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SUPERIMPOSITION OF KANSAN DRIFT ON SUB-AFTONIAN DRIFT IN EASTERN IOWA.

MORRIS M. LEIGHTON.

Many new exposures have been made by the Chicago, Milwaukee and St. Paul Railway in the reconstruction of their line across Iowa. Various ones of these have proved to be of especial interest to Pleistocene geologists, and among them are several cuts in the northern part of Clinton county, showing superimposition of the two oldest drifts, the Kansan drift on the Sub-Aftonian drift. This paper is devoted to a description of these and their interpretation.

1. A significant exposure is located at the second viaduct one-half mile east of Delmar Junction. The cut is through a divide with a rounded summit, 250 to 300 yards long, and has a maximum depth of sixty feet. By reference to figure 13, A, the relations of the following materials will be clear:

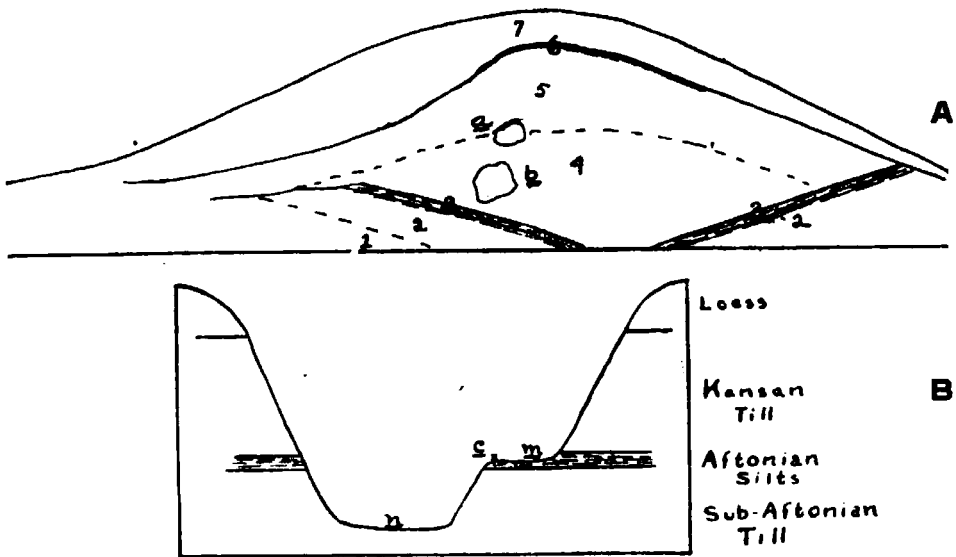


FIG. 13 A—Diagrammatic sketch of the relations of the materials shown in the south side of the Chicago, Milwaukee and St. Paul railway cut, one-half mile east of Delmar Junction.

FIG. 13 B—Cross-section of the railway cut referred to in A, showing the former track-level, *n*; the position of the mineralized stump, *c*; and the present track-level, *n*.

| | | FEET | |
|--------------------------|---|---|------|
| LOESS | { | 7. Loess, 1 ft. of soil at top, grading below into brownish yellow to buff loess, wholly leached of calcareous material, mantles the eroded surface of the Kansan drift; thickness at the summit..... | 8-10 |
| | | 6. Ferretto zone at the top of the till, absent from the slopes, reddish brown, leached, pebbles show considerable decomposition; thickness | 0-1½ |
| Grades downward into: | | | |
| KANSAN DRIFT | { | 5. Till, brownish yellow to yellow, summit rounded, leached of calcareous matrix and limestone pebbles in uppermost 7 to 8 ft., calcareous below with lime concretions and limestone pebbles, insoluble drift pebbles present throughout, lime concretions most abundant just below the base of the leached portion; maximum thickness.... | 25 |
| | | Grades downward into: | |
| AFTONIAN SOIL | { | 4. Till, blue-gray or slate-colored, containing two large sand pockets, <i>a</i> and <i>b</i> , which have the appearance of included bodies, sand pocket <i>a</i> lies in the transition zone of (4) and (5), matrix of till calcareous and limestone and other drift pebbles present, fragments of wood in the basal portion, fills an old depression; thickness..... | 0-28 |
| | | 3. Old black soil, with many small fragments of wood mineralized with iron pyrite, pebbles rare, some imperfectly laminated clay, soil-zone delineates an old depression with slopes as high as 12°. At <i>c</i> , on an old track level (Fig. 13, B), is a stump with roots and rootlets running through the old soil and underlying clay; the wood is mineralized like the fragments of wood throughout the soil zone. Thickness of soil zone | 2½-3 |
| Grades downward into: | | | |
| SUB- AFTONIAN TILL | { | 2. Till, dark bluish green on damp surface, light grayish green where dry, leached of calcareous matrix and limestone pebbles but other drift pebbles are present; thickness | 6± |
| | | Grades downward into: | |
| | | 1. Till, yellowish to brownish green, with some maroon-colored material in the lower part, leached 2-4 ft., calcareous below; thickness exposed | 0-14 |

Interpretation.—This exposure seems to show quite clearly two distinct tills. The dark bluish green color of the till below the old soil zone is the color of material which has undergone de-oxidation from a former oxidized state. Its transition below into material of yellowish to brownish color, with a greenish tinge, and the presence of carbonaceous material directly above, indicates that it was once oxidized but has been subsequently de-oxidized, probably since the soil material has been deprived of atmospheric oxygen. The leaching of the lower till to a depth of about eight feet requires an interval of time, much longer than post-Wisconsin time, during which oxidation would likely have taken place. Directly above the soil zone is till which has never been leached or oxidized. These relations show quite clearly that the deposition of the two tills was separated by an interval worthy of the designation of an interglacial epoch.

