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Preglacial Elevation of Iowa

H. Foster Bain

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The similarity of the higher exposure and the one near the river indicates the probable common origin of both. If this be so it indicates that the trough of the Missouri was excavated much as now, and yet that the water surmounted the Cretaceous bluffs with sufficient depth to float small icebergs. This conception will also explain why the boulder clay is so thin over the uplands; also, why it should be distributed so far down the Missouri, while it is so thin near the moraine.

Such a thickness of the drift as is found in southwestern Iowa and northern Missouri could seem, perhaps, to have been derived in a similar manner from the Des Moines ice lobe.

PREGLACIAL ELEVATION OF IOWA.

BY H. FOSTER BAIN.

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The long period intervening between the deposit of the Cretaceous rocks of Iowa and the advent of the glaciers has left in this state no record in deposits. Its history must be gathered entirely from the land forms then created, and from inferences drawn from orographic changes known to have taken place in other regions.

Over the greater portion of Iowa the land surface of post-Cretaceous time is now covered by a thick mantle of drift. It is only in the northeastern corner of the state that it is exposed, and it is in this region mainly that the history of the period has been read. It is, however, possible to find in other portions of the state much which confirms the results obtained from a study of the driftless region.

Throughout Iowa the records of well borings show the presence of numerous buried drainage channels, some of which can be traced with a measurable degree of accuracy for a considerable distance. In the course of recent detailed work in connection with the Geological Survey a number of these have been noted. One of the best examples is what may perhaps be called the Washington Channel, as it has been studied most in that county.

In 1888, Calvin* first called attention to this channel in discussing the deep well put down at Washington. This old valley has at this point been cut down 350 feet below the present surface, or to 419 feet above sea level. It has been cut almost entirely through the Kinderhook; and the base is 285 feet below the nearest outcrops of rock (Augusta) on Crooked creek, or 324 feet below the higher rock surface underlying the prairies near Keota. At Washington there is no definite evidence bearing on its width.

In the northwestern corner of the county evidence of a similar erosion is seen. In passing up English river the sharp bluffs of indurated rocks abruptly disappear. The bottom land expands on the south to a width of a mile and half or more. It is bordered by gently rounded hills of drift rising sixty to seventy feet above the river, or to an elevation of about 800 feet. This bottom land extends some six miles, when the hills close in on the river, and within a short distance a rock outcrop is found. A number of wells have been bored on the top of these drift hills, some being carried 100 feet or more below the level of the river, and yet in no case has the underlying rock been encountered.

In the southeastern portion of the county, near the great bend in Crooked Creek, similar relations obtain. There is the same marked absence of rock outcrops, the same soft drift topography, and the numerous deep wells, drawing their supply of water from deeply buried gravel beds.

In the region near Deep River, in Poweshiek county, the limestone surface is usually encountered about 200 feet below the general level of the drift upland, and yet one boring was carried to a depth of 450 feet, or to within about 460 feet of sea level, before encountering rock. There is thus evidence in this region of a broad and deep channel lying at a level of between 300 and 400 feet below the present surface, and running in a northwest-southeast direction.

Towards the southeast the evidence of such buried channels becomes more and more abundant. In Des Moines county, near Kossuth, a channel has been found, the base of which lies 342 feet below the present surface, or 274 feet above tide. A short distance west of Sperry two wells have been driven 360 feet to rock, while neighboring wells encountered the limestone at from

*Am. Geol., I. 28-31. Minneapolis, 1883.

40 to 50 feet. One of the most interesting of these buried channels has recently been described by Gordon,* and the figures given by him bring out in startling contrast the size and volume of this ancient river as compared with its present insignificant successor, the Mississippi.

At Bloomfield and Belknap, in Davis county, traces of a similar channel have been encountered, and in Appanoose such channels are by no means uncommon. At Des Moines there lies between Capitol Hill and the sand ridge upon which the fair grounds are located a broad, level plain, having an elevation of about 800 feet. It stands in marked contrast to the high hills both west and east of it. McGee and Call, † in discussing the loess and associated deposits of this region considered the current opinion that this represented an abandoned channel of the Des Moines river erroneous, and referred its origin to glacial agencies. Since their studies were carried on the work of the numerous mines along its edge, including the Giant, Garver, Standard and others, have conclusively shown that this is a filled channel, and that the bed rock here lies at least 90 feet below the present water level of the Des Moines river, or 120 feet below the surface of neighboring outcrops. Similar channels have been encountered in all portions of the state.

A comparison of the facts show quite conclusively that in preglacial time the land surface of Iowa stood at an elevation considerably above that now obtaining. This is well in accord with results obtained from studies in the driftless area and on the Missouri and Mississippi rivers. In the recent borings for locating the piers of the Pacific Short Line bridge at Sioux City, it was found that the Missouri river channel had been at that point filled in some eighty feet with loose sand and gravel above the hard shale of the Cretaceous. The river is also known to have filled in its channel to an average depth of from 70 to 100 feet between Sioux City and Kansas City. The Mississippi River Commission reported in 1881 that river to have also filled in its channel 100 feet or more with sand and gravel, along the eastern boundary of Iowa, the water now only reaching the rock at two points; the LeClaire and the Keokuk rapids. Throughout the driftless area there is evidence that the region, after being reduced to a base level of erosion, has been elevated and is now being reduced to a second base level,

*Iowa Geol. Sur., vol. III, 237-255, 1895.

†Am. Jour. Sci., (3), XXIV, 202-223, New Haven, 1882.

the inter-stream divides alone remaining to outline the former plain.

At the opening of Cretaceous times the greater portion of Iowa was a land surface. The open sea lay to the west and the drainage was in that direction. As the sea line crept farther inland successive portions of the country were submerged, and at the same time the unsubmerged portion was exposed to erosive agencies. At the close of this period about one-half of the state was probably covered by the newly deposited beds and the remainder was reduced to a monotonous plain barely above sea level. It is known that at that time a very large portion of the United States had been similarly* reduced to a peneplain.

The close of the Cretaceous was everywhere marked by orographic changes. It was a time of elevation and of re-arrangement. The changes which took place in the Rocky mountains at that time had a most important influence upon Iowa, and indeed the whole upper Mississippi valley. The elevation produced a corresponding, though much smaller elevation over the great plains. Upham† estimates this in northwestern Minnesota and westward at from 5,000 to 10,000 feet, decreasing towards the east. This had the effect, as pointed out by Westgate‡, of turning the direction of drainage over this region from the west or southwest to the southeast, and of setting in motion the influences which first blocked out our present drainage system.

During the whole of Tertiary times Iowa was probably a land surface.

Whether the buried channels here described had their origin in the general Tertiary erosion period, or whether they were formed during the second period of base-leveling differentiated by Upham§ at the close of the Tertiary and during early Pleistocene times, cannot now be definitely stated. The width and depth of these channels, so far as they are known, bear out the conclusion reached by Chamberlin and Salisbury and by McGee in studies of the driftless region that the period of erosion was a long one, and may possibly be taken as confirmatory of the belief that the two periods of base-leveling are not here so distinct as elsewhere.

* Woodworth: *Am. Geol.*, XIV, 209-235. Minneapolis, 1894.

† *Am. Geol.*, XIV, 238. Minneapolis, 1894.

‡ *Am. Geol.*, XI, 257. Minneapolis, 1893.

§ *Op. cit.*, p. 238.

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