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SOME FEATURES OF THE CHANNEL OF THE MISSISSIPPI RIVER BETWEEN LANSING AND DUBUQUE, AND THEIR PROBABLE HISTORY.

BY SAMUEL CALVIN.

The courses followed by the major streams of the interior of the North American continent during Paleozoic and Mesozoic times, can not now be pointed out with any high degree of certainty. The numerous upwarps and twistings to which the continental ridge was subjected, caused large portions of what is now North America to be at times above the sea, at other times below, and the drainage was shifted from area to area, from one direction to another. During a period as recent as the late Cretaceous the drainage of the middle Northwest flowed westward into a great sea that overlapped the western part of Iowa and extended away to the Sierras of California. There were no Rocky mountains such as we now know, for it was not until the close of the Cretaceous that the ridges of the Rockies, as a whole, rose above the waters; not until this event took place, could there be a Mississippi valley with extensive surfaces sloping from mountain chains on the east and west toward a central axis; not till then could the master stream of the continent enter upon its permanent career.

During practically the whole of the Tertiary period the axial part of the Mississippi valley was low; the Gulf of Mexico extended to the mouth of the Ohio; the great river and its immediate tributaries meandered sluggishly on a base-levelled plain. Toward the close of the Tertiary, however, there occurred a succession of disturbances, not violent, whereby the central part of the valley was elevated to a height of probably 2,000 feet above tide at what is now the northeastern corner of Iowa. All the streams were quickened by the uplift, and corrasion of the channels proceeded with more or less energy until grade was again reached and the drainage courses were adjusted to the new conditions. Corrasion and upward movement were so balanced that, in general, the streams continued to follow their previous winding courses and entrenched their old meanders. This fact is well illustrated by the

sinuous gorge of the Oneota, or Upper Iowa river in the western part of Allamakee county.

The episode of energetic erosion was preglacial. The work accomplished by the great river during its progress and before the episode came to an end is represented by a rock-walled gorge seven, or eight, or nine hundred feet in depth and four to six miles in width. This old preglacial gorge was deeper than the present one, for soundings, as at Clinton and many other points along the river, show that the channel has been filled with sand and clay and other detrital material to a depth of from one, to two hundred feet. This filling is probably the work of glacial time. Before the glacial period, however, the valley had been widened by recession of its walls, the bluffs rose from the level of the water in gentle, rounded slopes, the lateral valleys were also broadened, the topographic features of the region were practically mature.

Some of the changes wrought in the features of the Mississippi river by the earlier ice sheets, especially by the Kansan and the Illinoian, are recorded in the portion of the valley between Clinton and Keokuk; but there are no clear records of any important changes, referable to the earlier glacial stages, in that part of the gorge lying between Lansing and Dubuque. On the other hand, the latest stage of glaciation, the Wisconsin, has left its impress on the valley from Dubuque northward, in a multiplicity of records of unusual interest. The Wisconsin ice invaded the upper part of the drainage basin of the great river. While the glaciers of this stage did not extend as far south by several hundred miles as some of their predecessors, the volume of ice seems to have been very great, so much so that, during the period when the ice was melting, enormous floods of water poured along all the drainage courses which connected in any manner with the ice margin. Some or all of the streams were loaded to the limit of their capacity with sand and gravel. The Chippewa and Wisconsin rivers deserve especial mention on account of the vast quantities of material which they carried and discharged into the central drainage channel. The old gorge of the Mississippi, widened as it was by weathering and recession of the bluffs until it was far beyond the necessities of the preglacial stream, was now overtaxed by the great Wisconsin floods.

