

# THE OHIO JOURNAL OF SCIENCE

---

---

Vol. XXXVI

NOVEMBER, 1936

No. 6

---

---

## THE THEORY OF LAKES AND MOUNTAIN BARRIERS IN EARLY AMERICAN GEOLOGY

A. S. FURCRON

Between 1750 and 1820, views upon American physiography were embraced in a conception of mountain barriers holding back an enormous lake which occupied the central part of the United States. The great barrier which held back this lake was the Blue Ridge. It was thought that modern Appalachian topography was formed when this lake broke through the barrier and drained the area now occupied by the central states.

The theory probably arose at Philadelphia and gained widespread popularity in the scientific world of the day, especially through the writings of Jefferson and Volney. It was the first attempt of American and European scientists to explain the physiography of the eastern United States, and was based upon the belief that mountains were formed before rivers and lakes, a belief which survived until 1880. The theory presented a strong appeal to active imagination. It is still encountered locally in the east where it is used to explain the origin of gaps in the Blue Ridge.

The early seventy years of American geology (1750-1820) were necessarily a period of speculation. There were no accurate maps to show the positions of the Appalachian mountains and Blue Ridge, and little was known of their elevation. Thomas Jefferson determined the elevation of some of the peaks and gaps in the Blue Ridge of Virginia, yet he thought that the Peaks of Otter were the highest mountains in the United States. The geologists, Maclure and Volney, pursued their studies on foot. Travel in general was by coach, which afforded little opportunity for the study of natural features. Many basic principles in geology were not developed at this period, and many who wrote upon geology had no particular training in that field.

Thomas Hutchins (1730-1789), the first American topographer, outlined the physical features of the eastern colonies in 1778. On his map the Appalachian ridges extend as far west as Fort Pitt. and swing southwestward in a great arc from Pennsylvania to Muscle Shoals (sic) near Mississippi River.

It is probable that the conception of a great inland lake held in by an eastern mountain barrier first spread from Philadelphia, which was then the intellectual center of middle-eastern United States. The first reference to this theory known to the writer, is found in the travels of Peter Kalm<sup>1</sup> who, while in America (1748-1751), spent some time near Philadelphia with the botanist Bartram.

Mr. Bartram was a remarkable observer for the times. Kalm asked him "Whether he had observed in his travels that the water was fallen, and that the sea had formerly covered many places which were now land." Bartram answered that from his experience he was convinced that the greatest part of the country had formerly been under water. He listed many reasons for this belief. (1) Oyster shells occur in the Blue Mountains and its valleys, three hundred miles from the sea. They are found loose and also in the rock. (2) They are dug up in Virginia, Maryland, New York and Philadelphia. Trees, roots and oak leaves are encountered by well diggers at Philadelphia and other places. (3) Valleys bounded by mountain ridges in this country once were covered by lakes. The water finally broke through the mountains and released the lakes. "Such vallies and cloven mountains are very frequent in the country, and of this kind is the peculiar gap between two mountains, through which a river takes its course, on the boundaries of New York and Pennsylvania. The people, in a jest, say, that the opening was made by the devil, as he wanted to go out of Pennsylvania into New York." (4) "When savages are told that shells are found on these high mountains, and that from thence there is reason to believe that the sea must formerly have extended to them, and even in part flown over them, they answer, that this is not new to them, they having a tradition from their ancestors among them, that the sea formerly surrounded these mountains."

Bartram seems to have believed that the mountain barriers were broken and lakes released at the time of the Deluge.

<sup>1</sup>Peter Kalm, "Kalm's Travels in North America," translated by J. R. Forster, London (1772), 2nd ed.

Later observers make little mention of the Deluge, but thought that the breaks in the mountains were made by natural rather than supernatural processes. Thomas Twining, who later helped to lay the foundation of the Indian Empire, said that it was common belief among American geologists that the "Blue Mountains were once the boundaries of an immense lake till the Susquehannah, Potomac, and other rivers burst through them."<sup>2</sup>

Smyth in 1784, writing of the eastern central states, mentions "the mountains suddenly broken through and severed by mighty rivers."<sup>3</sup>

Maclure was interested in the classification of rocks and avoided any discussion of the theory.

