Use.—In conclusion it should be said that a trial of the first slide made it evident that the use of such illustrations would materially increase the facilities for teaching geography and increase the educational value of the work accomplished. Such material may not only help the lecturer to avoid technical description of features usually not illustrated at all, when simplicity of treatment is demanded, but with this aid he is enabled to show his class or audience a mass of facts upon which he bases his interpretation of the phenomena discusssed. By this means, the lecturer may even treat somewhat technical and involved problems so that they may be made easy to comprehend, and, most important of all, whatever geographical knowledge be absorbed, is properly attained through the exercise of observation, comparison and deduction. For just so far as the student subjects himself to such mental discipline, in the same degree does he acquire a scientific knowledge and the power of analysis that is lasting and of true educational value.

The picture attached below is a copy from the negative from which the lantern slide was prepared.*

River Bends and Bluffs.

By Wm. M. Heiney.

Bends and bluffs of rivers are interdependent. While under the universal river law of taking the course of least resistance, the embryonic bluff must first exist, the matured bluff is the product of the river's course. But, early the relation begins shifting, and the bend becomes the consequence of the bluff. Again, however, the bend batters down the bluff, so that the relations first attained are repeated.

The above propositions are verified by tracing the historical relation of the bluffs and bends in a very crooked section of about fifteen miles of the Salamonie River, found in the southern part of Huntington County, Indiana.

Fig. A represents the stream in its present course, with the bluffs and their connecting ridges, which define the territory over which the stream

*I will be glad to correspond with any person who desires to obtain copies of these slides for school or college collections. Others are being prepared.

has been shifting its course during the past few centuries. The dotted lines indicate the location of ridges, which when carefully traced are found to mark one or the other of the banks of the more ancient stream.

I will return to this after detailing some of the operations of the agencies which I have observed during the past quarter of a century.

At z, Fig. A (enlarged section, Fig. C), is a small tableland (t), which twenty to twenty-five years ago was broader and extended upstream five to seven rods further than it now does. In half a century more, at the present rate of erosion, the part of the tableland still remaining will all have disappeared, and what is now a well defined ridge will have become a bluff. Both the ridge and the tableland are covered with forest trees, while the bluff for a mile up the stream, and from the point of contact (u) of river and ridge, is barren, indicating constant and rapid weathering, and consequently a gradual northward movement of the stream bed. I shall return to this again after giving fuller observations of similar changes at the bend y, Fig. A.

This bend is best studied in Fig. B. More than twenty years ago I was familiar with the bar, n′, lying under but upstream from the sycamore tree, v, which still stands. Then the bar, n′ (see n, Fig. D), was the only one, and formed the river bank. It was of pure, washed sand and had no vegetation whatever growing upon it. It now has willow and sycamore trees five or six inches in diameter. Now, also, there is another bar (w′ in Fig. B and w in Fig. D), which is the one bordering the river, of pure, washed sand and without vegetation.

These facts stimulated further investigation and furnished the key to deeper secrets. I examined the topography farther east and found a considerable elevation about forty feet wide (m′ in Fig. B and m in Fig. D), and succeeded by a lowland; then, again, another rise, l (l′), extending eastward for two hundred and fifty feet, and in turn succeeded by a sink, better marked than any of the others (see k in Fig. D and k′, Fig. A). Both these bear evidence of being former bars, and their relative ages are evidenced by the trees, which I have tried to indicate in my drawings, by trees and stump. Those trees which have grown upon m (m′) are not larger than fifteen inches in diameter, while those upon l (l′) were large forest trees, many three and four feet in diameter. This last is all cleared of its timber now and is a well cultivated field. In Fig. A, n″, m″, l″, and k′ do not represent the correct relative distances, only relative position.

From f to y, Fig. A, is a barren bluff and gives evidence of the river bed's gradual southward movement, but at y (enlarged section of which is found in Fig. B) the westward movement of both bed and bluff is quite marked. Within the time of my own observation, I am certain that from twelve to fifteen feet of the bluff, which is some fifty feet in height, has disappeared. A year ago a mass of earth (see g in Fig. D) 6x8x30 feet dropped down five feet at the north end, but still clings to the surface at the south end. It is rapidly yielding to the elements, and two years hence no trace of it will remain. As this bluff moves westward the one at x is moving eastward at about the same rate of speed. Thus in the course of two thousand years will occur a phenomenon rarely found on this stream, i. e., a waterfall or rapid—a fall of thirteen feet in one thousand, and possibly a canyon, also.

Yet there will still remain enough bend to renew the northward movement of the channel and in time the highland of the "Heiney Bend" will disappear—the stream will bend far to the north—the bottom lands will lie south of the stream, with the adjoining bluff of the river on its north bank. The newly formed bottom lands will lie much lower than those of the "Sheet Bend" at present.

Now let us leave the present and future of the stream and go back to its past. Following the old bed as indicated by its right bank (the dotted line, pq, in Fig. A, and p′, Fig. B), and taken in relation with some sink holes (o in Fig. A and o′ in Fig. B), along the foot of the ridge, it is evident that the old bed crossed its present bed at p and q, and that the "Shutt Bend," which is extending itself southward, was once much smaller than now. This bend has been greatly eroded. It is considerably lower than its neighbor on the west, the south part of the "Heiney Bend," and as a consequence does not bear the remains of as ancient river beds as the latter. In Fig. B, I have endeavored to show the low places in the surface by shortening the lines which indicate the bluffs and ridges; thus r′ and s′ correspond with the dotted lines r and s in Fig. A, and doubtless locate the successive channels of the river before it settled down between the ridges and bluffs which bound its present immediate basin, or what the farmers term the "first bottom," more generally recognized as the "lower terrace." From the present topography it is certain that after the river left its channel, r, and before it took its present general course between the ridges, it crossed at s, and again at h. A far

more ancient channel than any of these, however, is found from a to b. This rises on much higher ground at a and though not so well marked as the more recent channel its lower course, as it nears b, has become well emphasized by recent drainage of the adjacent country.

The stream will probably forage its way to all the bounding ridges and denude them—render them bluffs—before cutting its new channel, xy, when it will again leave them to weather themselves into symmetrical shapes, dress in forest verdure and present history as well as future possibilities, which speculation in this age is unable to suggest.

Notes on the Ordovician Rocks of Southern Indiana.

By Edgar R. Cumings.

The present paper dealing with the stratigraphy of the Ordovician of Indiana is preliminary to a more complete report on this interesting series of rocks, which the writer has in preparation. In the latter paper an extended discussion of the faunas of these rocks will be possible. At present the study of the large collections obtained is not sufficiently advanced to admit of any such presentation. It is therefore proposed to give here practically nothing but the notes taken in the field, with such supplementary remarks as may seem necessary.

The work of the Indiana University Geological Survey during the field season of 1900 covered the counties of Dearborn, Switzerland, Ohio and Jefferson. The following sections were measured and from most of them extensive collections were made:

Section in Kentucky opposite the mouth of the Miami River (5.9A):*

	Ft.	*In.*
51—Covered to top of hill	112	..
50—Fragments of Strophomenoid shells	..	7
49—Shale	1	..
48—Limestone. Fragments of Brachiopods	..	6
47—Shale	1	..
46—Hard limestone with *Rafinesquina*	..	5
45—Shale	2	4
44—Limestone. *Rafinesquina* abundant	..	5
43—Covered, probably shale	17	6

* This section in Kentucky is given because it is the farthest east of any section showing exposures of rock to river level.