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Grant E. Finch

changes, based on the succession of strata within the county, may be represented in the on following diagram:

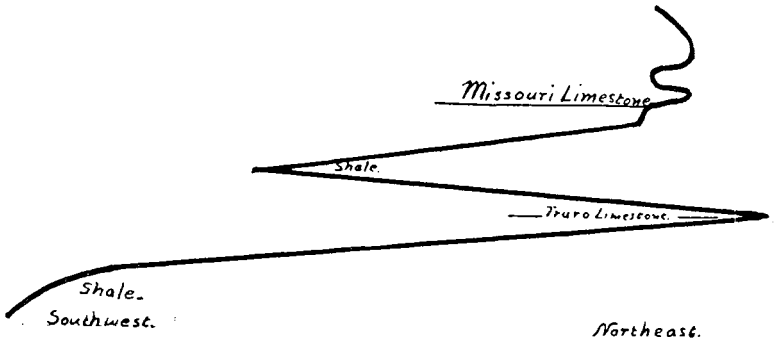


Fig. 3. Diagram representing the relative positions of the shore lines as indicated by the general character of the strata within Madison county.

NOTE.—A later comparison of outcrops proves that those shales in the upper Des Moines which are mentioned in this paper as calcareous, lie a few feet above those to the east with which they were compared; hence the local evidence mentioned that the upper part of the Des Moines shales becomes calcareous toward the west is wanting.—AUTHOR.

## DRIFT SECTION AT OELWEIN, IOWA.

BY GRANT E. FINCH.

Just outside the limits of the growing town of Oelwein, Iowa, to the southeast, the Chicago Great Western Railroad company, in order to lessen a troublesome grade, have excavated a cut nearly a mile in length. At the end farthest from the town, where it passes diagonally through a ridge, it has a maximum thickness of thirty-two feet. This ridge has a northwest-southeast trend, and is one of the ordinary gentle swells characteristic of the drift of this region.

To pass along the front of so extensive a section, twice the depth of ordinary drift cuts, fresh and untarnished by sun and rain, is a pleasure to any one, whether geologist or not. The great variety of colors—strata black, brown, gray, blue, green, and several shades of yellow; the distribution of boulders like plums in a Christmas pudding; the intricate twistings and turnings of some layers and the unexpected, fantastic intrusion of others, all could not help but hold the eyes of both trained and untrained observers.

Though of great interest throughout its entire length, the section exposed where the cutting pierces the before-mentioned

ridge proved most interesting to me, and I shall therefore attempt its description somewhat in detail.

Beneath the eighteen inches or so of black soil at the surface, covering the top and slopes of the hill, is a yellow clay with a liberal admixture of sand, gravel, pebbles and boulders. Many of the boulders show striated and polished surfaces. Numerous small, angular fragments of limestone are everywhere present. In one of these was a number of specimens of *Nucula levata*, a lamellibranch which is found in the Maquoketa shales. There are great variations in the composition of this bed, but they occur in the form of irregular, curling drifts rather than of definite strata. This lack of any definite plan of structure combines with the great variety of materials found to give the yellow clay the heterogeneous look of a dumping ground.

At an average depth of about eight feet below the surface the yellow clay shades almost imperceptibly into a blue, which is so tenacious and compact as to require the use of the pick instead of the shovel in digging it. It offers an effectual barrier to water, which readily penetrates the loose, sandy clay above. It is everywhere broken up into polyhedral, usually cubical, fragments, whose angles project conspicuously in the face of the exposed section. This tough blue clay fills a trough under it, and rises in a broad curve above, determining the form of the hill; hence, it varies much in thickness. Below the highest point of the hill it is fully eighteen feet thick; three hundred feet either side, about one-fourth as much. Its structure is fairly uniform throughout. Boulders are very few and much decayed. Limestone fragments are found, as in the bed of yellow clay above, but there are also small fragments of wood and peat sparsely scattered through the whole bed, several fragments of both being found within eight feet of the surface of the ridge.

