

THE WORK DONE BY NORMAL BROOK IN THIRTEEN YEARS.

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A small stream which enters the Wabash valley three miles east of Terre Haute attracted the attention of the senior author of this paper many years ago by its remarkable meanders. Within a length of 1,000 feet it presents most of the phenomena characteristic of the lower Mississippi, and it has been visited so often by geography and geology classes from the Normal school that it has acquired the name of Normal brook.

The stream rises by two principal forks which drain about a square mile of Illinoian glacial clay plain, cuts through the east bluff of the Wabash valley and is lost upon the great gravel terrace below, by percolation and evaporation. Along the edge of the bluff the clay overlaid by a belt of sand dunes about half a mile wide, and the most interesting part of the stream, is that where it passes through the dune belt. A hasty survey of this part of the valley was made in 1897 and a map of it was published in the *Inland Educator* for June, 1898. During the past season (1910) a second and more careful survey has been made and a comparison of the two maps shows the changes which have taken place in thirteen years. (See Figs. 1 and 2.)

The part of the valley shown measures along the median line 1,150 feet, while the stream, by its meanders measures 1,960 feet, an excess of 68 per cent. In the upper 650 feet of the valley the length of the stream is 1,360 feet, an excess of 109 per cent. The valley floor, 100 to 200 feet wide, is flat flood plain bounded by bluffs 25 to 40 feet high. The material exposed on the floor is wholly alluvial, mostly sand with occasional bars of fine gravel and beds of tough, blue clay. In the valley floor the stream has cut a channel 20-70 feet wide and three to six feet deep. The stream is perennial and in ordinary stages is a thread of clear water four or five feet wide and six inches to a foot deep, which is much more crooked than the channel. In times of flood it fills the channel, but has never, in seventeen years of observation, overflowed the valley floor.

Sharp zigzags, oxbow bends, cut-offs, caving banks on the outside and bars on the inside of the bends are numerous.

