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SOME VARIANT CONCLUSIONS IN IOWA GEOLOGY.

BY J. E. TODD.

Having been a resident in southwestern Iowa for many years and conversant with several localities in the state of geological interest, the writer has naturally followed closely the publications of the present Survey treating of them.

In casting about for a subject for some different conclusions which had come to his mind, he thought first of "corrections and additions", but as that savored rather of too much self-assurance the milder form was preferred. Since the writer does not arrogate superior knowledge in the cases, he would simply state his views and leave them to whatever acceptance they may deserve.

1. The first variant conclusion concerns a *folding of Carboniferous rocks in Fremont county*:

Prof. Udden, in his admirable report, has fallen into the same error as Dr. White did more than 30 years before. The writer was in the region a few years before he discovered the mistake. It was finally made perfectly clear by a visit to the west side of the Missouri river at Jones Point, just above the mouth of the Weeping Water. There is a fine exposure there which seems to have escaped Meek and Hayden. It shows a dip of 4° or 5° SSE. which carries over 100 feet of strata, which are exposed in the summit of an anticlinal about a mile north, entirely below the level of the river, in less than that distance. Taking the direction from that point to the break in the strata south of Wilson's quarry perhaps half a mile, near the south line of section 23, T. 70, R. 43, we find the axis of the fold is N. 60° E.

The fold is so sharp that the heavy limestone strata and nearly the whole of White's section at Wilson's quarry, or Udden's X, XI, and XII, passes entirely out of sight before the south line of section 26 is reached. At Nebraska City a section corresponding somewhat to XIX has been noted by many and Meek gives a record of Croxton's boring (Hayden's Final Report of Neb. p. 105) to a depth of 344 feet starting 13 feet above high water mark. By a comparison of exposed sections with the record of the boring, it seems fairly clear that the top of the sandstone exposed in the bottom of Wilson's quarry and also in the large quarry opposite Haney's, (Udden's sections X and V, though he fails to report this at either point) is at the depth of 238 feet or 210 feet below low water of the river there. This sandstone is what White called the base of the Upper Carboniferous. The sandstone which he records as exposed at Plum Hollow (Thurman now) and at Hamburg is not the same, but is probably that exposed at Wyoming, Nebraska, and Nebraska City, though

possibly those at the two northern localities may correspond to a sandstone down 90 feet in the boring. The fold is quite sharp at Jones' point and may become a fault on the Iowa side. At any rate there is no considerable dip in strata not more than half a mile apart.

The general fact of a southern dip was recognized by Owen, Meek and Hayden, Marcou, and other early explorers, but there seems not to have been a clear location of it, nor of its amount till the writer presented a paper which was published in the Proceedings of the Iowa Academy of Sciences, Vol. 1, part 1, p. 58. As that seems to have been overlooked, he adds more from it:

"Paleontological evidence seems to coincide with the conclusions from stratigraphy. Of the more than 100 species listed by Meek as found in Eastern Nebraska 20 are found north of the steep fold at Jones' point and not south; 47 are found south but not north, and 35 are found on both sides of the line."

Combining the section west of Nebraska City, at that point, including the boring (Fin. Rep. pp. 103, 101 and 105), section at Wilson's (White's Report on Iowa, Vol. 1, p. 358) the section at Rock Bluff and below Plattsmouth (Hayden's Report, pp. 95 and 93), we have the following:

<i>Section of Carboniferous Rocks in Southwestern Iowa.</i>		Thickness.	Total.
16.	Blue, red and ash colored clays, with two layers of limestone 2 and 4 feet thick	19	19
15.	Yellow micaceous Sandstone	10	29
14.	Drab, ash, lead and chocolate colored clays or shales with a thin blue limestone	39	68
13.	Limestone in thin layers, light yellow and gray	12	80
12.	Shales, mostly gray, some red and blue with 5 thin layers of limestone and 4 of sandstone	185	265
11.	Bluish limestone, interstratified with black shales and 1 foot of coal near center	12	277
10.	Drab clays, enclosing 3 strata of limestone, 2-4 feet thick.	30	307
9.	Compact limestone, mostly thin-bedded and some layers stylonitic	20	327
8.	Drab clays, carbonaceous at two levels, and with 2 thin limestones	12	339
7.	Soft, fine-grained yellow sandstone, White's No. 1 at Wilson's	12	351
6.	Clays and slates, bluish and gray, with 3 or 4 limestones, one much the thickest sometimes 7 feet	45	396
5.	Limestones, yellow and gray, many <i>Fusilina</i> .	20	416
4.	Clays, ash and red with black shale in middle	5	421
3.	Yellowish soft sandstone	4	425
2.	Limestone, very fossiliferous	10	435
1.	Greenish and chocolate clays above and shales below	25	460

Level of the Missouri at Plattsmouth.

A careful comparison of sections on both sides of the River shows two anticlinals, the higher with its crest near Plattsmouth, the other about 1-4 miles above Jones' Point. Taking the top of the sandstone No. 7 of the above general section, we may represent the folds by the following:

TABLE.

	Omaha	Bellevue	LaPlatte	Plattsmouth	Rock Bluff	Kenosha	Summit	Jones' Point	Wyoming	Nebraska City
Altitudes above Missouri R.	16	12	23	128	91	38	78	62	212	237
Miles from Omaha	0	5	8	14	19	22	26	27	30	35

The above data was given in the paper in 1889 already referred to, but are here revised in statement.

