological Survey geologists, G. W. Walker and D. A. Swanson, have mentioned several dates which were made before the widespread nature of the *Mesa basalt* was recognized.[4]

In northern Nevada where the *Mesa* was first described by Merriam, the potassium-argon method dated the basalt at 1.2 million years. A date of 7.2 million years came from the basalt near Alturas, California. Near Millican, Oregon, the basalt dated at slightly over 6 million years. An occurrence of diktytaxitic olivine basalt not originally recognized by Wheeler and Coombs as part of the *Mesa basalt* on Steens Mountain in southern Oregon was dated at 14.5 million years.

In view of these and other widely divergent potassium-argon dates and the more conclusive evidence of Wheeler and Coombs for a single *Mesa basalt* flow, we must conclude that the potassium-argon dating method is unreliable.

Walker and Swanson, however, place their faith in the potassium-argon method and believe that the various occurrences of diktytaxitic basalt mentioned by Wheeler and Coombs represent dozens of smaller, individual lava flows separated by millions of years of time. Walker and Swanson claim that the supposed evolutionary order of vertebrate fossils confirms potassium-argon dating, and conclude (erroneously) that Wheeler and Coombs are in serious error concerning the existence of their regionally extensive *Mesa basalt*.

Not only are potassium-argon dating and evolutionary interpretations of late Cenozoic fossils in grave difficulty, but the basic popular assumption in historical geology is in serious question. The *Mesa basalt* is an outright contradiction of the so-called Principle of Uniformity.[5] The flowage of the *Mesa basalt* represents the largest lava flow known and far exceeds any of the present. The catastrophic outpouring of the *Mesa basalt* very possibly took only a few days.

One of the most perplexing difficulties presented by the *Mesa basalt* is its horizontal extent compared to thickness. As an illustration of the remarkable thinness of the Mesa compared to its widespread flow, imagine that the actual thickness of the flow were reduced in scale to the thickness of a page of this *Quarterly*. In order to represent to scale the maximum horizontal dimension of the flow, the page would have to be 20 feet long! Wheeler and Coombs write,

> We confess ourselves no better prepared than Merriam was to explain the mode of long-distance transport of the *Mesa basalt.* We still must ask how (or whether) any lava *flow* (in the *normal* sense of the term) can remain sufficiently hot and fluid while being spread so widely—especially across a terrain with appreciable topographic relief. . . . It seems only logical to speculate that the *Mesa basalt* also may not have been a lava flow in the completely conventional sense.[6]

In their recent geology textbook Dunbar and Waage report,

> One very destructive flow, the Mesa Basalt, so called because it caps so many of the mesas in parts of 3 states, has recently been stated to have covered approximately 100,000 square miles, although it is generally less than 40 feet thick. The mechanism by which it was able to spread so widely before congealing is unknown, but as a molten lake of this size it must have presented a lurid scene such as the earth has seldom seen.[7]

The rock just below the *Mesa basalt* is remarkable because it must have formed a nearly level planar surface of at least 100,000 square miles over which the lava could have flowed. If any considerable topography existed in the 100,000 square mile area, the molten lava would have "pooled" or been deflected and drained off, and would not have spread so evenly over such a broad surface. The vast plane of flow we imagine for the *Mesa basalt* is in striking contrast to the *present* mountainous topography of the region.

The vast planar surface can be explained best by the ash beds which lie immediately below the *Mesa.* Enormous volcanic eruptions seemed to have blanketed the entire area with ash filling in the topography which existed previous to the flow of the *Mesa basalt.* Then, almost immediately, before streams had eroded canyons in the ash, the molten lava blanketed the vast area.

While most of the outcrops of *Mesa basalt* occur east of the Cascade Mountains, some outcrops are found west of the Cascades near Portland, Oregon, and near Redding, California. These facts can only mean that the Cascade Mountains have been uplifted *after* the flowage of the *Mesa basalt!* Thus, the Cascades, contrary to what many geologists have supposed, are among the most recent geologic features and probably were uplifted just prior to the glaciation of the Northwest.

Mesa Basalt and Noachian Flood

It is the opinion of the author that the *Mesa basalt* as well as many other Cenozoic basalts flowed *after* the Noachian Flood. The *Mesa basalt* could not have flowed *during* the flood otherwise it would have been "quenched" by the waters and could not have spread so broadly.

Other Cenozoic basalts that the author has inspected show various evidences of subaerial accumulation such as widespread flow, development of columnar structures which is an evidence of slower cooling, and lack of rounded masses called pillow structures caused by rapid cooling in water. Included in the author's study are the widespread Columbia River basalts (Miocene), the basalts of the John Day formation (Oligo-Miocene) and those of the Clarno formation (Eocene).

Certain types of Cenozoic ash deposits also could not have accumulated in the waters of the flood. The best example is welded tuff. Some of these deposits which are over 60 feet thick were amassed so rapidly that the ash at the top of the deposits has trapped the heat and gases of the ash below and have flattened and "welded" fragments of pumice at the base. If these ash deposits had accumulated underwater the heat and gases could not be retained and the fragments would not be welded.