Merrill<sup>4</sup> quotes S. L. Mitchell (1818) upon the "Theory of Barriers." Mitchell, however, merely expanded the general theory from the viewpoint of the northern states. The theory had been in existence for at least seventy years prior to Mitchell's article. His work followed and amplified the opinions of Volney and other writers upon the topic.

Thomas Jefferson popularized the conception of barriers which he may have encountered at Philadelphia. Travelers in the United States generally visited Jefferson at Monticello. In the hall at Monticello they saw mammoth bones, "maps traced by the Indians on leather," and other curiosities. They talked with him upon Indians, climate, timber, Natural Bridge, and the natural wonders of Virginia. For years Mr. Jefferson served as a voluntary tourist's bureau. English travelers listened and sometimes disagreed, but French and German travelers with greater confidence in his opinions, left Monticello convinced of the truth of his scientific theories.

Jefferson's colorful description of the break in the Blue Ridge at Harper's Ferry placed the conception of barriers upon a firm footing for many years.<sup>5</sup>

"The passage of the Patowmac through the Blue ridge is perhaps one of the most stupendous scenes in nature. You stand on a very high point of land. On your right comes up

<sup>2</sup>Thomas Twining, "Travels in America 100 Years Ago," (1894), Harpers, New York, p. 99.

<sup>3</sup>J. F. D. Smyth, Esq., "A Tour of the United States of America," (1784), 2 vols., London.

<sup>4</sup>George P. Merrill, "The First One Hundred Years of American Geology," (1924), New Haven, Yale University Press, pp. 50-53.

<sup>5</sup>Thomas Jefferson, "Notes on the State of Virginia," (1800). Baltimore, W. Pechin, pp. 20-21. Many editions. The Notes were first written in 1781.

the Shenandoah, having ranged along the foot of the mountain an hundred miles to seek a vent. On your left approaches the Patowmac, in quest of a passage also. In the moment of their junction they run together against the mountain, rend it asunder, and pass off to the sea. The first glance of this scene hurries our senses into the opinion, that the earth has been created in time, that the mountains were formed first, that the rivers began to flow afterwards, that in this place particularly they have been dammed up by the Blue ridge of mountains, and have formed an ocean which filled the whole valley; that continuing to rise they have at length broken over at this spot, and have torn the mountain down from its summit to its base. The piles of rock on each hand, but particularly on the Shenandoah, the evident marks of their disrapture and avulsion from their beds by the most powerful agents of nature, corroborate the impression. But the distant finishing which nature has given to the picture, is of a very different character.—It is a true contrast to the foreground. It is as placid and delightful, as that is wild and tremendous. For the mountain being cloven asunder, she presents to your eye, through the cleft, a small catch of smooth blue horizon, at an infinite distance in the plain country, inviting you, as it were, from the riot and tumult roaring around, to pass through the breach and participate of the calm below. Here the eye ultimately composes itself; and that way too the road happens actually to lead. You cross the Patowmac above the junction, pass along its side through the base of the mountain for three miles, its terrible precipices hanging in fragments over you, and within about 20 miles reach Fredericktown, and the fine country round that. This scene is worth a voyage across the Atlantic. Yet here, as in the neighborhood of the Natural Bridge, are people who have passed their lives within half a dozen miles, and have never been to survey these monuments of a war between rivers and mountains, which must have shaken the earth itself to its centre.”

A “lofty crag upon the margin of the river,” from which Jefferson is said to have viewed the scene, was once called “Jefferson’s Rock.” Jefferson told Volney that he had taken his description from “the report of a French engineer, who, during the Revolutionary war had scaled the hill.” This account of Jefferson was frequently quoted in American geographies where it may be found as late as 1850.

Count C. F. Volney, an authority of the times upon history and geography, visited the United States in 1795, and traveled extensively for three years. He hiked through rural America making observations upon climate, soils, and geology. Twining met him in 1795 and said "he was cold and satirical. . . . He was little pleased with America, and where he was not pleased he expressed himself with much severity." The following episode recorded from rural Virginia may have been typical of Volney:<sup>6</sup>

"Some thirty or more years ago, at the close of a summer's day, a stranger entered Warrenton. He was alone and on foot, and his appearance was anything but prepossessing; his garments coarse and dust-covered, like an individual in the humbler walks. From a cane resting across his shoulder was suspended a handkerchief containing his clothing. Stopping in front of Turner's Tavern, he took from his hat a paper, and handed it to a gentleman standing on the steps. It read as follows: 'The celebrated historian and naturalist, Volney, needs no recommendation from G. Washington.'"