Next below this lenticular bed of clay is a bed of grayish-blue clay which has a nearly uniform thickness of about four feet. This bed curves downward at the center, its lowest point being about under the crest of the ridge. While the face of the section was fresh and unaffected by exposure, no distinction was noticed between this and the lenticular layer of clay above, but after repeated visits, the last one after the clay had been washed by the heavy rains and repeatedly frozen by night and thawed by day, a dim yet definite line of demarkation was visible.

Under the action of weathering this lower blue clay became distinguishable too, by reason of its smoothness of surface, from the upper blue clay, the face of which it has been already stated is covered with rough right-angled projections.

This difference would seem to be caused by a greater proportion of sand in the lower clay, which may be seen by close inspection to be the case.

Thus, while weathering dims the attractive colors, while it mutilates and must soon destroy the exposure, its immediate effect is to reveal stratification and texture that in the fresh surface of the glacial section are sometimes concealed.

This lower blue clay also shows a liberal number of angular fragments of limestone, one being observed which was a foot square and three inches thick. The entire bed, too, is found to be strongly impregnated with lime.

Fragments of wood are abundant throughout this four feet of sandy clay with its mixture of lime. Though the wood is fairly uniform in distribution in the different parts of the stratum, there seems to be no observable system in its distribution, no definite forest bed corresponding to the numerous instances given by McGee. This would seem to indicate that these woody fragments had been borne in from elsewhere rather than overwhelmed *in situ.*

The woody remains consist of stumps, trunks, branches and twigs. Such short roots are found only as remain attached to the stumps. The tree trunks are most frequently in a horizontal position, and in that case are flattened out of the cylindrical, thus showing the effects of pressure from above, since the vertical diameter is the shorter one. The maximum thickness of the trunks observed was eight inches, in a much decayed specimen. The length was uncertain. Preservation of the bark was observed in very few instances.

Nearly all the specimens found appear to belong to the same species. Its lines of growth are very close together, an indication that it grew slowly. It is apparently some soft wood.

All of the wood when found was saturated with water, which dried out very slowly on exposure to the air.

Though wood is found in both strata of the blue clay, fifty fragments may be found in the lower to one in the upper. Besides, the fragments in the lower bed are by far the larger.

It seems worthy of notice that the lower blue clay was deposited so evenly over the undulating sides as well as the

bottom of an irregular, basin-like depression. Taking this into account, and the difference in the occurrence of the wood of the two strata and their definite line of separation, one wonders whether the relation of the lenticular layer of clay may not be closer to the yellow clay above than to the blue below. The gradual blending of the upper into the middle stratum has been noticed, and the fact that wood occurs even in the transition between the two beds leads one to question whether it might not have been found up through the yellow clay were not that bed so loose of texture.

Next below the four feet of blue clay occurs a peaty bed that shows the same saucer-shaped depression as the clay above. On its upper surface, separating it from the clay, is a sheet of incoherent white sand which is fairly pure and shows irregular lines of sedimentation. Its thickness varies from nothing to six inches but it is fairly constant over most of the surface of the peat. The peaty formation has at the center a thickness of four feet, but it thins out and disappears within 300 feet in either direction. Its brown color makes it the best defined bed of the exposure, yet it is in structure far from uniform. The planes of stratification are frequently irregular, rising through the bed to the eastward. Such parts are clearly the results of sedimentation. Other layers are pure peat in regular and extensive sheets composed of closely compressed laminæ of moss as plain as if it was fresh from the botanist's press. These are certainly *in situ*.

Other vegetal remains than moss are wanting. Repeated and careful search discovered but one fragment of wood which was found in a sandy loam that underlies a small part of the peat. No roots are found except small ones, apparently those of the moss. Below the peat is a greenish colored clay, the lowest formation found. At the middle of the section it is invisible because below the bed of the cut, 300 feet either way it rises to a height of six or eight feet. It is a compact clay containing a considerable amount of sand and quartz, and other crystalline pebbles, but no limestone fragments, neither does this formation, nor the peat, show any impregnation with lime.

In the depression in this green glacial clay must have existed the swamp where the peat bogs formed during a great pause in the Ice Age. Upon this peat marsh came a flood of clay and sand bearing in its embrace the forest debris and limestone fragments. Next came a huge windrow of drift building a hill

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.

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## 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