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Evidence of a Sub-Aftonian Till Sheet in Northeastern Iowa

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over the ancient marsh; lastly, the mantle of yellow clay on which another soil has formed and now bears another growth of vegetation.

Thanks are due to Professor Calvin for kind encouragement and for the photographs of the section; to Professor Sardeson, of Minneapolis, for helpful suggestions, and to Engineer Wilkins, of the Chicago Great Western railroad, for use of the profile map.

EXPLANATION OF PLATE I.

Section of Pleistocene deposits as shown in the railway cut at Oelwein.

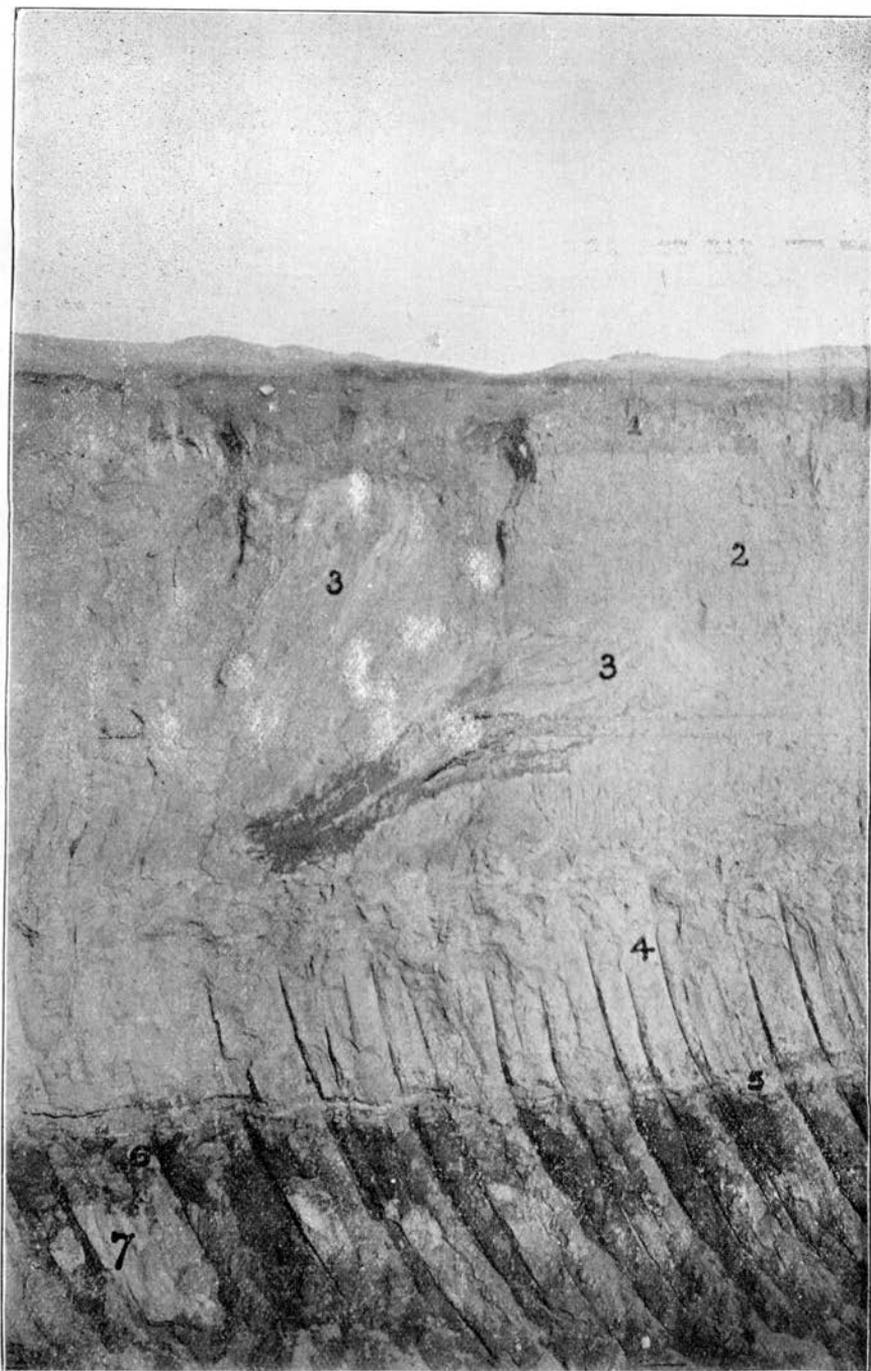
1. Thin layer of Iowan drift. Materials unoxidized, and boulders fresh and sound.
2. Kansan drift, oxidized and leached near the top. Many of the boulders in an advanced stage of decay. Grades downward into unoxidized blue till.
3. Sand boulders in Kansan drift. Upper ends are included in oxidized portion of this drift sheet; lower ends extend down into unoxidized portion.
4. Lower phase of Kansan drift which here shows physical characteristics resembling Number 7.
5. Thin layer of stratified sand, of Aftonian age, overlying peat.
6. Peat bed of Aftonian age.
7. Sub-Aftonian drift.