Volney talked with Jefferson, Washington, "Mr. Barton" and many others, and his views were colored by their opinions. It seems more than probable that Volney developed the idea of barriers after his talks with Jefferson, although his views are stated as if they were original. Volney brought this theory into a position of the greatest importance in American geology.

He believed<sup>7</sup> that the Blue Ridge was once a great barrier and that the Great Lakes are a shrunken remnant of a great inland sea which stood behind it. He thought that the sea has broken through at Harper's Ferry and at other places. The breaks in the Blue Ridge were produced by stream erosion and by earthquakes. High gaps in the ridge were formed by the first efforts of the lake to reach the sea. Terraces along the Ohio he believed to be due to successive lower water levels as the barriers were lowered. Horizontal strata west of the ridges were deposited in this ancient sea and rivers washing in trees laid down the beds of coal. Coal beds in Virginia east of the Blue Ridge may have somehow been produced by earthquakes, although the beds near Richmond were laid down in a basin which was held in by rocks at the present Fall line.

<sup>6</sup>Henry Howe, "Historical Collections of Virginia," (1845), p. 261.

<sup>7</sup>C. F. Volney, "Tableau du Climate et du Sol des Etats Unis d'Amerique, etc." (1803). Several editions. English translations by C. B. Brown, Philadelphia, (1804).

According to Volney's map, the great eastern barrier extends from the southern side of the St. Lawrence in Nova Scotia southwestward to include the White Mountains of New Hampshire, the Highlands of New Jersey, and the Blue Ridge to Alabama. Appalachian ridges run into this mountain chain in such a manner as to make many isolated interior basins. From Alabama, the chain swings sharply westward to the junction of the Tennessee and Cumberland rivers with the Ohio. Here the mountain was presumably broken by the Mississippi. The "Haute Louisiane" west of the river extends the highland westward to the Stony Mountains. This chain extends northward to the Mackenzie River. He places an east-west mountain chain north of the Great Lakes from the Stony Mountains to Labrador. The St. Lawrence breaks through this chain and also through an inner chain which strikes across the east end of Lake Ontario from the Adirondack Mountains. His great inland sea or lake stood within this barrier of mountains. Volney made no definite attempt to explain the origin of the ridges.

French travelers followed Jefferson in their opinions upon American geology. It remained for the Marquis De Chastellux<sup>8</sup> to polish up the theory by using it to explain the origin of Natural Bridge in Virginia.

The first accurate survey of the bridge was made by Baron de Turpin under Count de Rochambeau and at the instigation of the Marquis De Chastellux. De Turpin took from "every part of the arch, and of its supporters" pieces of stone all of which were found to dissolve in aqua fortis and says that "these rocks being of a calcareous nature, exclude every idea of a volcano, which besides cannot be reconciled with the form of the bridge and its adjacent parts." Nor could a current of water break through here and make the bridge. Chastellux outlines the theory of lakes behind mountain barriers and says that rivers rising in the Alleghanies "have opened ways for themselves to the sea, by piercing the mountains at angles, more or less approaching to right angles, and forming more or less spacious valleys. Natural Bridge was formed by this process where water broke through." Other bridges formed in this manner have collapsed since.

While such views were held by famous men, Gilmer in 1815,

---

<sup>8</sup>Marquis De Chastellux, "Travels in North America," (1787), 2 vols. London.

after visiting the bridge with its owner, Jefferson, refused to accept this theory, and in this manner Jefferson lived into the day of modern science. In a remarkable article before the American Philosophical Society Gilmer said<sup>9</sup> that the bridge was due to solution effects in limestone.

