Composite Genesis of the Arkansas Valley through the Ozark Highlands
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Reviewed work(s):
Source: *The Journal of Geology*, Vol. 9, No. 6 (Sep. - Oct., 1901), pp. 486-490
Published by: The University of Chicago Press
Stable URL: http://www.jstor.org/stable/30060286
Accessed: 11/11/2012 08:51

COMPOSITE GENESIS OF THE ARKANSAS VALLEY THROUGH THE OZARK HIGHLANDS

On account of its singular course through the Ozark highland region the Arkansas River presents, at the present time, unusual geological interest. Its location in this part of its course, has given rise to two very different opinions regarding the geological age of the highlands; and also regarding the question as to whether there are two distinct uplifts, as has been advocated by the Arkansas geologists, or only one, as has been urged by others who have worked in the region. Recently there have accumulated new data bearing directly upon the problem.

Topographically, the Ozark highlands comprise two imposing, nearly equal, elevated regions, separated from each other by a broad deep trough—the Arkansas River valley. The vast plain surrounding the highlands is about 400 feet above sea level on the eastern side and twice this elevation on the west side. The Arkansas River flows along on the horizon of this general grade-plain. On the south side of the river the highlands rise to heights of nearly 3000 feet above the sea; and on the north to about 1800 feet.

Diverse apparently in topographic expression, lithologic composition, geologic structure, and geological age, the district south of the Arkansas River has been known as the Ouachita Mountains, and that north of the stream the Ozark plateau. On the assumption that there are two distinct uplifts, the river of Arkansas is regarded as forming a natural dividing line between the two regions. At first glance, the simplest explanation for the position of the stream is forced upon the attention. Premising a single uplift, the accounting for the waterway's course meets with difficulties which, from superficial consideration, appear well-nigh unsurmountable. The present note attempts to sum up the evidence going to show that the facts actually sustain the second premise.

In comparing the two districts, it is their differences and not their points of resemblance which are most conspicuous. In the Ouachita region the surface relief is notably mountainous, long ridges and isolated peaks, with wide, flat-bottomed valleys intervening. In the northern district the country is far from appearing mountainous; it is, for the most part, a vast undulating plain, but sharply and deeply dissected around the borders, with the streams flowing in V-shaped valleys. In the south the rocks are more or less indurated or metamorphosed, and cut at intervals by eruptives. Nowhere in the north do the strata

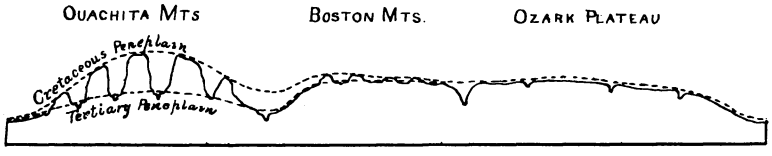

FIG. 1.— Peneplains of the Ozark region.

show alteration or evidence of the presence of eruptives. The southern district is folded to a marked degree, approaching closely the Appalachian structure; while the northern region is only gently bowed. Regarding the geological ages of the two districts, the Ouachita has been thought to have been upraised towards the close of the Carboniferous; the northern area has been commonly considered as having been an elevated region ever since pre-Cambrian times. The present uplift, however, is now believed to be of very recent origin; and the upward movement is thought to be still in progress.

The physiographical history of the region and the relations of the graded surfaces of the Ozark highlands are best indicated in diagram (Fig. 1).

Two distinct base levels are discernible in the region. They have been called the Cretaceous and the Tertiary peneplains. These titles will be retained for the present. The first of the peneplains rises out of the level savannas of the Mississippi embayment, but soon becomes deeply broken as it rises and passes into the Ouachita region. It is there believed to be

continued northward in the mountain summits, which are often flat-topped.[1] The later peneplain is thought to be represented in the intermontane flats which are about 1500 feet lower than tops of the mountains. The floor of the Arkansas valley is coincident with the Tertiary peneplain. Beyond the stream northward the Tertiary surface rises rapidly according to Hershey,[2] and soon in the region of the Boston Mountains the two peneplains practically merge. In Missouri only the Tertiary plain has been distinguished, and this is regarded as forming the general upland surface of the uplift.

It is probable that north of the Boston Mountains it will be exceedingly difficult to differentiate at any point the two peneplains. Present evidence goes to show that during the interval between the formation of the two peneplains in the south the erosion in the north was comparatively slight, and resulted in merely lowering the general surface of the plain already formed during the Cretaceous.