The upper till-body is unquestionably Kansan. The topography of the surrounding region is not only erosional, like the Kansan area, but the upper till is weathered similar to the till of the Kansan area, both from the standpoint of degree and depth of oxidation and from the standpoint of depth of leaching.

Hence, if the upper till is Kansan, the lower till must be sub-Aftonian, and the soil development and leaching and oxidation of the lower till must be Aftonian in age.

The age of the stump just at the old track-level was carefully considered. Upon examination of various parts of the stump and its roots, it was found that the wood is mineralized with iron pyrite just like fragments of wood which are scattered throughout the Aftonian soil-zone. This evidence led to the conclusion that the stump belongs to the Aftonian soil and was uncovered in the excavation of the cut. This attention has been given to the stump, not because it necessarily adds to the weight of evidence for the differentiation of the two till-bodies, but it is the first stump, having an interglacial position, known to have been reported.

The position of the loess above the ferretto of the Kansan drift and as a mantle on the eroded surface of the Kansan drift, warrants the usual interpretation that a considerable interval of erosion and weathering intervened between the deposition of the Kansan drift and that of the loess about the Iowan drift

: 2. Another important cut is just west of the depot at Delmar Junction, on the north side of the tracks. This cut has a maximum depth of about twenty feet, is one hundred yards long and its summit is round. The materials exposed are as follows (figure 14, A):

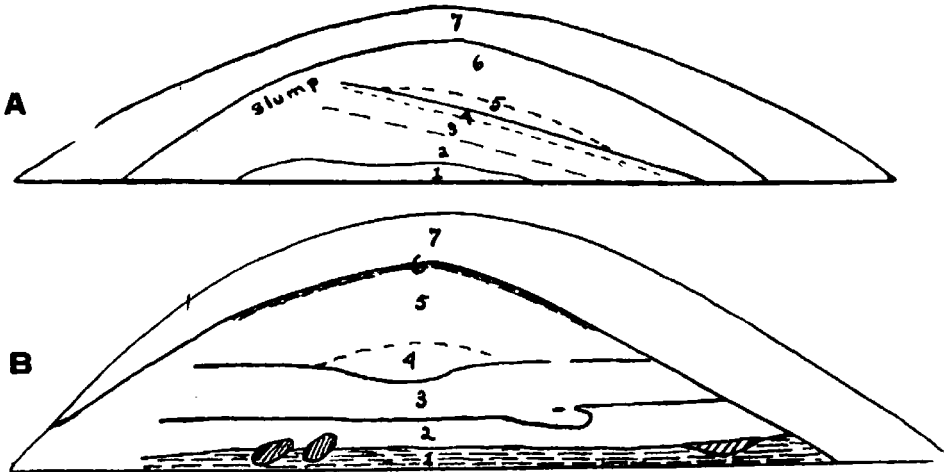


FIG. 14 A—Diagram of relations of materials in the north face of the Chicago, Milwaukee and St. Paul railway cut, just west of the depot at Delmar Junction, Clinton county.

FIG. 14 B—Diagram of the relations of the materials in the north face of the Chicago, Milwaukee and St. Paul railway cut, six miles east of Delmar Junction, Clinton county.

| | | FEET | |
|-------------------|---|---|-------|
| LOESS | { | 7. Sandy loess, buff, well stratified, leached, thin soil zone at the top, conforms to the rounded summit of the underlying materials; maximum thickness..... | 10-12 |
| | | 6. Till, brownish yellow to yellow, calcareous matrix, limestone pebbles present together with other drift pebbles up to the base of the loess where there is a concentration of pebbles; maximum thickness..... | 8± |
| KANSAN TILL | { | 5. Till, blue-black, containing some wood, line of oxidation above quite sharp, probably due to organic material, but <i>calcareous</i> like the above; thickness..... | 1-3 |
| | | 4. Silts, dark brown, laminated, appear to have much carbonaceous substance, <i>leached</i> ; thickness | 1-1½ |
| AFTONIAN SILTS | { | Grades downward into: | |
| | | 3. Silts, gray, laminated, leached..... | 3 |
| SUB-AFTONIAN TILL | { | 2. Till, brownish yellow to yellow, with maroon streaks and some lamination, pebbles and cobbles up to 6 in. in diameter, leached 4½ ft. in one place, calcareous and limestone pebbles present elsewhere up to the base of the gray silts, some decayed pebbles; thickness, maximum..... | 8± |
| | | 1. Till, bluish drab, calcareous; thickness..... | 0-3 |

