

the Kansas bank, rock crops out at Belmont and Wathena.

The clay banks, when excavated and exposed to the weather, stand for a long time with little change; this was instanced in St. Joseph, in 1871-73, where many streets were graded down to a depth of 30 to 40 feet, while the lots, with houses built upon them, were left standing, the only means of access to and from the street, being by stairways placed in very nearly vertical position in front of each house.

The nature of these clay bluffs is such that they are affected but slowly by the action of the flood, except in cases where undermining is caused by the washing of sand and gravel deposits. In such cases, large slides occur at intervals.

The current after striking at the foot of these solid banks, at an acute angle, is deflected gradually, and after following, for some distance, the bank is turned from it, and directed into a course tending towards the opposite side of the valley.

The "bottoms," or lands situated between the high sides of this valley, are generally formed of sandy alluvial deposit, timbered in part with heavy growth of cotton wood and other trees. In other parts, the later formation of the deposit is indicated by the smaller growth or timber, which gradually diminishes in size, until upon bars of recent formation a short growth of brush, only, is found. In the low ground, however, in front of the eastern portion of the city, and for some distance downwards, along the Missouri shore, the bank is composed of the toughest sort of clay, "gumbo," as called in western language. This stands almost vertically where washed by the current, and wears away but slowly.

In sinking pier No. 1 to bed rock, at the foot of this bank, sand was struck at a depth of 20 feet below low water, and was found to extend to bed rock, forming a stratum of 25 feet in thickness. This accounts for the subsiding of portions of this bank, which occurred during the progress of the work.

The great changes in the course of the river occur at times of flood. Cut-offs occur also at times, caused by the wearing of the neck of points formed by the bends of the river. In these cases the old channel remains in form of a "horse-shoe lake," the ends becoming silted up by wash from the new channel.

The frequency with which these horse-shoe lakes are found in following the course of the river demonstrates plainly the changes which have taken place, and which are to be expected to occur in future.

Through these bottoms, at high water, the river cuts its way, varying in width from 1500 to 5500 feet, alternating from bluff to bluff, on opposite sides of the river, describing in its course a succession of curves and reverse curves; removing sand bars, and placing them in new positions, rolling them (as it were) down stream, carrying destruction to any portion of the bottom lands where it strikes with force, and at points where it washes the base or face of hard clay banks wearing them slowly away; and at times undermining them, and causing slides of large dimensions.