In the normal development of every river valley the spurs and headlands between the lateral gulches assume more or less gentle slopes and become rounded and sodded over as the valley reaches maturity. The line marking the foot of the bluffs on both sides

of the stream is very sinuous, curving riverward around the salients and forming re-entrant angles landward at the mouth of every tributary valley or ravine. Furthermore, the opposite sides of the valley show little tendency to anything approaching exact parallelism. Between Lansing and Dubuque,—a portion of the river arbitrarily chosen to illustrate certain features equally well developed elsewhere in the upper valley,—the lateral stream courses show all the characteristics of the normal type of topography, mature or approaching maturity. The sides of the valleys are broadly divergent; the salients are normally rounded, with front slopes and side slopes approximately equal; and there is no very strong suggestion of parallelism between the opposite sides. The Turkey river or the Little Maquoketa may be taken as illustrations. While there are some steep cliffs along these streams, they are not continuous, and those occurring on one side usually face lateral valleys or rounded slopes on the other. The main valley, on the other hand, has the salients truncated, the projecting spurs cut away as if sliced off vertically. The ridges between the side valleys end in frowning precipices while the side slopes retain the characteristics of mature topography (Fig. 1). All short curves have been straightened out as if some great gouge had been driven down the channel, reducing it to a uniform width, clipping off the rounded points and making the walls precipitous, so that vertical bluffs in Iowa face parallel vertical bluffs in Wisconsin (See map, Fig. 2). The precipices are not due to recent undercutting caused by the swinging of the current from one side of the channel to the other. Their parallelism and continuity can not be so explained, and then they present precisely the same characteristics whether the river flows directly at their feet or is separated from them by one or two miles of sloughs and islands (Fig. 3). Neither can the precipices be attributed to the kind of rocks in which the river gorge has been cut, for the walls show rocks of many ages and are of many degrees of hardness, varying from hard limestones to very friable sandstones and soft shales. Furthermore, the tributary streams have cut through precisely the same kinds of rocks, and yet their valleys, at least on the Iowa side, show normal characteristics.

By way of explanation of the peculiar features noted in the major stream there may be offered the probability that the gravel-laden Wisconsin floods were the gouge which cut away the bases of the well-rounded projecting spurs and developed the succession of parallel rock cliffs on opposite sides of the river. As shown in figure 1 the side slopes and back slopes of the spurs still retain all

their old characteristics of topographic maturity; the faces looking toward the stream show all the features of extreme topographic youth. Some of the qualities of very young streams are here imposed on a very old valley.

Another notable effect of the loaded Wisconsin floods was the building of gravel terraces wherever slack-water conditions were present along either margin of the swollen river. Any conditions which checked the onward rush of the stream torrent caused the load to be thrown down in quantities so large as to be a constant surprise to the student of river phenomena. And so now gravel terraces are found where the waters evidently whirled and eddied and backed up into the mouths of the tributary valleys. The very conspicuous deposit (Fig. 4), twenty feet or more in thickness, extending up the valley of an insignificant stream in the western edge of Lansing, may be cited as an example. Gravel deposits are also found wherever the pre-Wisconsin valley had widened out so as to leave a low bench or flood plain rising somewhat above the level of the main channel. The Peru Bottoms, above Dubuque, afford a concrete illustration. Sand and gravel, to a depth of fifty or sixty feet or more, are here distributed over hundreds of acres. Similar deposits are repeated all along the stream from the mouth of the Chippewa southward to Dubuque. Gravels are not common below Dubuque, but trains of sand were laid down in large volume, wherever conditions were favorable, to points many miles below Clinton. In the upper end of Dubuque, toward Eagle Point every graded street cuts into an extensive sand terrace.

Still another event chargeable to the loaded Wisconsin floods was the diversion of the Little Maquoketa river from that part of its preglacial channel between Sageville and the lower end of the city of Dubuque. Couler Avenue extends up the old valley to the city limits, and the road which continues thence up to Sageville follows the pre-Wisconsin trench. Here is an old, well-developed, rock-cut river gorge (Fig. 5), more than a hundred feet in depth, now wholly abandoned as a stream course. In the most erratic and unreasonable way, apparently, the Little Maquoketa, near Sageville, turns away from its old bed and flows northward, seemingly in the wrong direction, for about two miles to its present confluence with the Mississippi. The swollen Mississippi of the Wisconsin stage seems to have divided at the upper end of the Peru bottoms, one swift current flowing close to the bluffs west of the bottoms, the other following the regular channel. The west current cut into the old valley of the Little Maquoketa and used that to its junction with the

main stream. This current scoured out a deep trench close to bluffs, but, probably when the floods were declining, it deposited some of its load in the preglacial gorge between Sageville and Dubuque. After the floods subsided the Little Maquoketa met with less resistance in flowing backward along the trench cut by the west current than it would have encountered in recovering and scouring out its preglacial channel. The great gravel ridge or plateau (Fig. 6), fifty feet high, which now separates the reversed portion of the Little Maquoketa valley from the main river, was doubtless built up in the slacker water between the two currents. For a clear presentation of the relations of the reversed stream to its abandoned channel, the small map, figure 7, may be consulted.