KANSAN DRIFT ON SUB-AFTONIAN

Pebble counts from the unleached portions of both tills yielded the following results:

| KIND | KANSAN TILL PER CENT | SUB-AFTONIAN TILL PER CENT |
|------------------------------|----------------------------|----------------------------------|
| Greenstone and Dolerite..... | 46 | 42 |
| Limestone | 30 | 28 |
| Granite | 8 | 6 |
| Chert | 4 | 8 |
| Quartzite | 6 | 6 |
| Schist | 4 | 2 |
| Quartz | 2 | 2 |
| Volcanic Porphyry | 0 | 6 |
| | 100 | 100 |

Interpretation:—In this exposure, which is one-half mile from the former, the existence of the non-calcareous silts, containing carbonaceous material, between the calcareous till above and the leached and calcareous till below, makes it obvious that here there are also two till-bodies of different age. Inasmuch as this general region is one of mature erosion, as mentioned in the former case, the upper till is believed to be Kansan till, the silts Aftonian, and the lower till sub-Aftonian. The relations of the loess to the Kansan till in this cut do not clearly show an interval between their dates of deposition, but in view of the relations in the cut first described and of the mantling nature of the loess, it is probable that the rate of leaching of the Kansan till was at least equaled by erosion and consequently no leached zone remains. The lithology of the two tills, according to the pebble count, does not show any marked difference.

3. Farther east, about six miles east of Delmar Junction and one mile northeast of Riggs, a Chicago, Milwaukee and St. Paul Railway cut, trending north 30° east, fifty to sixty feet deep, and two hundred yards long, exposes two bodies of till, separated by a body of gravel. By referring to figure 14, B, the relations of the materials, which are described below, will be clear.

- | | FEET |
|--|------|
| 7. Loess, soil-layer at the top 1 ft. thick, brownish yellow and non-calcareous down to the till, snail shells only in the calcareous portion; maximum thickness | 30± |
| 6. Ferretto zone of till, reddish brown, absent on lower slopes | 0-1½ |

- 5. Till, brownish yellow to yellow, leached 6 feet, calcareous and limestone pebbles below, upper horizon conforms to the contour of the hill and mantled by the loess, maximum thickness..... 20
 Grades downward into:
- 4. Till, gray-blue, calcareous, occurs below thickest part of the oxidized till and in a small depression of the underlying gravel; maximum thickness 8
- 3. Sand and gravel body, extends across the cut except where mantled on the slopes by loess; limestone and other drift pebbles present, yellowish to brownish in color, lens and pocket-structure; thickness 10-12
- 2. Till, light drab to dark drab at the top, brownish gray to dark gray below, dense and compact, limestone pebbles to the top, mostly decayed in the upper one foot, contains some inclusions of the underlying silt; thickness..... 12-14
- 1. Silt, somewhat sandy, yet compact, dark gray, no pebbles, fragments of wood or roots of wood 1 to 2 inches in diameter exposed near the bottom, upper horizon somewhat undulating and in places shows gouging by an over-riding ice-sheet; thickness 12±

Interpretation:—There is no zone of leaching and oxidation within the drift materials which warrants a separation into two distinct tills. It has been thought, however, in view of the other exposures, that possibly the gravel-body represents such an interval as the Aftonian and that the overlying drift is Kansan in age and the underlying is sub-Aftonian. In this case, the bottom silt formation would be probably pre-Pleistocene. These determinations, however, must remain somewhat conjectural.

It is quite clear, however, that the loess formation was deposited on the Kansan drift after the latter had been eroded and weathered to its present state. This means a relatively long interval between the deposition of the two as compared with post-Wisconsin time.

SUMMARY OF THE CHIEF POINTS.

- 1. These exposures definitely record the invasion of the sub-Aftonian ice-sheet into the extreme eastern part of Iowa. Taking into consideration the other known exposures of sub-Afton-

ian drift in Iowa and Nebraska, it appears that in a broad way the sub-Aftonian and Kansan ice-sheets covered approximately the same territory from east to west, a territory much more extensive than was covered by any of the later ice-sheets in the Keewatin field.

2. Where the sub-Aftonian drift is definitely differentiated from the Kansan drift, the sub-Aftonian shows a leached zone considerably deeper than that of the Wisconsin drift. On this basis the length of the Aftonian interval was considerably greater than post-Wisconsin time. This is in harmony with the evidence of the Aftonian mammalian fossils that the interval was long and warm, and when both evidences are considered it is to be inferred that the ice-sheet was melted back at least to its present limits.

3. The existence of the two oldest drifts in this locality and the absence of any evidence that the Maquoketa and Wapsipicon river valleys below Monticello and Anamosa, have been occupied by an ice-sheet, indicate that these superimposed valleys have been carved since the Kansan ice invaded this region.

4. The Kansan drift was weathered and eroded to its present state before the loess in this locality was deposited, hence this weathering records an interval much longer than post-Wisconsin time. The weathering and erosion of the Kansan drift does not, therefore, represent its age. The loess itself shows three to four times the leaching that the Wisconsin drift shows, and the length of time represented must be added to that shown by the weathering and erosion of the Kansan drift, in order to fully appreciate the great age of the Kansan drift.

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