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Summary of Discussion

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we recall the notorious fact that peat-bogs and marshes, whether by the abundance of humic acid or from other causes, are pronouncedly aseptic. If moss, developed under such conditions, was finally buried at a low temperature and sealed up, its preservation is explained. But again, the wood fragments referred to are saturated with a solution of ferrous sulphate. The occurrence of this salt in this condition is a problem to which the attention of the chemist, rather than of the botanist, may be invited.

In closing, one other fact may be mentioned. Some years since well diggers of Washington county, in the town of Washington, brought up from great depth, some hundreds of feet, a perfectly preserved and uninjured cone. This I identified at the time as the fruit of *Larix americana*. If our determinations are therefore to be trusted, the Oelwein peat bed and the Washington cone represent the same horizon. As the only drift in Washington county is Kansan, the position of the Oelwein peat as pre-Kansan is to this extent rendered more certain.

SUMMARY OF DISCUSSION*.

BY PROF. S. CALVIN.

The discussion following the preceding papers on the Oelwein section was participated in by Calvin, Fink, Bain, Shimek, Beyer, Finch and others. The facts developed during the discussion may be summarized as follows:

A few years ago geologists were content to look upon the glacial period as a unit, and the drift mantle of Iowa was regarded as the effect of a single invasion and retreat of glacial ice. Some time ago, however, McGee demonstrated that in northeastern Iowa there are two distinct drift sheets separated by a soil horizon and forest bed which represent an interglacial period of considerable length. The two sheets of drift were then named respectively the lower and the upper till. Later two distinct drift sheets were recognized in Union county, near Afton Junction. They are separated by a soil bed and by

*A motion that Professor Calvin be requested to summarize this discussion was carried unanimously.

extensive deposits of water-laid gravels. It was at once assumed that the two drift sheets at Afton Junction were the upper and lower till of McGee. Within the past year or so Mr. Bain, of the Iowa Survey, studied the Afton deposits and became convinced that the till above the gravels and soil bed was equivalent to McGee's lower till, that the upper till was not present in that part of Iowa, and that the lower bed at Afton is distinct from any of the drift sheets recognized in northeastern Iowa. The locality was afterward visited in company with Professor Chamberlain and others and Bain's conclusions were fully confirmed. Here is a drift sheet older than McGee's lower till. In the meantime a lobe of drift, crossing the northern boundary of the state with a width reaching from Worth to Dickinson counties and narrowing toward its apex at Des Moines, was recognized as younger than the upper till of McGee. This youngest drift has been named Wisconsin by Chamberlin, McGee's upper till Chamberlin calls Iowan, and the lower till Kansan. The drift beneath the Aftonian soil and gravels is so far unnamed, but it is provisionally called sub-Aftonian. Mr. Leverett has recently shown that a bed of till occupying a small area in southeastern Iowa was deposited by glaciers coming from the northeast through Illinois. These glaciers spread a characteristic sheet of till over a large part of the state last named, and this drift sheet, which is younger than the Kansan and older than the Iowan, is called the Illinois.

There is therefore in Iowa a record of five ice invasions separated from each other by interglacial periods of considerable duration. The drift sheets corresponding to the several ice invasions are named in the order of age: 1, sub-Aftonian; 2, Kansan; 3, Illinois; 4, Iowan; 5, Wisconsin. The interglacial deposits between the first and second are called Aftonian. Respecting the length of the interglacial periods it may be shown that many of them were many times longer than the period that has elapsed since the retreat of the Wisconsin ice. The Oelwein cut to which reference is made in the papers under discussion is particularly interesting for the reason that it shows three of these drift sheets, the sub-Aftonian, Kansan and Iowan, in their normal relations. The first and second are separated by the peat bed which represents the Aftonian interglacial period. The second and third are separated by a zone of oxidation. The Iowan drift at the top of the cut is thin, but it contains boulders fresh as when they left the parent ledge.

The Kansan drift is thicker. It is deeply oxidized at the surface, and its granite boulders are so far decayed that the steam shovel has cut through individuals a foot or more in diameter without encountering as much resistance as is offered by the surrounding clay. The sub-Aftonian contains small pebbles of very hard crystalline rocks, many of the pebbles being of vein quartz, but there are few granites. Concerning the climate of the Aftonian interglacial period the wood and peat would indicate conditions similar to those that may exist in northern Maine.

Iowa is now classic ground for the study of Pleistocene deposits, and geologists the world over, if they would study these deposits to best advantage, must come to Iowa to do it.

ADDITIONAL OBSERVATIONS ON SURFACE DEPOSITS IN IOWA.

BY B. SHIMEK.

During the past summer the author made a series of observations, at the request of Prof. S. Calvin, upon the surface deposits of the northern part of the state, the results of which may be worthy of record.

Borings were made with a two and one-half inch auger attached to gas pipe, and in addition to this cuts along railways and wagon roads and exposures along creek and lake shores were examined. The chief observations were made at the following points:

a. At Clear Lake, in Cerro Gordo county, three borings were made in the timbered ridge east of the lake, as follows: One within five rods of the lake shore and two on the topmost part of the hill to the east.

b. At Forest City the following work was done:

1. Eleven borings were made due east from Forest City on the timbered ridge which extends north and south, parallel with Lime creek and just east of it, beginning at the top of the ridge north of the road, and thence at irregular intervals for 450 yards to the south. Nine of these borings were made at or near the summit of the ridge and two, one on each side, were made near the foot.