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## Additional Observations on Surface Deposits in Iowa

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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.

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## ADDITIONAL OBSERVATIONS ON SURFACE DEPOSITS IN IOWA.

BY B. SHIMEK.

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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.

2. Two borings were made on a little plateau about one-half mile east of Lime creek, and notes on a well near by were taken.

3. Two borings were made on the timbered ridge south of Forest City, and several cuts along the Minneapolis & St. Louis railroad and at the gravel pit two miles south were examined.

4. Two borings were made between Forest City and Lake Edwards (in Hancock county), one near the top of a hill on which a few bur oak shrubs had gained a foothold, and one on lower ground. Observations were also made in cuts along wagon roads west of Forest City.

5. Well diggers were consulted at Forest City.

c. At Spirit Lake, in Dickinson county, exposures along the lake shores and cuts along railways and wagon roads were studied.

d. Near Granite, in Lyon county, five borings were made at various altitudes, about one mile west of Granite and south of the railroad, and observations were made in the railroad cuts between Granite and the Big Sioux river.

The results were fairly uniform and are here briefly summarized.

The succession of strata in the great majority of cases was as follows:

1. A fine black surface soil, sometimes mingled with fine sand, varying in thickness from six inches to two feet.

2. A compact yellowish layer of clay resembling loess, but sometimes with grains of sand and very small pebbles intermingled, and devoid of fossils. This is sometimes quite absent, but again reaches a thickness of nearly two feet.

3. A layer of yellow boulder-clay, with numerous boulders, these often several inches in diameter, occasionally much larger.

4. The boulders interfered with the borings, but where deeper sections could be observed it was found that this layer varied from five to fifteen feet in thickness.\*

Where borings were made in low or flat grounds it was found that strata 1 and 2 averaged a little greater in thickness, and stratum 1 was rather more frequently mingled with sand.

The borings at Clear Lake and east of Forest City were made in the timber. In all these stratum 1 was greater in thickness and was mostly made up of finer material.

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\* Beneath this layer at Forest City occur pockets of sand, underneath which is a blue boulder-clay of great thickness, said by the well diggers at Forest City to vary from sixty to 100 feet in that vicinity.

The yellow boulder-clay—stratum number 3—has boulders scattered throughout its thickness, but, as a rule, on slopes and near the tops of hills these are much more abundant in the upper part, immediately under strata 1 and 2.

This is strikingly shown in some of the cuts and exposures at Forest City, Spirit Lake and Granite. It appears as though this stratum had at sometime been much thicker upon the hills, forming their barren surface immediately after the recession of the glacial sheet. By the action of winds and water the finer material at the surface was sifted out and carried away before the hills were covered with vegetation, the heavier boulders being but little disturbed, excepting as they were undermined. As a result the hills were cut down and the boulders were brought closer together at the surface. Their accumulation retarded the surface disturbances and the vegetation peculiar to barren grounds was enabled to gain a foothold. Finer material, brought hither by the winds,\* was retained by this vegetation and a new surface soil was formed—the stratum number 2—of which a vegetation more abundant then took possession. This retained still finer material, mingling with it its own decomposed substance, and the present surface soil—stratum number 1—was gradually formed. It may here be noted that the finest part of the material from stratum number 3 seems to be in all respects like our loess.

The conditions which probably prevailed before the formation of strata 1 and 2 are still illustrated by comparatively barren prairie hills west of Forest City and in the vicinity of Granite, where stratum number 3, or mere indications of number 2, form the surface, whose vegetation, as incidentally noted in the following paper, is quite different from that of the more fertile surrounding prairie.

The occurrence of the scrub bur oak groves on some of these hills is interesting. The plants are chiefly shrubs, seldom more than five feet in height, and usually not closely crowded, and they seem to prosper best on the leeward side of the hills and in ravines.

