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## Additional Evidence of Post-Kansan Glaciation in Johnson County, Iowa

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## ADDITIONAL EVIDENCES OF POST-KANSAN GLACIATION IN JOHNSON COUNTY, IOWA.

MORRIS M. LEIGHTON.

Johnson County offers a field of phenomena that are strikingly applicable to the theme of our late Pleistocene controversy, namely, "Has the northeast quarter of Iowa, except the Driftless Area, been invaded by an ice-sheet later than the Kansan?"

It is with certain of these phenomena that this paper will attempt to deal. The area studied in particular was the northwest two-thirds of Johnson County. As shown in Fig. 1, it includes the North Liberty and Shueyville lobes of the Iowan drift, mapped by the late Professor Samuel Calvin, and the bordering areas of the Kansan drift.

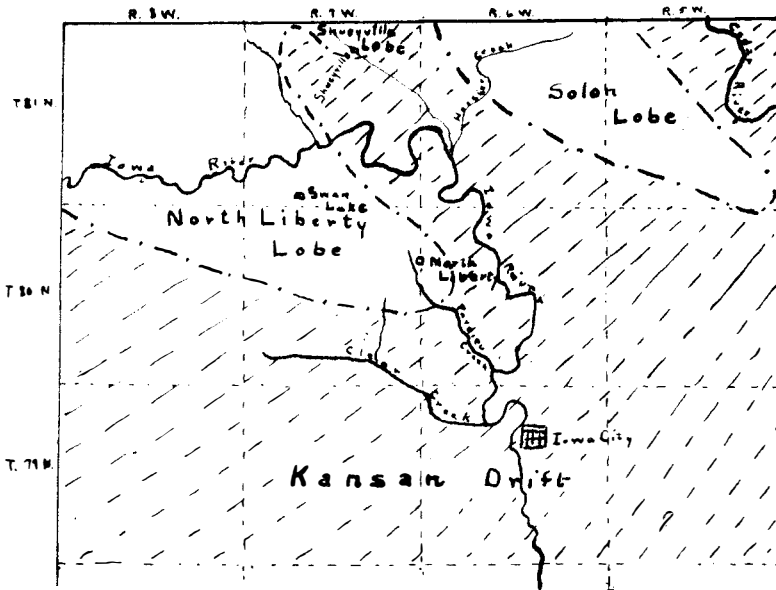


Fig. 1.—Drift map of northern part of Johnson county.

## FORMER DISCUSSIONS.

A discussion of this area has been partially entered into by Calvin. The contrast between the youthful topography of the North Liberty lobe and the mature topography of the bordering Kansan, together with the marginal deposits of loess bounding the lobes of the Iowan, are noted in Volume VII of the Iowa Geological Survey, pp. 39-46 and 83-87. Reference is also made in several of the county reports to terraces of Iowan gravel in the valley of Iowa River, but no location, description, or adequate significance is pointed out concerning them. During the field-work of the present writer, some of these terraces, formerly unknown to him and perhaps the identical ones referred to by Calvin, were found. The typical ones of these will now be considered.

## VALLEY-TRAIN TERRACES.

In valleys leading down from the North Liberty lobe and from the Shueyville lobe to Iowa River, and along Iowa River from Curtis to Iowa City, are the following terraces of sand and gravel:

*Pardieu Creek Terrace.*—A notable terrace occurs on the west side of the valley of Pardieu Creek about one mile below the North Liberty lobe, in the west central part of section 29, township 80 north, range 6 west. The terrace is about  $\frac{1}{4}$  mile long, 15 feet high, and from 25 to 75 yards wide. Except where dissected it has a flat top, and is backed by a hill that rises 60 feet above the terrace. (See Fig. 2.)

Several exposures in the side of the terrace show stratified sand and gravel, with a few small lenses. The sand is dominant, but gravel, ranging in size up to three inches, is mixed with the sand. The material shows no alteration, and it is so loose that it will not stand with steep face. In every way it presents a fresh appearance.

The deposition of the sand and gravel took place, it is clear, after Pardieu Creek had cut its valley. Whether the deposition took place by drainage waters from the North Liberty lobe or from a wash into the valley from the west, the significance is the same. The material is of glacial origin, and the fact that Pardieu Creek was changed from an eroding stream to a depositing one for a period sufficiently long to aggrade its bed 15 feet, together with the fact that it drains from the North Liberty lobe, indicates that Pardieu Creek was a drainage line from an ice-sheet after its valley was eroded.