2. In the Report on Plymouth county two points need modification. The first is the mistaking the chalky stratum of the Benton, now named Greenhorn for the Niobrara. Dr. Bain, in making the statement simply followed the interpretation which had been first made by Hayden, who named the Benton and Niobrara, and very naturally followed by all observers after him, with the exception of White and St. John, who wisely used other names.

The mistake was virtually corrected by Iowa geologists finding Benton fossils above the limestone in Sioux county. Iowa Geol. Surv. X. p. 114.

The other mistake grew out of the first, viz: the top of the chalkstone is taken for the bottom of the till or Pleistocene (Ia. G. S. VIII, p. 331). The thinness of the chalkstone was ascribed to glacial erosion consequently Cretaceous shales 50-60 feet thick in some places, and forming a distinct bench along the face of the bluffs in section 13, T. 91, R. 49, was called till. This is somewhat excusable because the clay was weathered to a structureless mass near the surface and it was well sprinkled with pebbles and boulders from the drift beds above which are comparatively thin and much stratified above. The Cretaceous clays are usually readily recognized by striking a pick into them. The clay a few inches from the surface is gritless and waxy.

3. Another variant interpretation concerns the exposure at the old site of Otis's mill on the Dakota side of the Big Sioux below Hawarden. The differences of reading are difficult to account for except by considerable changes in the exposure.

The Section given in Iowa Geol. Survey, Vol. VIII, p. 334, is as follows:

6. Loess, sandy with many lime concretions	20	feet.
5. Drift, new, fresh pebbles, yellow color, and with traces of soil at top	30	
4. Old soil, black to drab, sandy	2	
3. Sands, white to lemon yellow, very fine above, coarser and orange, below,	10	
2. Niobrara, principally thin shelly limestone, with few chalky streaks	35	
1. Shale, black to drab, with poorly developed laminations	20	117

The writer has more recently studied the locality with the following results:

Table of Exposures at Otis' Mill.

Top of hill back about 135 feet above river.		
Grassy slope mostly loess though pebbles may show as high as the top of the exposure.		
8. Loess, apparently in situ, though probably slipped	8	8
7. Till, yellowish, though bluish in places	22	30
6. Slope with loess and yellow till mingled	15	45
5. Dark fossiliferous soil or mud, <i>Planorbis</i> large and small, <i>Pisidium Cyrena</i> , <i>Limnea</i> 2 or 3 species, <i>Valvata</i> , <i>Unio</i> , large jaw of horse, rather larger than domestic, with three molars, thicker to south	7-3	48
4. Yellowish loam and sand coarser below passing into gravel thicker northward	2-10	38
3. Dark waxy shaly clay mingled with till above, shown at extreme south	4-0	58
2. Bluish chalk, with hard shaly limestone interstratified, softer above and below passing into shale	18	76
1. Shale, laminated, black and blue	12	88
Level of Big Sioux at medium stage.		

The rational interpretation seems to be that Nos. 5 and 4 were deposited in an old bend of the river when its surface was about 40 feet higher than at present, the sand being the true river deposit, while the loam and dark mud record the accumulation after the bend had become a bayou. The slope which overlaps it and gives an impression of a second till is probably the caving and wash from the cut bank back. It is interesting to note that this bend would correspond to the Unio Terrace which Dr. Bain noted at several points, and considered pre Wisconsin. I can see no sufficient reason, however, for considering it very ancient.

4. Professor Wilder in his *Geology of Lyon and Sioux counties*, thinks he has found reason to locate the Altamont moraine east of Sioux Falls and of the Big Sioux further north, instead of south and west in a broad curve, west of Wall Lake as was done by the writer. There is not time now for discussion, but the writer wishes to reaffirm his former interpretation of the facts, with much confidence so far as concerns most of the moraine. Possibly a comparatively faint and early member may be traced along the line he indicates.

In this connection the writer would add that after a re-examination of the cuts along the Illinois Central and Sioux Falls, which were visited jointly by Bain, Leverett and himself, and treated by him in *Proceedings of I. A. S. Vol. VI, p. 125*, he returns to his former interpretation, viz: that they are all in an old terrace of the river. The terrace topography and the general character of the deposits are his main reasons, which time prevents giving here in detail.

5. Time permits the very brief discussion of only one more "variant". Prof. McBride, in his discussion on Clay and O'Brien counties (*Iowa Geol. Survey, Vol. XI, p. 488*), records 700 feet to water in a well east of Primghar and another 1,000 in Caledonia township, and apparently infers that the till probably goes to those depths. That is certainly deep enough to reach the Dakota, and it seems more rational to believe that 5-600 feet of that depth is Cretaceous. Similar records are frequently given in South Dakota, where it is clear that such is the case. In fact if no sand is found or noticed separating the till from the Cretaceous few can tell when the drill passes the line of separation. The concretions in the shale simulate closely in shape, hardness and frequency the boulders and pebbles in the till. And the till often has almost the same composition as the shale from which it has been mainly formed.

With this the writer would respectfully submit this paper to your candid consideration and kindly judgment, and only hopes that it may be of some service, if not to others, to himself, through criticism by others.