Acquired Automatism: The individually modified physiological basis of the performance of acquired movements or activities which have been stereotyped by repetition."

Professor Morgan points out that there is some overlap in these definitions, but it is difficult to see how such overlaps are to be avoided. H. F. O.

SOME MEANDERING RIVERS OF WISCONSIN.

Two years ago Professor Davis* called attention to the wide meanders of the Osage river of Missouri. He said: "The meanders of the river are peculiar in not being like those of the Mississippi, spread upon a flat flood-plain. High spurs of the upland occupy the neck of land between every turn of the stream. Evidently the meanders are not of the ordinary kind." He explained the peculiar tortuous course of the river as an inheritance from an earlier cycle, during which the river had worn the land down to a surface of faint relief. The stream at that time swung to and fro in broad meanders developed on a wide flood-plain. The whole region was then somewhat elevated, and the stream again set to work to cut down its channel to the new baselevel. But the meandering course which it had acquired late in the preceding cycle was carried over into the new cycle of its life.

A recent visit to a part of the driftless area of Wisconsin, Lafayette and Grant counties, gave me an opportunity of observing a similar habit of some of the rivers of that region. The general surface of the country is that of a gently rolling plain, at an elevation of from 850 to 1000 feet, A. T. The interstream surfaces are broad and slightly undulating, but well drained. The surface rock, except in the immediate vicinity of the streams, is the Galena limestone. Occasionally the general level of the top of the country is broken by hills, which rise 200 to 300 feet above the general level. The highest of these are capped by the hard Niagara limestone; the lower by beds of the Cincinnati group. These hills form the so-called 'mounds,' of which, in the area visited, the Platte Mounds—1250–1300 feet, A. T.—are the highest. The hard Niagara limestone caps of these mounds are the remnants of beds which formerly stretched over all this region, and which has since been removed by denudation. To hills of this type Prof. Davis has given the name, Monadnocks.

The rocks of this region are nearly horizontal, and in general there is not a sharp contrast between the slant of the beds and the general slope of the upland surface. It seems, therefore, as if the upland might be a structural plain due to a resistant stratum, the Galena limestone, at the level of the upland—a stratum which had been revealed by denudation of the overlying beds. If this were the case, the upland level would be independent of any former baselevel. But such a conclusion does not seem to be admissible; although nearly horizontal, the limestone has been bent into gentle flexures, some of which are sufficient to bring the underlying Trenton limestone and St. Peter's sandstone up to the level of the upland surface. The plain is continuous across these low arches and bevels the edges of the gently inclined beds. Moreover, to the north of the outcrop of the Galena limestone, the upland plain bevels the gently inclined edges of the underlying formation, which there come to the surface. In that region, however, the plain is now more completely dissected than further south. Whatever correspondence exists between the inclination of the beds and the slope of the plain is fortuitous and not due to structure primarily. It is believed that this plain is a surface of denudation, the result of long continued erosion on a greater land mass when the land stood lower

*SCIENCE, April 28, 1893, vol. xxi., p. 225 et seq. SCIENCE, November 17, 1893, vol. xxii., p. 276 et seq.

than at present. The upland surface is believed to be an elevated peneplain.

It is now moderately dissected by valleys which along the larger rivers are from 100 to 200 feet deep. In comparison with the width of the gently undulating interstream surfaces these valleys are not very wide. The slopes are quite steep and locally form bluffs, but towards the top they pass by a graceful curve into the almost level upland. The present flood-plains along the bottoms of the valleys are generally from an eighth to a quarter of a mile in width. In terms of development the present valleys are well on towards maturity. The sharp narrow valleys of extreme youth are entirely absent. The rivers have made considerable progress in the present cycle in reducing the land mass to the level dependent on the grade of their channels, but the amount of work still to be done is vastly in excess of what has already been accomplished.

The three topographic features mentioned, namely, the broad undulating upland, with an elevation of from 850 to 1,000 feet; the few monadnocks rising above it, and the valleys cut into it, give a clue to the stages of geographic development of this region. The upland peneplain is a surface of denudation produced by long continued erosion, when the land mass stood lower than at present. This cycle of erosion lasted a long time and the baseleveling was almost completed. Very few monadnocks rose above the general plain. The cycle was ended by an uplift, which quickened the streams, restored to them their cutting powers, and compelled them to erode new valleys in the old peneplain. They have now cut down their channels until their ability to transport material is just about equal to the material which they have to carry. Rivers, the profiles of whose stream-channels are in this condition of equilibrium, have been called by Davis (SCIENCE, N. S., Vol. I., p. 176) graded rivers. The difference in the slope of the valley sides and the upland plain indicates a change of level before the excavation of the valleys and after the formation of the upland plain. The process by which the valleys are being formed is not a direct continuation of the process by which the gentle upland slopes were fashioned. The valleys were cut in the upland surface after it was elevated from the low position which it had during its formation.