Descriptions of Figures.

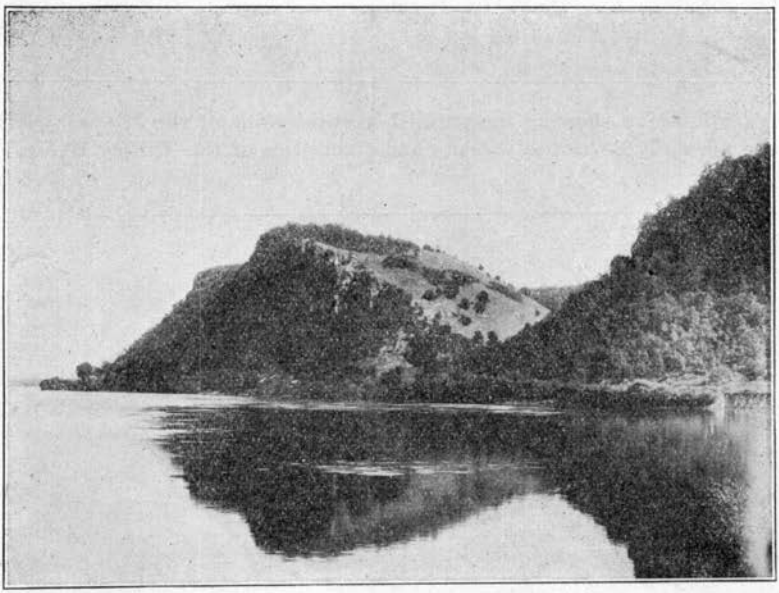

Figure 1.—Bluffs a short distance below Lansing, Iowa, showing vertical faces fronting the river, but with side slopes and back slopes old and rounded—a combination of young and mature topography.

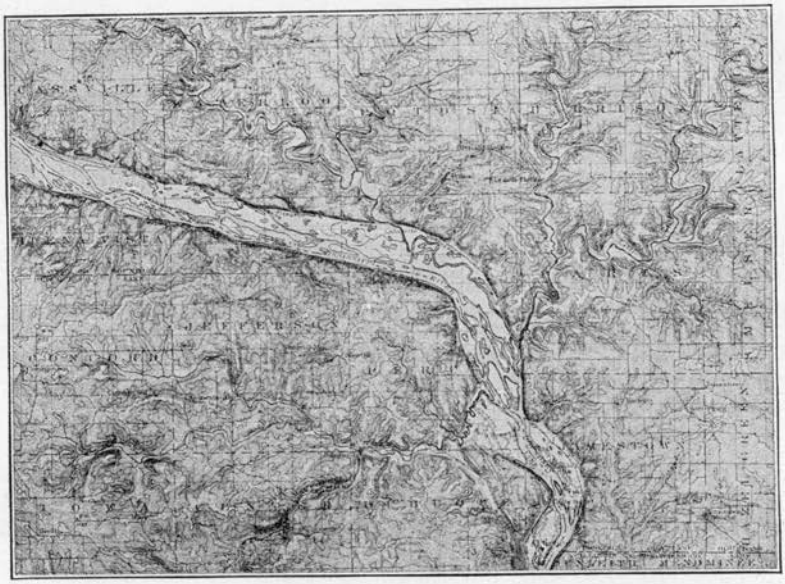

Figure 2.—Map showing the parallel, vertical walls of the Mississippi river, and the normally developed salients and sinuosities of the Turkey river.