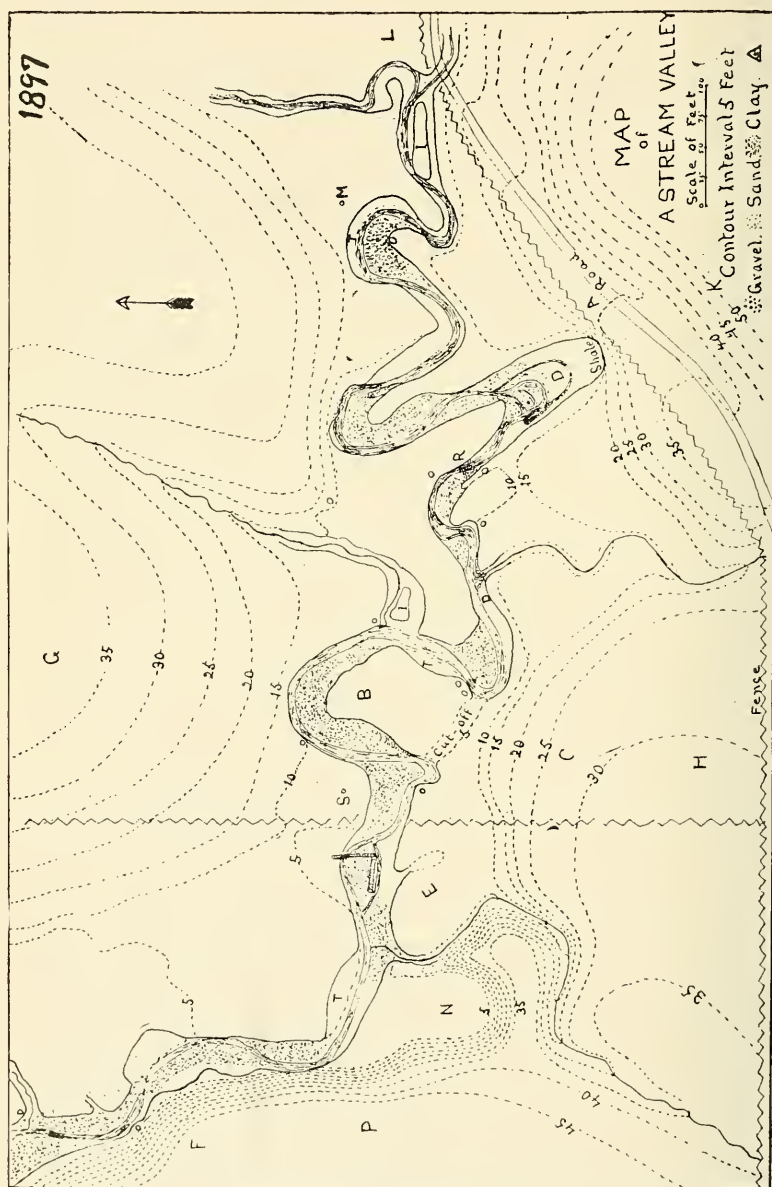
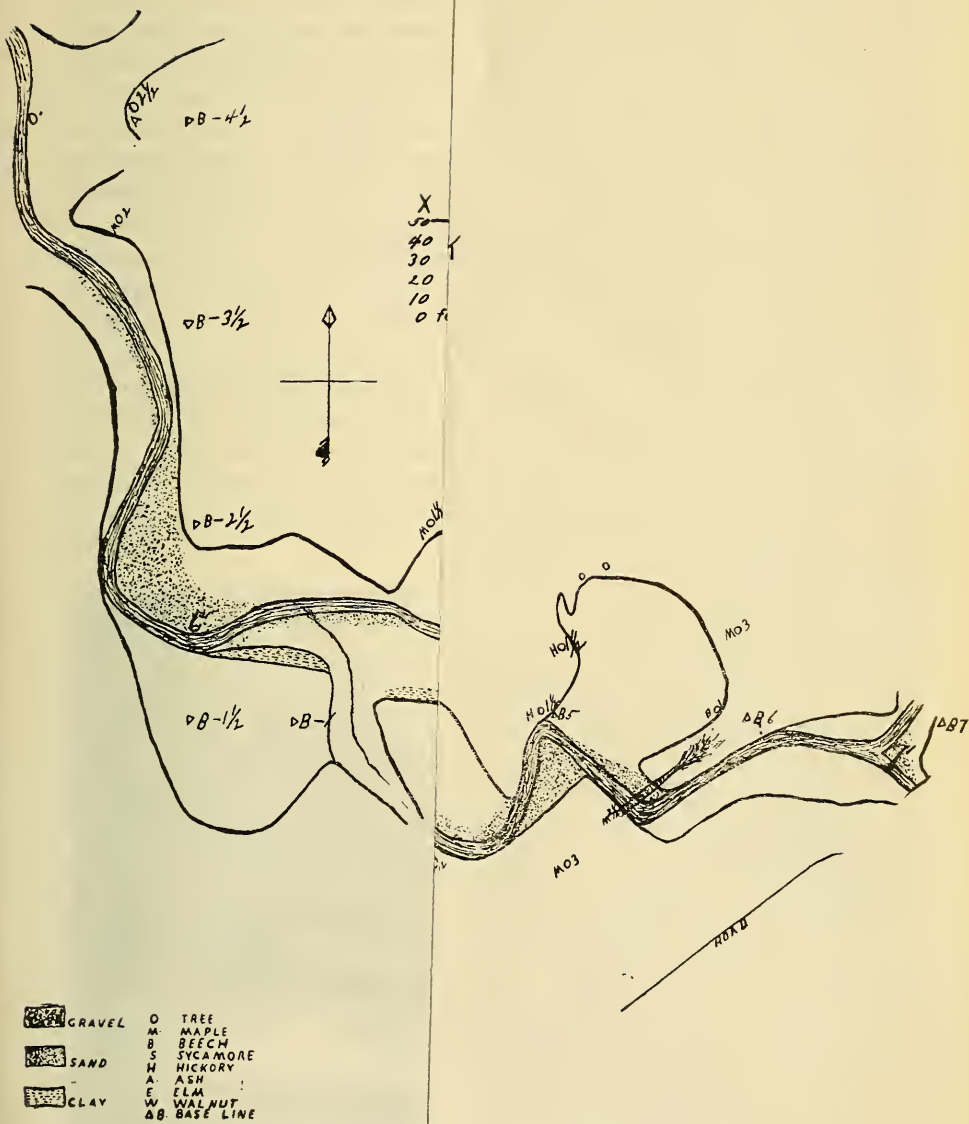


Fig. 1.