Observers at an early date attacked Volney's conception of inland lakes. David Thomas,<sup>10</sup> an astute New York traveler, made a westward journey by coach in 1816 to study the "Waubash lands in the New Purchase." Wherever the coach stopped, he continually tested Volney's theories against personal observations. Although Volney was "said to be a genius of the first order in physical geography," he found that the knobs at New Lexington which Volney said once held back a great lake, could not have done so, since the rocks below their summits are not alluvial but are calcareous and siliceous (secondary). He condemns the tendency of the geologists of the time to "imagine that every valley which pours a stream through mountain ridges, was formerly the bed of a lake." He states that the Blue Ridge, for example, was too massive for its breaches to have been made by pressure of water, nor could these ruptures have been made by earthquakes as Volney suggested. He says that Volney's theory is absurd because the Knobs do not extend across the valley of the Ohio or the White River, because the secondary strata including coal beds and limestone, are not the kind of rocks to be laid down in recent lakes, and that the marine shells in the rocks west of Volney's lake can not be explained according to his principles."<sup>11</sup>

The conception of mountain barriers and inland seas died obscurely. Scientists lost faith in it before a better theory was advanced. Writers of geological texts avoided it. Except in

---

<sup>9</sup>Francis W. Gilmer, "On the Geological Formation of Natural Bridge, Virginia," (1818). Trans. Am. Phil. Soc., vol. I, new ser., No. 13.

<sup>10</sup>David Thomas, "Travels Through the Western Country in the Summer of 1816," (1819), Auburn, N. Y.

<sup>11</sup>Although beyond the scope of this paper, it should be said that from his study of coal and invertebrate fossils, Thomas caught a glimpse of organic evolution 40 years before the publication of the *Origin of Species*. He says, p. 260:

"The grand order of our system is to spring, to flourish and to die. The period for which many\* plants and animals were intended, is past; and like the individuals of every race, whole species have perished. The space assigned them has been filled; new orders arise; and combinations more beautiful are unfolded. The sheep tenants the deserted ranges of the wolf, and the yellow gleams of harvest, succeed the dark foliage of the forest.

\*It is questionable whether the beds of coal are the remains of any vegetable species now in existence."

school geographies, little mention is made of this theory after 1820.

In 1821, Wilson<sup>12</sup> attacked Volney's Views, Jefferson's Notes, and the opinions expressed in the appendix to an early American edition of Cuvier's theory. He said that the barrier does not have sufficient height to pond up a large lake, and that the lake could not have broken through at six points at once.

Charles Lyell visited America in 1841-42. He calls special attention to the *absence of lakes in the Appalachians*. He may have been thinking of the supposed lakes when he said "it is singular that there are no lakes in the Appalachian chain, all the rivers escaping from the longitudinal valleys through gorges or cross-fissures, which seem invariably to accompany such long flexures of the strata as characterize the Alleghanies or the Jura."<sup>13</sup>

From discussions which arose upon the origin of these "cross-fissures" came the conception of antecedent streams, and the development of modern physiography by Davis.<sup>14</sup>

Although abandoned many years ago by science, the theory of lakes and mountain barriers is not entirely dead to this day. It is still encountered in rural Virginia and perhaps at other places, where it is probably a survival from the past. Sometimes it arises spontaneously. Dyott,<sup>15</sup> a South American explorer has recently invoked the theory to explain the geology of the Amazon valley.

In 1902 the existence of an inland lake held back by the Blue Ridge was suggested by the writer of a soil report.<sup>16</sup> Because waterworn cobbles occur in the fans at the western slope of the Blue Ridge "this talus slope has been subjected to the action of water, probably while forming a shore of an inland sea.

<sup>12</sup>J. W. Wilson, "On the Bursting of Lakes Through Mountains," *Am. Jour. Sci.*, (1821), pp. 252-3.

<sup>13</sup>Charles Lyell, "Travels in North America," (1845), 2 vols. New York, p. 240.

<sup>14</sup>William Morris Davis, "The Origin of Cross Valleys," (1883), *Science*, I, pp. 325-27, 356-57.

<sup>15</sup>G. M. Dyott, F. R. G. S., "Man Hunting in the Jungle," (1929), Bobbs-Merrill Co., pp. 111-112.

<sup>16</sup>Charles N. Mooney and F. E. Bonsteel, "Soil Survey of the Albemarle Area, Virginia," U. S. Department of Agriculture, Bur. of Soils, (1902), p. 207.