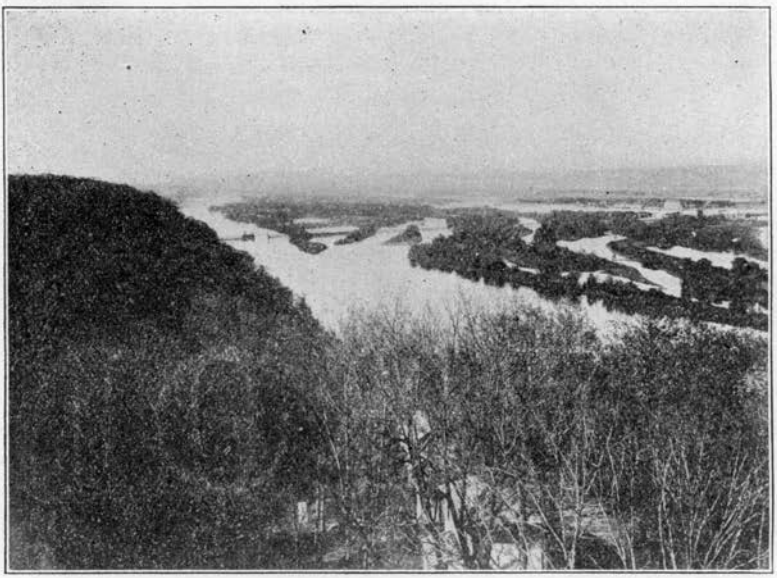

Figure 3.—View below McGregor, Iowa, showing sloughs and low islands occupying the greater part of the flat bottom of the Mississippi gorge, with the vertical, rocky cliffs of the Wisconsin side dimly seen in the distance.

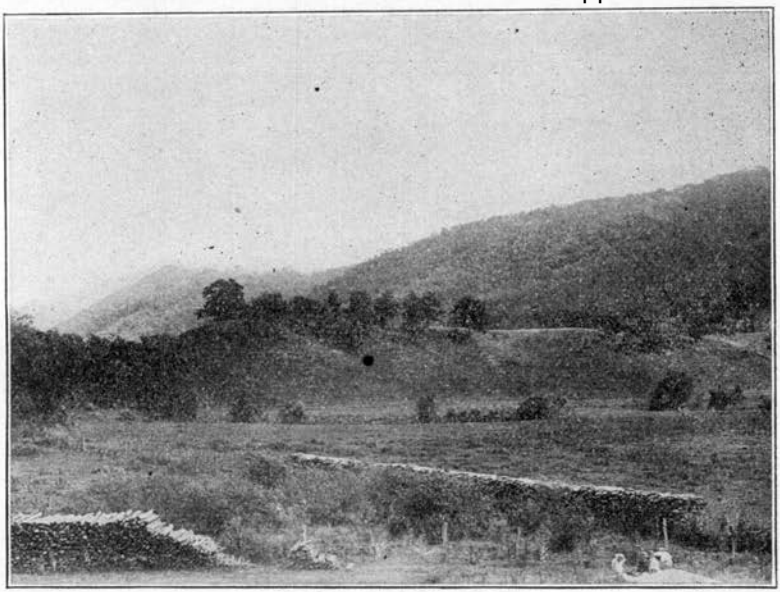

Figure 4.—Gravel terrace of Wisconsin age in the ravine west of Lansing, Iowa, deposited during the high Wisconsin floods.