In the opinion of the author many of the Precambrian, Paleozoic and Mesozoic volcanics, which were deposited before the Cenozoic volcanics, show many evidences of accumulation simultaneous with flood conditions. These precenozoic volcanics in many cases have lava which has been extruded underwater and has quickly cooled forming pillow structure. Dunbar and Waage in their historical geology text comment on the Precambrian metamorphosed volcanics of the Canadian Shield, as follows:

> Metamorphosed lavas take on a greenish color from certain minerals produced in their alteration and are commonly called greenstones. Alteration, however, has not completely obliterated the structure that proves they were surface flows. Pillow structure, formed by sudden chilling where viscous lava flows into standing water, is a common feature. . . . The frequency with which pillow structure occurs in the greenstones of the shield indicates that these enormous masses of lava were extruded into water, presumably into the seas of the time.[8]

In the northeastern United States and in New Brunswick and Newfoundland, Paleozoic volcanic rocks are common. Dunbar and Waage say,

> In a local basin about Westport, Maine, layered volcanics have the impressive thickness of some 10,000 feet. In part these were submarine, for interbedded lenses of sediments include marine fossils. These date the volcanics as Silurian. Farther to the northeast, about Black Cape on the New Brunswick coast of Chaleur Bay, the Silurian sedimentary formations have a thickness of about 8000 feet, all exposed in the sea cliffs,

> and in the midst of the Middle Silurian beds is a thickness of about 4000 feet of black lava flows (whence the name Black Cape). The basal flow poured out over the sea floor engulfing corals and brachiopods which are still well preserved. Here a geologist may have the unusual experience of collecting marine fossils in igneous rock. In north central Newfoundland, where the Silurian section is very thick and is all detrital, it includes some 1600 feet of rhyolitic and andesitic lava flows.[9]

The Mesozoic Franciscan formation of western California has volcanic rocks all of which are claimed to have been deposited in a submarine environment at great depth. The catastrophic significance of the volcanics, sandstones and precipitates of the Franciscan formation was discussed recently by Dr. Bernard E. Northrup.[10] Also, the Metchosin volcanics of Olympic National Park, Washington, which are thought to have been deposited during the Paleocene early in the Cenozoic Era, were extruded under water.

Sedimentary rocks associated with many of these water-laid Precambrian, Paleozoic and Mesozoic volcanics show abundant evidences of catastrophic deposition under flood conditions. Commonly encountered Precambrian, Paleozoic and Mesozoic rocks such as widespread dolostone, bedded chert, black shale, coal and graywacke can be best explained in most cases by flood deposition.[11] The pan-continental distribution of some sandstone, limestone and shale beds is a striking feature of the Paleozoic and can be most simply accounted for by flood deposition. In terms of our thinking that many of the Cenozoic rocks were deposited *after* the flood, it is noteworthy that in late and middle Cenozoic strata widespread dolostone, bedded chert, black shale, coal and graywacke are rare. This agrees with our original observation that pre-cenozoic lava flows are generally submarine while late and middle Cenozoic flows are commonly subaerial.

Summary

Important events in the geologic history of the northwestern United States include:

First, the Noachian Flood which deposited great thicknesses of pre-cenozoic sedimentary rocks;

Second, the building of the Columbia Plateau by a series of Cenozoic basalt flows and ash falls after the flood waters had subsided;

Third, an enormous volcanic eruption spread a layer of molten rock (the *Mesa basalt)* averaging 30 feet thick over parts of Oregon, Idaho, California and Nevada, covering an estimated 100,000 square miles;

Fourth, the uplift of the Cascade Mountains occurred;

Fifth, volcanoes developed on the crests of the Cascades, glaciers covered much of the region, and flooding streams quickly carved canyons leaving buttes and mesas.

Many questions about the *Mesa basalt* still remain unanswered. How did the *Mesa basalt* spread so widely? How many years after the flood did the flow of the *Mesa* occur? Further investigation may supply the answers.

References

[1] Wheeler, Harry E., and Howard A. Coombs. 1968. 100,000 square miles of burning rock. *Saturday Review:* 60-61. October 5.

[2] *Ibid.,* pp. 61-62.

[3] Wheeler, Harry E., and Howard A. Coombs. 1967. Late Cenozoic mesa basalt sheet in northwestern United States. Bulletin Volcanologique 31:23.

[4] Walker, D. W., and D. A. Swanson. 1969. Discussion of paper by H. E. Wheeler and H. A. Coombs, Late Cenozoic mesa basalt sheet in northwestern United States. Bulletin Volcanologique 32:582.

[5] The principle of uniformity specifies the uniformity of process rates or material conditions through geologic time, and the invariance of natural laws in space and time.

[6] Wheeler and Coombs, *Op. Cit.,* p. 62.

[7] Dunbar, Carl O., and Karl M. Daage. 1969. Historical geology. John Wiley & Sons, Inc., N. Y. p. 425.

[8] *Ibid.,* p. 137.

[9] *Ibid.,* p. 223.

[10] Northrup, Bernard E. 1970. Book review: Franciscan and related rocks and their significance in the geology of western California. *Creation Research Society Quarterly* 6(4):161-171. March.

[11] Nevins, Stuart E. (in press). Stratigraphic evidence of the flood. (in) Symposium on creation III. Edited by Donald Patten. Baker Book House, Grand Rapids, Michigan.

NEW PUBLICATION

"Creation, Evolution and the Christian Faith" (Pamphlet of 31 pages) by Richard Acworth. Evangelical Press, 136 Rosendale Road, London, 1969.

The author outlines main attempts to reconcile Christianity with the theory of evolution, and subjects the evidences generally put forward for evolution to careful examination.

He concludes, "Christians have been far too credulous in accepting the assertions of evolutionists; and, as a result, they have allowed themselves to be stampeded into accepting a theory which, as we have seen, has not been proved, and which contradicts the whole biblical teaching as to the relationship of God, man and the world." (p. 29)

This pamphlet reproduces the substance of a Lecture given by Richard Acworth at Westminster Chapel on November 3, 1969. The author is an Anglican clergyman, and the son of the late Captain Bernard Acworth, a distinguished opponent of the theory of evolution.