NORMAL BROOK.



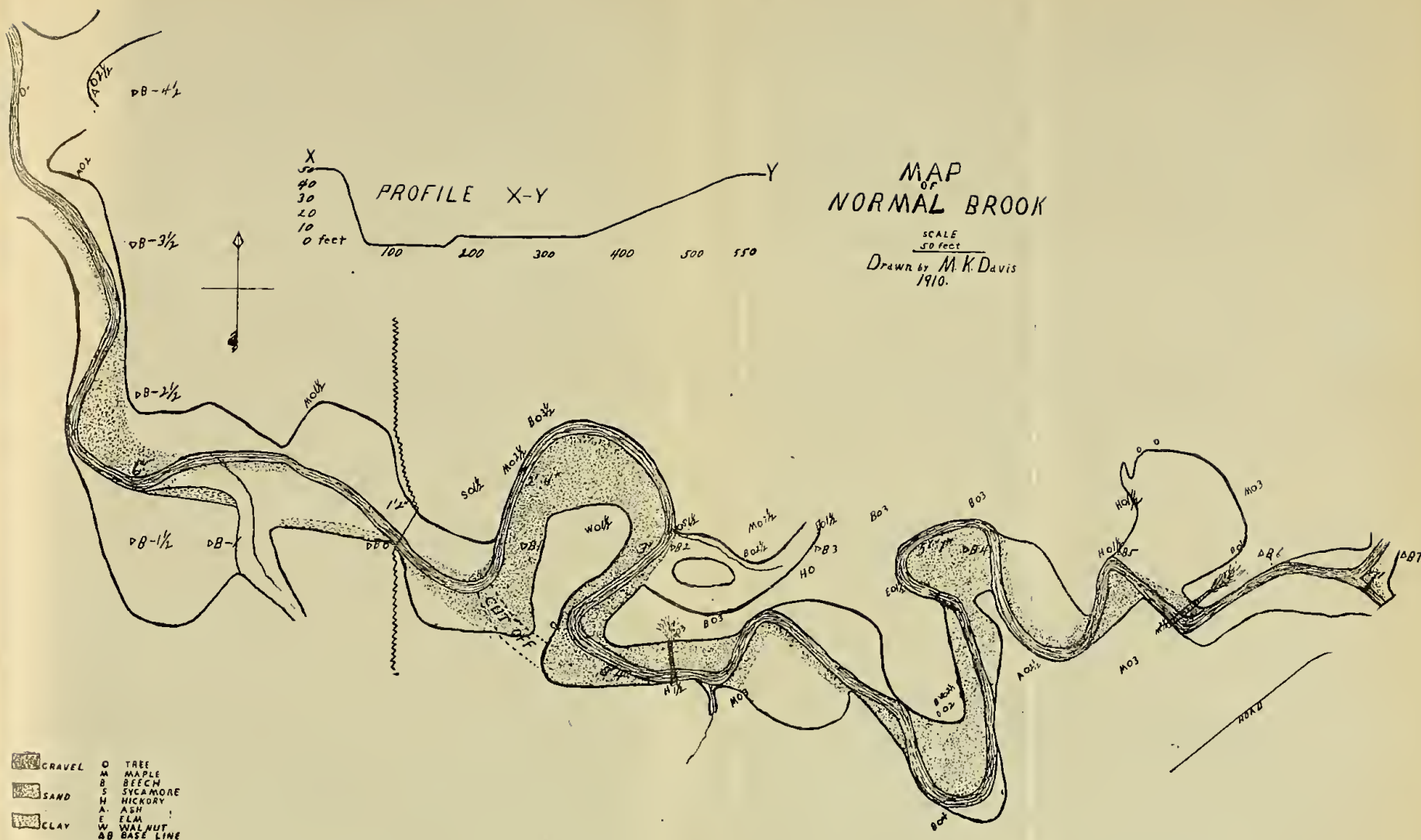


Fig. 2

A detailed description of some of these features and the changes which have taken place in thirteen years, as shown upon the two maps, form an interesting demonstration of stream work.