Some time ago it was incidentally stated that the Ozark highlands formed a single unit bowed up from the Red River to the Missouri.[3] The most obvious support for this conclusion is found in the physiographic development of the region. But the evidence is not alone from this source.

The physiographic data would indicate that in the Ozark region the uprising since Cretaceous times has been not only periodical in its character, but that it has been also differential. Lately the movement has been more marked in the north than in the south.

But there were special conditions existing that enabled the Arkansas River to hold its own against the great barrier which started to rise across its course. In a limited belt in this part of the Ozark region an enormous mass of non-resistant clay shales had been deposited in Carboniferous times. The thickness attained was much greater than that of the Carboniferous

[1] Arkansas Geol. Surv., Ann. Rept., 1890, Vol. III.

[2] American Geologist, Vol. XXVII, p. 25, 1901.

[3] Missouri Geol. Surv., Vol. VIII, p. 331, 1895.

sediments anywhere else on the American continent, being upward of 20,000 feet, according to Branner.[1] The peculiarities of this great sequence of soft shales have lately been discussed in some detail, and the real significance of the Arkansan series, as it is called, pointed out.[2]

Thus, independent of whatever geological structure the Arkansas valley may have, the enormous column of shales was of such character as to enable the great stream to scoop out a trough sufficiently vast and broad to give its topographic form

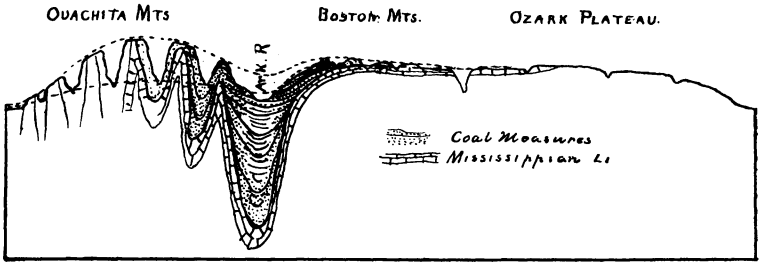

FIG. 2.— Stratigraphy of the Ozark Highlands.

the effect of a depression between two uplifts.

There is another deceptive feature connected with the valley of the Arkansas, that must be taken into consideration. Besides being a topographical trough, the valley is also a structural trough. A broad and shallow syncline stretches from the crest of the Boston Mountains to the first range of the Ouachitas. The strata closely folded in the extreme southern part of the highland district spread out rapidly towards the north until they form gentle undulations that are so characteristic of other parts of the Mississippi basin. The Ozark arch in Missouri constitutes the last great swell northward. Its southern limb passes into the broad syncline which contains the Arkansas valley. This relationship of structure is represented by a north and south cross section (Fig. 2).

The operation of different geological processes may be either

[1] Am. Jour. Sci., (4), Vol. II, p. 235, 1896.

[2] Bull. Geol. Soc. America, Vol. XII, p. 173, 1901.

all compensating, or all cumulative in their effects. Between the two extremes the sum of the antagonistic tendencies may have very variable values. The present valley of the Arkansas River as it crosses the Ozark highlands is a noteworthy illustration in which the combined effects of perfectly independent processes are curiously cumulative in character. It is on this account chiefly that the real facts concerning the development of the great uplift have been so largely obscured.

Summing up: The different geological conditions when the Arkansas River initiated its course across the Ozark region, (1) an undeformed lowland flat in which the strata had been folded to a marked degree before being beveled and the country reduced to the state of a peneplain, (2) a remarkable, yet narrow, belt, bordered on either side by resistant rocks, of soft shales of prodigious thickness which, when a new epoch of uprising was inaugurated, enabled the stream to easily keep its channel down to the general base level of the country surrounding the uplift, and (3) a broad structural trough, which, however, was only one of many synclines nearby and parallel to it—were highly cumulative in effect in imparting to the uplift the present aspect of twin elevations. By this singular combination of geological conditions the Arkansas River instead of being forced to turn aside by the great topographic dome which, out of the Cretaceous peneplain, arose athwart its path, was able to saw in two the arching strata.

Topographically, the Ozark highlands form two distinct elevated regions. Structurally as well as topographically the Arkansas valley is a trough. But structurally the Ozark highlands, as a whole, form an immense dome bowed from the Red River to the Missouri.

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