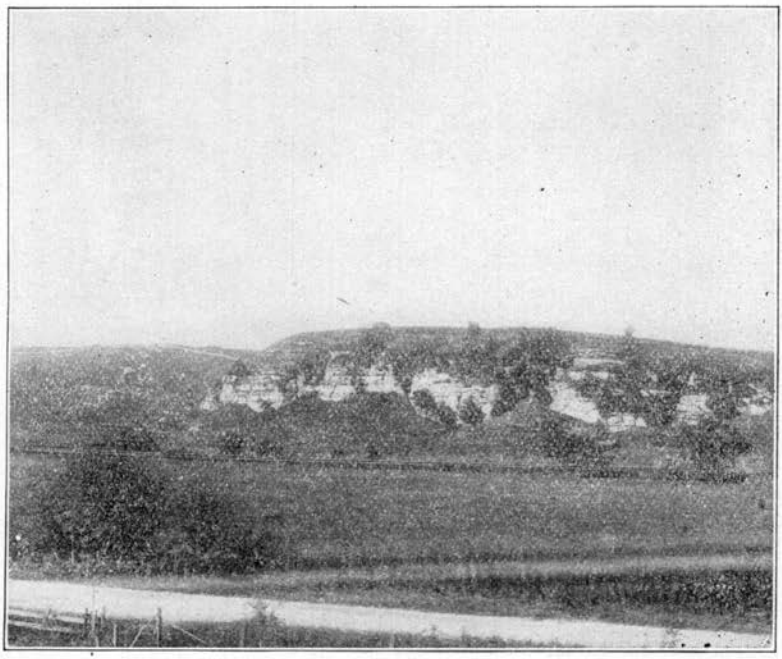

Figure 5.—The east bluff of the abandoned valley of the Little Maquoketa, between Sageville and Dubuque. View taken a short distance south of Sageville.

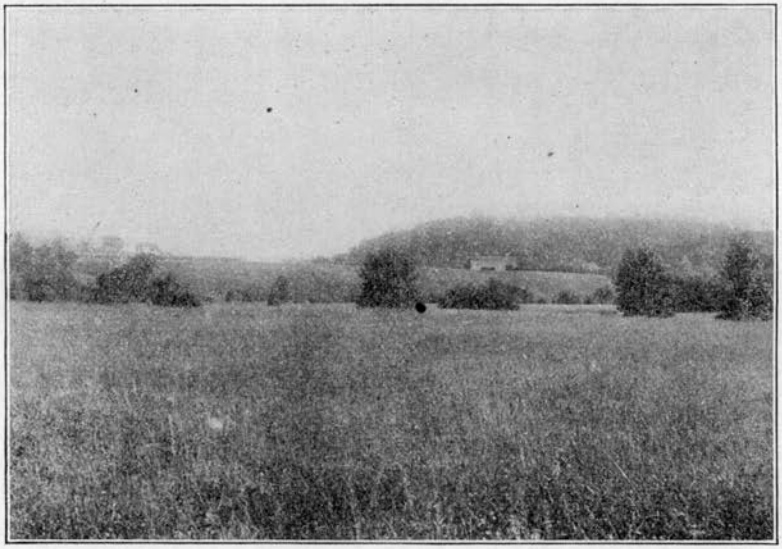

Figure 6.—Edge of the high gravel plateau between the reversed portion of the Little Maquoketa valley and the Mississippi river.

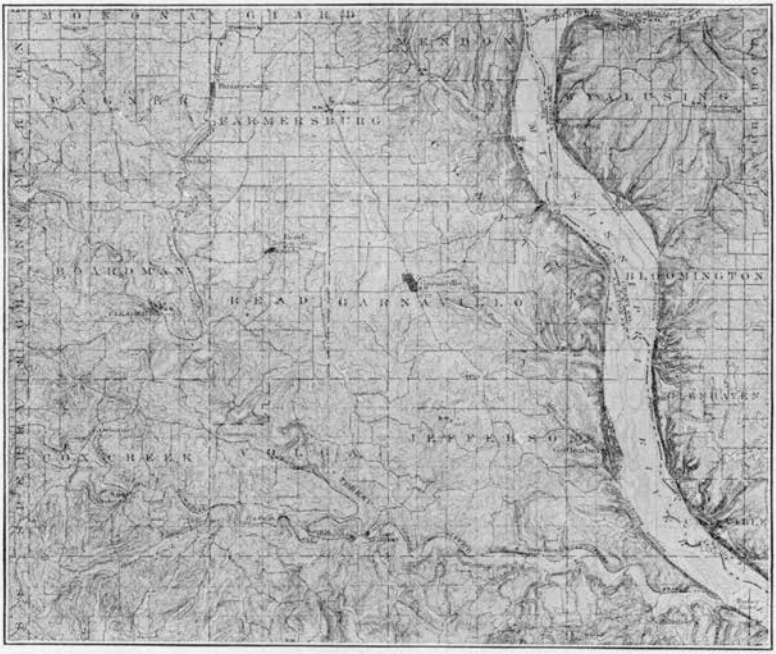

Figure 7.—Map showing the parallelism and vertical walls of the gorge of the Mississippi river, the reversed portion of the Little Maquoketa valley, and the abandoned channel between Sageville and Dubuque.