The island at I has disappeared. The horse shoe near M has been cut off, a beech tree removed from its center, and the whole area converted into flood channel. The next bend to the west has been widened and rounded (all done at two or three spring freshets), and the neck nearly cut through. The sharp bend at D has also been widened and the tongue shortened. The cut-off channel across the neck of bend B, a foot deep thirteen years ago, has not been enlarged, and the cut-off, then apparently imminent by overflow, is now likely to take place soon by lateral erosion of the neck. The south bank opposite S has been cut back twenty-five feet, including a large beech tree. West of S the north bank has been cut back forty feet including a large maple. Near P the stream strikes and undercuts a boulder clay bluff, turns to the north and ceases to meander. The general result is a notable enlargement of the area of the flood channel floor, which has become a new flood plain, leaving the old one as a terrace.



Fig. 3.

The valley floor and sides are occupied by an open, park-like forest, consisting of oak, maple, elm, beech, hickory, basswood and other trees, mostly from two to three feet in diameter. The smallest one is eighteen inches and one beech is nearly four feet. The area has never been under the plow, and has for many years been used as a pasture. Evidently the stream channel is shifting rather rapidly from side to side, and the alluvial material has not been deposited in thin layers over the surface, but has been transferred from one side of the channel to the other by lateral corrasion and deposit. The trees do not check the process of lateral shifting in the least. If the stream comes against one it undermines and tips it over as readily as it cuts away its bank elsewhere. There is only one tree in the valley more than about 100 years old and that stands near the foot of the bluff. Therefore the inference seems justified that a complete shifting of the channel from side to side and a working over of all the alluvial material takes place about once every century.

The most puzzling question about this stream is the obvious one, what makes it so crooked? At ordinary stages it carries almost no sediment, and at flood it does not appear to be overloaded except on the inside of the bends. The valley is straight, the flood water channel is very crooked and the low water channel is still more crooked. The fall of the stream in 1,900 feet of length is seven feet, or at the rate of 19 feet per mile, and in the upper 1,360 feet is 22.5 feet per mile, which equals the average fall of the Colorado river through the Grand Canyon. The fall in the lower 600 feet is 10.3 feet per mile. The slope of the valley floor in 1,150 feet is 32 feet per mile, but in the upper 650 feet is 42 feet per mile. Therefore the stream is most crooked where the valley slope is steepest. Its law seems to be, the crookedness varies directly as the steepness of valley slope. This supports the conclusion of Jefferson that "maturely meandering streams may be regarded as finding their slope too steep."¹

It works in easily eroded material and the extraordinarily crooked portion of it is just where it crosses the belt of sand dunes. These facts indicate that a temporary and local excess of load may be one of the factors concerned in the problem.

¹ National Geographic Magazine, Vol. 13, Page 373.



Fig. 4.

Abandoned bends at high levels show that the stream has been meandering for a long period. The fact that it no longer overflows its valley floor, but only the channel floor, means that it is slightly entrenched, is making a new flood plain at a lower level, as the cross profile shows (Fig. 2), and leaving its former flood plain as a terrace. In entrenched meanders cut-offs are rare, because they occur only where a neck is cut through by lateral erosion. The cut-offs of Normal brook are made in this way and not by overflow across a neck. In such cases the meander belt has no self-limiting width, but is restrained only by the bluffs. In Normal brook the width of the belt is about thirty times the width of the low water stream and not more than five times the average width of the high water channel. The present base level for the brook is the surface of the gravel terrace in the Wabash valley. The brook once emptied directly into the river when it stood at a level ten or fifteen feet above the terrace. Therefore the brook has been subjected in post-glacial times to a fall of base level of that amount. Meanders acquired during a condition of higher base level and gentler slope may have been inherited and moderately entrenched by the present stream.



Fig. 5.



Fig. 6.