EVIDENCE OF A SUB-AFTONIAN TILL SHEET IN
NORTHEASTERN IOWA.

BY S. W. BEYER.

Until very recently, geologists working in Iowa have been content to refer the various boulder clays represented in the state to two till sheets, a so called "upper" and "lower," separated in many places by the "forest beds" of McGee, or in other localities by gravels, often in conjunction with a vegetal horizon, the Aftonian of Chamberlin.

Early in the present year it was suspected by the assistant state geologist of Iowa that the lower till in central Iowa was not the equivalent of the lower drift sheet at Afton Junction. Later in the season Mr. Bain, in company with Prof. T. C. Chamberlin of the University of Chicago, revisited the Afton section, and what was at first a suspicion rapidly became a conviction. It was clear that the then recognized lower till of central and northeastern Iowa, extending southward into Kansas



and currently known as the Kansan, must be correlated with the upper till at Afton Junction. The Aftonian gravels were demonstrated to lie below the Kansan instead of above it, and the lower boulder clay at their type locality must be rechristened. Professor Chamberlin,* in an editorial on the series of glacial deposits in the Mississippi valley, designates the lower till at Afton by the term sub-Aftonian and suggests its probable equivalency with the Albertan of Dawson.

This fortunate discovery and happy recognition of a sub-Aftonian drift sheet in south central Iowa naturally suggested its probable presence in other portions of the state.

During the present autumn one and perhaps two sections in northeastern Iowa have been brought to light which afford additional evidence of a pre-Kansan ice sheet.

Oelwein Section.—The cut on the Chicago Great Western railway, east of the town of Oelwein, in southern Fayette county, exhibits the following series of glacial deposits:

- | | |
|---|-------------|
| 5. Boulder clay, rather dull-yellow in color; the upper portion is modified into a thin soil layer. Large boulders, mainly of the granitic type, are present, often resting on or partially imbedded in the deposits lower in the series. (Iowan) | 0-10 feet. |
| 4. Sand and gravel—not a continuous deposit; often shows water action expressed in parallel stratification lines and false bedding. The gravels are usually highly oxidized and fine textured. (Buchanan) | 0-2 feet. |
| 3. Till, usually bright-yellow above, graduating into a gray-blue when dry or a dull-blue when wet, below. This deposit is massive and exhibits a tendency to joint when exposed. Decayed granitic boulders are common. (Kansan) | 3-20 feet. |
| 2. (a) Sand, fine-white, well water-worn; often with a slight admixture of silt and clay. (Aftonian) | 0-6 inches. |
| (b) Vegetal layer and soil, from two to four inches of almost pure carbonaceous matter, with one to three feet highly charged with humus. The peaty layer often affords specimens of moss (<i>Hypnum</i>) perfectly preserved. (Aftonian) | 0-4 feet. |
| 1. Till, greenish-blue when wet or gray-blue with a greenish cast when dry. Greenstones and vein quartz pebbles predominate. (Sub-Aftonian or Albertan.) Exposed.... | 10 feet. |

The Oelwein hill trends northwest and southeast and is bilobed. The divisions will be referred to in the present paper as east and west lobes.

*Journal of Geology, vol. IV, No. 7, p. 873 *et seq.*, 1896.

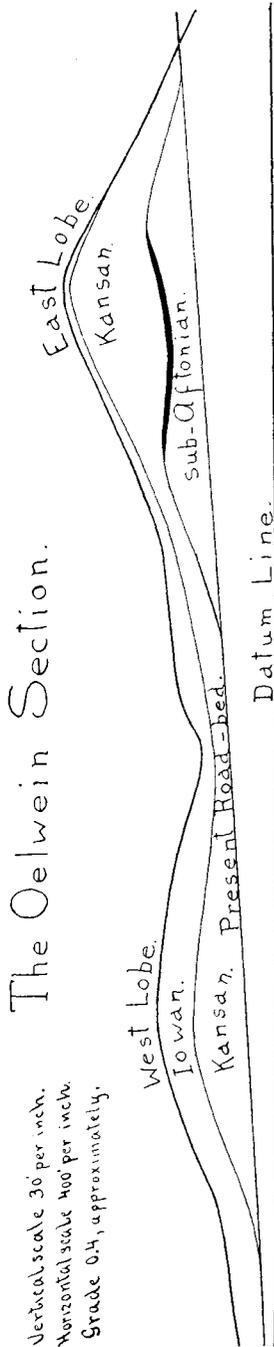


Fig. 4.

The Iowan reaches its maximum development near the summit of the west lobe, where it attains a thickness of some ten feet. The deposit thins eastward. At the crest of the east lobe little more than a foot of Iowan till is present, while at the extreme eastern limit of the cut Iowan boulders are partially imbedded in the Kansan. The till varies from a pale yellow to a moderately bright yellow color, and is not thoroughly leached nor oxidized. The Iowan shows a tendency to crumble on exposure, which is in striking contrast to the older drift sheets.