This is strikingly shown near Granite. The observer may stand on one of the hills west of Granite, and looking to the

\* Even such small pebbles as those which occur in stratum number 2 could be rolled a considerable distance by winds. The author saw, last spring, an accumulation of sand on a hill in the southern part of West Cedar Rapids which completely covered a fence fully five feet high. In the deposit were small pebbles, yet the wind had clearly formed the stratum full five feet in thickness since the fence had been built. When the workmen were removing a portion of the deposit for the purpose of opening a road it was observed (by the author) that the sand was quite regularly stratified, the numerous lines following the surface configuration.

south and southwest, and also to the west and northwest across the Big Sioux river into South Dakota, he may locate almost every one of the little ravines with which the slopes bordering the deeper ravines are scarred, by the dark lines of bur oaks. The number of these smaller ravines which are tributary to some larger one is often so great that a pinnate arrangement of these dark lines results. The shrubs in that vicinity are found generally on the northern and eastern slopes, where they are best protected from the prevailing strong southwesterly winds, and the surface soil on these slopes is much deeper and finer, and is also covered with a richer flora. On the other hand, many of the western and southern slopes are strewn with granite boulders, and a scant vegetation barely covers the surface, which almost lacks a finer soil—stratum number 3 forming the surface. These groves would probably have formed nuclei of greater forests had not man interfered, for, in the northern part of the state at least, the bur oak seems to be the pioneer among trees, being followed by the red oak, which now forms the greater part of our northern and northwestern upland groves.

The conclusion seems warranted that while soil largely determines the character of a flora, the converse is equally true that the flora will in time affect the character of the soil, and that the influence of vegetation upon superficial geological changes should not at least be disregarded.

The conclusions drawn from the observations here briefly recorded are the following:

1. The boulder-bearing stratum marked 3 formed the surface at one time throughout the region studied. Before vegetation had taken possession of it the finer material was sifted from the upper part of the stratum, concentrating the boulders.
2. Subsequently a comparatively scant vegetation took possession, making possible the retention of a somewhat coarse soil,—stratum 2.
3. A richer vegetation then followed, enabling the retention of a finer soil,—stratum 1.
4. Forests, where occurring, followed next in order, being ushered in in the manner suggested by the present bur oak scrub-tracts.
5. The agency concerned chiefly in accumulating the finer surface soils was wind, the material being retained in place by vegetation.

6. The action was probably not simultaneous over the entire area, the fine material removed from the most barren parts being deposited in places already prepared for its retention.

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## THE FLORA OF THE SIOUX QUARTZITE IN IOWA.

BY B. SHIMEK.

The Sioux quartzite is exposed in this state only in the extreme northwestern corner of Lyon county. Other and greater exposures however are found in the adjacent parts of South Dakota.

The chief exposure on the Iowa side is located only a few rods south of the state line and about one and three-quarters miles east of the Big Sioux river.

It occupies a depression in the rolling prairie, which is bordered by hills on the north, east and south, and slopes gradually to the Big Sioux bottoms to the west. It is best seen at and near the junction of two streamlets, one coming from the east and the other from the south, the course of the resulting stream being westward.

At the time that the observations herein recorded were made (August 4 and 6, 1896), these streamlets were almost dry, there being only a few disconnected pools of water.

The greater portion of the exposure is horizontal, vertical ledges not exceeding six feet in thickness being found only along the streamlets for a few rods above their juncture.

The exposure is in part barely disguised by a scant surface soil upon which, and upon the bare rock, flourishes a flora in some respects unique, and strikingly different from that of the surrounding prairie, a fact already noted by Prof. J. C. Arthur, who in the "Contributions to the Flora of Iowa," No. VI,\* says: "The extreme northwestern corner (of Iowa) is geologically and botanically very unlike the rest of the state."

The list of plants herein given is undoubtedly far from complete, being the result of a rather hasty survey. It shows a flora which is sufficiently unique, however, to be of interest to the student of plant distribution.

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\* Proc. Davenport Acad. Sci., vol. IV., p. 73.