Two deposits, apparently of similar character, occur in other drainage lines leading from the North Liberty lobe. One of these is in a

tributary to Clear Creek, about the central part of section 26, township 80 north, range 7 west; the other lies in a tributary leading east from the lobe to Iowa River, about 1½ miles east of the village of North Liberty.

*Valley-train Material from the Shueyville Lobe.*—From the Shueyville lobe, a tributary flows southeastward through the village of Shueyville, joining Hoosier Creek just above its junction with Iowa River. In this tributary on the south side, where crossed by a north-south road, in the northwest quarter of section 13, township 81 north, range 7 west, occurs a terrace that extends for about ¼ mile, and is 20 feet high and 50 to 100 yards broad. No good natural section shows the character of the material, but in a side-wash and along the slopes sand is evident, suggesting that it is a sand terrace and that it probably has the same relation to the Shueyville lobe that the terrace in Pardieu Creek has to the North Liberty lobe.

Along the north side of the ravine running parallel with the Cedar Rapids and Iowa City Interurban Railway from Swisher to Cou Falls, in Iowan territory, there is a bench-like feature averaging as much as 30 feet above the present stream. Apparently it has lost some of its former distinctiveness by lateral dissection. In the excavations made by the Interurban, sands mixed with coarse gravel, and in places cross-bedded, are exposed. The material is the same in character as that in the Pardieu Creek terrace, and is probably of similar origin.

*Section in an Outwash-like Plain.*—Three or four miles west of Cou Falls, in the southwest quarter of section 19, township 81 north, range 7 west, an intermittent creek has cut a vertical-walled channel 10 feet deep into a very gently sloping area which resembles an outwash plain and leads up to some morainic-like hills of drift capped with loess. The materials are outwash and afford the following section:

- |   |       |
|---|-------|
| (3). Soil and clay, unstratified.....                                       | 2'-4' |
| (2). Gravel parting, apparently residual.....                               | 0'-3' |
| (1). Sands, stratified in long lenses, yellow, medium-grained, arkose ..... | 2'-4' |

*Terrace-like Feature at the Helman Sand-pit.*—At the Helman sand-pit, situated on the north side of the bend of Iowa River just north of Iowa City and on the west side of the tributary that cuts the valley wall, is an exposure of silt, sand, and gravel, overlain by loess. The site resembles a remnant of a terrace. On both sides of the tributary, particularly on the east, the summit is flat-topped for some little distance back to the higher land. The uniform elevation to the west for a quarter

of a mile, with higher land to the north, as shown in Fig. 3, still further suggests a terrace. Were it not for the break in continuity by the tributary, the semblance would undoubtedly be even more perfect.

In the bottom of the pit, are distinct pockets and lenses of gravel, sand, and some silt, with a range in texture from very fine to pebbles the size of a walnut. The outlines of the pockets depict well the courses of rapid currents, which afterward became filled with sand and gravel. About 4 feet higher the material grades into sand and silt. From the dominancy of sand the material grades upward until it becomes dominantly silt and finally loess, containing terrestrial molluscan shells. The material at the bottom is unquestionably a running water deposit, that at the top is clearly eolian, but no line between them can be drawn. However, at least ten feet of the bottom of the exposure is aqueous. Just how much lies below this is not shown. At present the deposit is separated from Iowa River by a "second-bottom" one-eighth of a mile wide, and by a vertical distance of 24 feet. The materials are heterogeneous in composition, fresh, and unconsolidated.

Inasmuch as the materials are of glacial character and similar to those in Pardieu Creek and other tributaries to Iowa River upstream, it seems best to refer them to the same origin.

There are several other terraces along the course of the river between the one mentioned above and upstream to where the Iowan drift-area crosses the river, some of which are quite perfectly developed. One especially deserving of mention occurs just above the Mehaffey bridge, in the southeast quarter of section 32, township 81 north, range 6 west. It is about 30 feet high,  $\frac{1}{4}$  mile long,  $\frac{1}{8}$  mile wide at a maximum, and is backed by a distinct valley-wall 40 to 60 feet high. A well by the house on the east end of the terrace has the following log, as given by the digger: Depth 63 feet (dug 27 feet, drove 36 feet); yellow clay 16 feet, river-sand and gravel about 27 feet; hard-pan 20 feet.