The line of separation between the Iowan and Kansan is not as well marked, in all cases, as could be desired but in most instances can be traced with some degree of confidence. In the west lobe a layer of sand sharply divides the two sheets for a distance of 100 feet, but when followed in either direction becomes much disarranged by the latter and in some places entirely loses its identity.

The Kansan is the predominant sheet in the cut and the topographic features of the region are faithfully depicted by the stiff boulder clay of this deposit. Its maximum exposure is in the east lobe, where it exhibits a thickness of twenty feet. The upper portion is oxidized to a bright yellow, sometimes brownish-yellow, often closely resembling the Iowan in color. The most distinctive feature in its separation from the latter are the character of the included boulders and the greater tenacity of the Kansan till. The Iowan pebbles and boulders are prevailingly of the granite type and

well preserved, while in the Kansan, greenstones are common and many of the granites are in an advanced state of decay. A granitic boulder more than a foot in diameter was noted which had been cleaved by the steam shovel without being loosened from its matrix. Sand boulders, lenses and wedges anomalously distributed through the oxidized portion and often extending into the upper portion of the blue till are common features. The wedges usually maintain a more or less vertical position with their apices pointing downward. The filling material in all cases very closely resembles the sand layers between the Iowan and Kansan. Oftentimes the position of the various sand forms is such as to suggest their common origin with the Buchanan. In many instances stratification lines are common. In the trough of the hill the lower portion of the Kansan contains lime concretions similar to the loess-kindchen and püppchen in great numbers. The lower three or four feet of the blue till contains wood fragments in considerable abundance in a state of almost perfect preservation. The physical properties of this portion of the Kansan are very similar to the sub-Aftonian.

The dividing line between the Kansan and sub-Aftonian is more sharply marked than between the upper two drift sheets. In the major portion of the section the sand layer and the peat bed are continuous, demonstrating the extreme gentleness of the advance of the Kansan ice. It seems remarkable that perhaps the greatest ice sheet that ever appeared in the Mississippi valley could override a peat-bog with no perceptible disarrangement of materials. The pertinence of Prof. T. C. Chamberlin's remark is apparent "that a glacier builds its own causeway." The surface of the sub-Aftonian is much more even than that of the Kansan; in fact it is not unlike that ascribed to our more modern peat-bogs. In certain places the upper part of the sub-Aftonian has been shifted and spheroidal masses of the peaty soil appear at the junction line imbedded in a Kansan matrix.

The drift sheet below the Kansan is represented by a massive gray-blue till with a marked greenish tone when unoxidized. The upper portion contains much humus and gives off a characteristic marsh-like odor when wet. The distinctive characters which serve to distinguish this boulder clay from the preceding are its color, the predominance of greenstone, and vein quartz pebbles and a less tendency to joint on

exposure. Granitic pebbles and boulders are, almost if not entirely, wanting. The pebbles in this as in the Kansan often exhibit polished, striated and faceted surfaces. The sub-Aftonian shows oxidation only where the superficial deposits are thin and the indications are that such oxidation took place after the deposition of the Kansan. At the extreme east end of the cut, beyond the peat-bed, there is an apparent exception to this rule. Blue till boulders of the Kansan are imbedded in an oxidized matrix of the basal drift sheet.

Albion Section.—Another section has come to the writer's notice during the past year which bears additional testimony to a drift sheet older than the Kansan. At the Albion mills on the Iowa river about ten miles northwest of Marshalltown, the following series of deposits may be observed:

- | | |
|--|----------|
| 6. Loess, stratified sands below..... | 20 feet. |
| 5. Till, yellow in some places apparently wanting and often represented by characteristic boulders, only. (Iowan)..... | 0-1 foot |
| 4. Gravel, some boulders four or five inches in diameter; granitic members often much decayed; limestone pebbles are common and boulders of Kansan till decorated with pebbles were noted. (Buchanan)..... | 2 feet. |
| 3. Till, the upper portion highly oxidized to a deep reddish-brown, unoxidized portion a gray-blue, exhibiting a jointed structure. (Kansan)..... | 4 feet. |
| 2. Sands and gravels, stratified and coarser below; oxidized in streaks, and bands approximately parallel to bedding planes; certain bands contain a considerable percentage of silt and clay. (Aftonian)..... | 10 feet. |
| 1. Till, blue. (Sub-Aftonian)..... | 10 feet. |

The Kansan at this point is more highly oxidized than at Oelwein, while the gravels between the Iowan and Kansan are very sharply defined.

The Aftonian does not present the iron-stained appearance usual to such deposits. Many of the pebbles and boulders are, however, in an advanced stage of decay.

EXPLANATION OF PLATES.

Plate II. The Oelwein Section.

1. Sub-Aftonian.
2. Aftonian.
3. Kansan, composed of an upper oxidized and a lower unoxidized portion.
5. Iowan.

Plate III. The Albion Section.

2. Stratified sands and gravels of the Aftonian.
3. Kansan till oxidized in part.
4. Buchanan, consisting of coarse gravel.
6. Loess, with stratified sands and silts below.

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PLATE II.