Confirmatory evidence for this hypothesis is found in the winding courses of the valleys which now dissect this upland. Fever river was studied in the field, and the topographical atlas of the Wisconsin Geological Survey shows that the Platte, Little Platte, Grant and Pecatonica rivers have this same habit. If the geographical development of this region was as outlined above, the streams at the close of the earlier cycle must have possessed wide, flat valleys, with broad flood-plains, in which they meandered freely. The elevation of the land would have caused the streams to degrade their channels rapidly. In many cases the meanders on the flood-plain would have been superimposed upon the rock below, as the river bed was lowered. The valleys cut in the elevated peneplain would thus come to preserve, and, as pointed out by Winslow, also increase the meanders of the earlier cycle.

Such seems to have been the case with the Fever river. Its meanders have an average radius of a little less than half a mile, but they are by no means constant. Rock spurs of the upland project into each curve. The slopes on these spurs are generally gentler than on the outside of the curves, where the stream is often undercutting the base of the slope and increasing the meanders. Both open and close ox-bows occur. The most marked of the close type of meanders was noted near Benton, where the river makes an almost closed sig-

moid curve, the halves of which are from one-half to three-fourths of a mile in diameter. The rock neck of land between the two ends of the closer curve is less than a hundred yards in width and rises about seventy feet above the stream.

Along Platte, Little Platte, Grant and Pecatonica rivers, larger streams than Fever river, the meanders are slightly larger on the average than along the smaller streams. Both open and close curves occur. Rock salients between 100 and 200 feet high project into the bow of each meander. Almost as complete a series of meander types can be found among the curves of the rock valleys of these rivers as along the broad flood-plains of other streams. Indeed, the small meanders of these rivers in their present flood-plains can readily be duplicated by the wider curves of the rock valley. There can be no reasonable doubt but that the meanders of these valleys are an inheritance from meanders developed on broad flood-plains in a previous cycle of erosion. So far as could be made out, these meanders are not due to difference in hardness or structure of the rocks of the region. The limestone does not present sufficiently marked differences of structure to account for these curves upon a theory of readjustment of courses due to the contrasts between hard and soft beds. Whatever differences exist are not distinctly such as to modify the courses of rivers, particularly in a manner such as to resemble so closely flood-plain meanders. Nor does it seem to be admissible to suppose that these curves are the perpetuation of meandering courses taken when the land first emerged from the sea bottom. Such a supposition presupposes too constant and stable a relationship, through an enormous lapse of time between all the forces which control erosion and determine the position of streams.

The sinuosities of these meanders may have been somewhat changed since the elevation of the peneplain. In places the increased velocity may have straightened the curves to some extent. In other instances the meanders have been somewhat increased. Such seems to have been the case near Benton, where the stream is now undercutting the narrow strip of land separating two parts of the curve. If this process continues, a cut-off will result.

In comparison with the Osage river, these streams are small and their meanders insignificant. But apart from size, the analogy between them is complete. They must be added to the growing list of streams known to be persisting in habits acquired under conditions which have long since disappeared.

Henry B. Kümmel.
The University of Chicago.

CORRESPONDENCE.

MISSOURI ROTANICAL GARDEN.

The attention of botanists is called to the facilities afforded for research at the Missouri Botanical Garden. In establishing and endowing the Garden, its founder, Henry Shaw, desired not only to afford the general public pleasure, and information concerning decorative plants and their best use, and to provide for beginners the means of obtaining good training in botany and horticulture, but also to provide facilities for advanced research in botany and cognate sciences. For this purpose, additions are being made constantly to the number of species cultivated in the grounds and plant houses, and to the library and herbarium, and, as rapidly as it can be utilized, it is proposed to secure apparatus for work in vegetable physiology, etc., the policy being to secure a good general equipment in all lines of pure and applied botany, and to make this equipment as complete as possible for any special subject on which original work is undertaken by competent students.

A very large number of species, both