CAVERNS AND ASSOCIATED FEATURES OF THE VALLEY OF VIRGINIA

BY

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It is the purpose of this paper to give a brief summary of the geology, physiography, and physiographic history of part of the Appalachian Valley in Virginia, with emphasis upon the numerous caverns, the famous Natural Bridge, the unique Natural Tunnel, and the events of geologic history which led to their origin.

Geologic provinces of Virginia.—As the southern boundary of Virginia is about 440 miles long, with the southwest corner of the State being in the longitude of west-central Ohio, the State lies in several geologic and physiographic provinces. These are, from east to west, (1) the Coastal Plain, (2) the Piedmont Plateau, (3) the Blue Ridge, (4) the Appalachian Valley, or Valley and Ridge province as it has been recently designated,[1] and (5) the Appalachian Plateau. This discussion is concerned only with the Appalachian Valley.

The Appalachian Valley.—Between the imposing east front of the mountainous part of the Appalachian Highlands, or Blue Ridge, and the east front, in places called the Allegheny Front, of the broad dissected Appalachian plateau to the west, is a remarkable lowland, the Appalachian Valley, which extends from central Alabama northeast through the length of the Appalachian Mountains. It consists in general of an almost continuous eastern lowland, the Great Valley, and a coextensive series of prominent more or less parallel to sub-parallel linear narrow ridges and alternating valleys on the west. Ridges predominate in the northwestern part of the Appalachian Valley in Virginia but valley-like lowlands are more abundant in the southeastern part.

Valley of Virginia.—The Great Valley in Virginia is commonly known as the Valley of Virginia. As concisely described by Stose[2] it "extends for over 300 miles from the north boundary to the south boundary of the State, bending to west-southwest in its southerly portion.

[1] Fenneman, N. F., Physiographic divisions of the United States; Annals Assoc. Am Geog., vol. 18, pp. 261-353, 1928.
[2] Stose, G. W., Virginia Geological Survey, Bull. 23, p. 5, 1922.

Although it is occupied by parts of several large drainage systems—the Shenandoah, James, Roanoke, New, and Holston rivers— and is in places notably dissected by these rivers and their tributaries, and, although the floor of its several parts stands at various altitudes between 500 feet and 2,500 feet above sea-level, it is, nevertheless, when examined in a broad way, seen to be a single, generally broad flat-bottomed valley everywhere several hundred feet, and in places 2,000 to 3,000 feet, below the summits of the Blue Ridge on the east and the Valley Ridges on the west."

The Valley of Virginia is divided by projecting and transverse spurs into five rather distinct valley lowlands, which are in a northeast-southeast series like huge flat beads on a string. Shenandoah Valley to the northeast is the largest, and of chief concern in this discussion. In Virginia, it is about 150 miles long and from 10 to 20 miles wide. It is locally constricted by spur ridges and also divided lengthwise by Massanutten Mountain, a very prominent medial ridge in the northern third of the valley.

Geology of Shenandoah Valley.—The west slope of the Blue Ridge, along the east side of Shenandoah Valley, consists mainly of sandstones, quartzites, shales, and limestones of Cambrian age. The floor of the valley is underlain chiefly by shales and limestones of Cambrian and Ordovician age. The limestones occur in broad extensive northeast-southwest belts. Bounding ridges on the west contain highly resistant sandstones, mostly of Silurian age. Other formations along the west side of Shenandoah Valley, or in ridges and valleys to the west, are composed of shales and sandstones with few limestones, which range in age from Cambrian to lower Mississippian.

The Cambrian to Mississippian formations of the Appalachian Valley are enormously thick. Their total thickness is more than 20,000 feet, and may be considerably more. The Cambrian-Ordovician limestones and shales in Shenandoah Valley are at least several thousand feet thick. Some limestones are a few thousand feet thick.

Although the stratigraphic and structural relations of the Valley are complex, the field studies of numerous workers have shown that the structure of the Valley may be briefly described as a series of huge northeast-southwest folds broken by numerous faults. The highly folded structure is characteristic of the region east of the more gently folded and warped Appalachian Plateau. Some of the anticlines have been so closely folded that the beds have been broken. In places slaty cleavage is well developed even in the limestones. The faults are mainly overthrusts from the southeast.

