

of the lime used in the state comes from Texas and Missouri. Our one plant is at Fort Towson in the southeastern part of the state where much of its output finds its way into adjoining states. This lack of lime plants is not caused by any lack of suitable limestone within the state. There are several localities where both the stone and wood for fuel are well situated with regard to transportation.

Such brick plants as the writer has visited were doing a better business in 1922 than they did in 1921. The brick-making industry is handicapped by high fuel, high freights, lack of cars, and the high cost of brick laying as compared with the cost of pouring concrete.

The portland cement plants now operating in the state have a combined capacity of 250,000 barrels a month, or 940,000 sacks a month. It would require 1,175 large freight cars to move the month's output. At the height of the season the demand was greater than the capacity.

XXIII. A PRELIMINARY INTERPRETATION OF CERTAIN PECULARITIES OF THE NORTH AND SOUTH CANADIAN RIVER BASINS IN THE RED BEDS AREA OF OKLAHOMA

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The North Canadian and South Canadian river basins in the Red Beds plains area are quite unlike those of near by Cimarron and Washita. These differences present an interesting physiographic and geographic problem since the somewhat unique physiographic history of the Canadian basin has resulted in differences not only in topography, but also in soil, soil erosion, land utilization, problems of road building and maintenance, location of railroads, location and development of cities, water supply, flood control, and sewerage disposal. It is the purpose of this paper to point out the distinctive topographic features of the region in question and their causes rather than to trace out their human consequences.

The most striking features of the North Canadian and South Canadian basins in this region are (1) their narrowness; (2) the relatively high position of the region above sea level; (3) the small local relief and unbroken character of the topography. (1) The average width of the North Canadian and South Canadian basins in Canadian and Grady counties is six to eight miles, whereas, the

width of the Cimarron on the north is fifty miles and that of the Washita on the south ranges from thirty to fifty miles. The slopes from the South Canadian-Washita divide to the Washita at Chickasha is 18-20 miles long, while the slope northward from this divide is but five or six. Similarly, the slope northward from the North Canadian-Cimarron divide is about 25 miles long while the slope southward to the North Canadian is but two or three miles in length. (2) The high elevation of the region is perhaps best indicated by comparing the elevation above sea level of the beds of the major streams. The following table indicates that the beds of the two Canadians are from 170 to 300 feet higher than the Cimarron and Washita.

Table Showing Elevation Above Sea Level of Major Streams
Crossing the Red Beds in West Central Oklahoma:*

Washita at Chickasha	1080
South Canadian North of Minco	1250
North Canadian at El Reno	1300
Cimarron at Kingfisher	1000

Upland elevations indicate a still greater contrast.

(3) The smaller local relief and less broken character of the topography may be readily observed in travelling across the divides between North Canadian and Cimarron on the South Canadian and the Washita. A similar contrast may be noted in going from the North or South Canadian basin in this region to the Deep Fork or to the Little river basins.

It is believed that these topographical peculiarities are not accidental and that an explanation may be found through a study of the structure of the underlying rocks and the physiographic history of the region. The following hypotheses may be advanced:

1. That the greater elevation has been due to an uparching of rocks, perhaps along an axis parallel to the Wichita-Arbuckle uplifts. If, however, such an uplift exists it never has been described. Moreover, such an uplift, if recent, would rejuvenate the streams and produce a dissection of the topography. The topography on the contrary seems to be less dissected and present erosion less rapid in the Canadian basin than either the Cimarron or Washita.

(2) That the rocks in the region under consideration are more resistant than those northward or southward and as a result the rate of erosion has been less rapid. Somewhat limited field studies, however, do not indicate that this is the case. The rocks are largely Permian shales with no conspicuous structural or textu-

*Chickasha and Kingfisher Quadrangles, U. S. G. S.

ral differences as compared with adjacent areas. If any important difference in resistance exists it seems to be in favor of the Canadian basin, since in the Washita basin erosion must be checked by the course White Horse sandstone extensively developed in part of that region.

(3) That the ridge has resulted from conditions outside the region in question which have reduced the downward cutting of the North Canadian and South Canadian rivers and incidently their tributaries as compared with the downward cutting of the Washita and Cimarron.

The writer believes this to be the case. This hypothesis would seem to account for the narrowness of these basins since the lower elevation of the beds of the Washita and Cimarron would not only produce a shifting of the divides toward the Canadians thus narrowing these basins, but also would permit a greater dissection and lowering of the surface within their basins.

If the last hypothesis is the correct one it remains to ascertain, if possible, what conditions are responsible for the comparatively slow downward cutting by the North and South Canadian. Much work must be done on all of the rivers in question before a conclusive answer can be given. However, the writer believes it to be largely due to two conditions:

1. The fact that the South Canadian and North Canadian flow across resistant rock formations in the area of Pennsylvanian rocks eastward, particularly such formations as the Seminole conglomerate, Thurman sandstone, Senora formation, and Calvin sandstone. There is a well defined narrows some 300 feet deep in the North Canadian valley in township 11N, R.14E., McIntosh county, where the stream is cutting through sandstones* (Thurman). Also the town named, Keokuk Falls, in Eastern Seminole county suggests this, although the writer has not had an opportunity to visit this place. Likewise, the South Canadian in the vicinity of Calvin has a rather pronounced narrows. These formations appear to have formed a temporary base level. A similar result could have been produced by uplift but the fact that the narrows are limited to the resistant formations favors the above interpretation. Since these formations grade into shales to the northward† the Cimarron-Arkansas drainage crosses the upper Pennsylvanian rocks where they are less resistant while the Washita-Red river drainage goes farther south and hence misses these resistant sandstones.

2. Downward cutting by the South Canadian appears to be

*Canadian Quadrangle U. S. G. S.

checked by the large quantities of sand with which its channel is choked. During a considerable part of the year the stream bed is dry, all of the water moving slowly through the sand and hence powerless to erode or transport clastic materials while even in flood the transportation of large quantities of sand then in suspension must consume much of the stream's energy and reduce its cutting power. The fact that Little River, a tributary of the South Canadian, which is not sand choked, has been able to reduce its bed and much of its basin lower than the bed of the South Canadian in Eastern Cleveland and Pottawatomie counties supports the view that the sand choked character, particularly of the South Canadian, has been an important factor in its inability to degrade its basin. This sand not only retards downward cutting of the Canadian but also of its northern tributaries which are choked by sand blown from the stream bed by the south winds. Much of this sand must be removed by erosion before the streams can erode the underlying residual materials. This appears to be an important secondary factor in determining the location of the Cimarron-North Canadian divide. That the sand choked condition is of secondary, rather than primary, importance in the control of erosion appears evident, however, from the fact that the Cimarron, like the South Canadian, has a sand choked channel.

XXIV. SOME OBSERVATIONS ON THE SOUTH CANADIAN RIVER NEAR NORMAN

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The laws of stream action have been worked out mostly from the study of streams of the humid regions. The streams of the arid and semi-arid regions have been given less attention and it is quite common when such streams do not conform to the usual humid type to consider them as abnormal. However, the intermittent stream is just as normal a type for the dry regions as the permanent stream is for the humid regions. While the same laws of stream action hold for both types of streams yet the conditions of work are so different in the two cases that an attempt to interpret the phenomena of the streams of the arid districts by direct deductions resulting from the study of streams of the humid regions is apt to lead to erroneous conclusions. This paper is for the most part a result of observations made in the bed and valley of the