#### CONTORTED BUCHANAN GRAVEL.

An excellent exposure of folded and contorted Buchanan gravel in intimate relations to weathered and unweathered Kansan and overlain by till, is shown in the first Interurban cut north of the upper Interurban bridge across Iowa River. The railroad grade here runs through the south end of a divide projecting somewhat into Iowa River Valley, the summit of the divide at the surface of the cut being about 30 feet above the valley flat. This is within the area mapped as Iowan Drift by Calvin.

The cut is about 250 yards long and attains a maximum depth of 20 feet. One hundred twenty yards of the east end is till, 100 yards of the west end is yellow fossiliferous loess, and between these are the contorted folds and rolls of Buchanan gravel in peculiar relation to the Kansan below and overlain by 2 to 8 feet of till. The arrangement of the materials is shown in Fig. 4.

The oldest material in the cut is Kansan till—blue at the bottom and grading up in places into a grayish to yellow color according to the degree of weathering. The blue drift is very clayey, contains small pebbles, many of which are greenstone, and breaks with polyhedral fracture. Joints are prevalent in the yellow clay and in the upper part of the blue, but instead of being vertical they dip to the west, suggesting that they are the result of pressure from that direction. In that case they might be regarded as slight shear-planes resulting from the same force that produced the distortion of the gravels above. Overlying this, in a peculiarly folded and contorted manner, is Buchanan gravel, the textural range of which is from fine flour to boulders 1 foot in diameter. The gravel exhibits the oxidized, weathered, and decayed character common to the Buchanan, iron-stones being not uncommon and cementation by iron oxide sufficiently prevalent to have preserved stratification lines at many points.

Referring to Fig. 4 from left to right, the gravel appears at (1) in a narrow band and rises at an angle of about 45 degrees to a point near the top of the cut, from which it takes a horizontal course and assumes various forms of folds and loops to where it ends rather abruptly against till.

A striking feature of this cut, besides the contortions, is the fact that the gravel deep in the cut is as much weathered as that near the surface, whereas the till is not. Also at several points there is no gradation of weathering from the gravel into the underlying till. At (1) the gravel, so altered that some boulders can be picked to pieces by the fingers, rests against the blue unweathered till; along the lower contact of (2) and around the lenticular body (3) the contact is sharp; and around the lower part of (4) and between (4) and (5) the till is scarcely changed whereas the gravel is much altered.

Overlying the gravel is a yellow, blue-streaked till, 2 to 4 feet thick along the summit and attaining a thickness of at least 8 feet along the west monoclinical limb. On the western slope of this, beginning at the point (X) and lying in contact with the drift along a diagonal line (made clearer by dotting), lies yellow fossiliferous loess which is not

contorted but which shows deposition after the disturbance of the gravel. This body of loess makes up the west end of the cut.

*Interpretation.*—To account for such folds and contortions of Buchanan gravel into Kansan till in such a way as is revealed here, only one possible interpretation can be given. The uniform weathering of the gravels at different depths in contrast to the non-uniform weathering of the underlying till, and the sharp contacts of the decayed gravel with the more or less fresh underlying till proves that the time of the disturbance was after the weathering had taken place. If the weathering had taken place since the disturbance there should be a gradation zone between the weathered and unweathered portions. Such, however, does not exist.

It is therefore clear that an ice-sheet, capable of distorting and molding this hill of material, invaded this region after the Buchanan gravel and some of the Kansan had been much weathered.

In view of the above interpretation there are four important points embodied in this cut: first, the Kansan drift and the Buchanan gravel record the invasion and retreat of the Kansan ice; second, the weathering of the same represents a considerable time interval after the Kansan invasion; third, the sharp contacts record the close of the interval and these and the folds give identity to the presence of a later ice-sheet and its movement; fourth, the yellow loess, at least in this exposure, was deposited subsequent to the advance and retreat of the later ice-sheet.

#### GENERAL CONCLUSIONS.

The last evidence seems to be conclusive proof that an ice-sheet later than the Kansan advanced upon the area mapped as Iowan drift. The significant features that were noted preceding the last evidence—namely, the valley-train terraces and outwash features—and the glacial topography of the North Liberty lobe and the bordering deposit of loess, noted by Calvin, add the corroborative phenomena to be expected.



Fig. 2.—Photograph of Terrace in Pardieu Creek Valley.



Fig. 3.—View of Terrace-like Feature at the Helman Sand-pit, one mile north of Iowa City.





Fig. 4.—Photograph of the folded and contorted Buchanan gravel in the first Interurban cut north of the upper Interurban bridge across Iowa river.