Cavern characteristics.—The Valley of Virginia contains numerous caverns, some of which are famous, with others becoming better known each year. The features of the various caverns can not be described in this brief paper; rather only some features that they have in common can be indicated.

The caverns occur in definite northeast-southwest belts of limestone along the anticlines in the Valley. They appear to be definitely related also to the erosion levels which are so prominently developed in the Valley. Detailed studies, however, will be necessary before the relations can be fully determined, but some suggestions are made below. Most of the caverns that have been explored are exceptionally large, comparing favorably, in this respect, with the largest known caverns of other regions. Each cavern contains a wealth of stalactites, stalagmites, and other deposits, commonly in fantastic and striking arrangements.

Origin of the caverns.—Following prolonged deposition of an enormous thickness of sands, muds, and limy muds during the Paleozoic era in the various troughs of the great Appalachian geosyncline, late Paleozoic mountain-building forces crushed and crumpled the formations into a mountainous tract of large sub-parallel folds, many of which were broken by great overthrust faults. During this time the limestones were in places much broken and shattered.

During subsequent geologic time the folded Appalachian tract has undergone erosion by streams, ground-water, and other agents, with the result that the folds have been planed across, forming several partial peneplains, or old floors of extensive valley systems. Remnants of four of these peneplains are well shown in the Valley of Virginia. The lowest, and best-preserved, is called the Valley Peneplain. It forms the broad, gently rolling floor of Shenandoah Valley, and other similar lowlands of the Great Valley in Virginia. After the formation of this peneplain, further uplift has renewed stream erosion, so that the present streams are, in general, several hundred feet below this surface.

The beveling of the folds has exposed the belts of limestone between parallel belts of less soluble rock. Hence, in a word, ground water has been enabled to attack these zones of planed limestones, especially where the structure is most favorable, gradually dissolving out caverns of great size. As the surface streams cut more deeply into the uplifted Valley peneplain, underground streams and the general movement of underground waters in places formed caverns with rooms at several levels.

The Natural Bridge.—The famous Natural Bridge of Virginia is also largely a product of solution by ground-water. It is a great lime-

stone arch, 198 feet high and with a span of 90 feet, across Cedar Creek, a small tributary of James River. Different interpretations of its origin have been made,[3] but each emphasizes the part of underground solution along channels in the limestone.

Natural Tunnel.—A somewhat similar feature is the unique Natural Tunnel in Scott County, Southwest Virginia. Here a large channel has been eroded through the almost horizontal beds of a projecting spur.

Other features.—The Valley of Virginia contains other features, resulting from the cycle of ground water erosion, which can only be mentioned here. Sink-holes are numerous in some areas. Some are of the collapse type, due to the infall of cavern roofs, whereas others appear to be of the swallow-hole type.

A unique feature in Virginia is Mountain Lake, about three-fourths mile in diameter, at an elevation of 4,000 feet on Salt Pond Mountain, Giles County. It appears to have been formed by the choking of the outlet of a large sink.

In many places, where the soil and subsoil are removed from the limestones in quarrying or in mining for residual ores, typical pinnacles of a karst topography are found to be excellently developed.

Summary.—The work of ground-water in the limestone belts of the Valley of Virginia has been of great importance in producing many significant and interesting features, among which are numerous large caverns, Natural Bridge, Natural Tunnel, a mountain lake, as well as an abundance of sinks and limestone pinnacles. Many features remain to be studied in detail.

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[3] Gilmer, F. W., On the geological formation of the Natural Bridge of Virginia: Trans. Amer. Phil. Soc., 1, pp. 187-192, 1818.
Walcott, C. D., The Natural Bridge of Virginia: Nat. Geog. Mag. 5, pp. 59-62, 1893.
Reeds, C. A., The Natural Bridge of Virginia and its environs, Nomad Publishing Co., Inc., New York, 62 pp., 1927.
Malott, C. A., Origin and development of Natural Bridge, Virginia: Am. Jour. Sci., 5th ser., vol. 19, pp. 257-273, 1930.