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## STRUCTURE OF THE DES MOINES SERIES AT REDFIELD, IOWA

C. S. GWYNNE

In southwestern Dallas County, in the vicinity of Redfield and for several miles farther east along the Raccoon River, there are exposures of sandstones and shales of the Des Moines series. These were studied by Leonard<sup>1</sup> who concluded that the strata were not flat lying nor with a gentle southwest dip, but assumed the form of an anticline of presumably north-south axis in the vicinity of Redfield. He based this conclusion upon an apparent rise of a prominent sandstone member along the Raccoon River west toward Redfield, upon the non-appearance, at Redfield, of beds found in sections east and west along the river, and upon the presence of fracture cleavage in one of the outcrops of the sandstone.

This anticline is also referred to by Dille<sup>2</sup> who states that the Redfield anticline is a well known structure which has been drilled for oil and gas. His information, however, is evidently drawn largely from Leonard's report, although he also concludes, from Leonard's sections, that there appears to be another structure in the vicinity of Booneville, some twenty miles east of Redfield.

It should be noted, however, that Norton<sup>3</sup> in discussing the underground waters of the Central District makes no mention of it. His opinion is that "west of Des Moines the strata probably continue their westward dip through or nearly through Dallas Co., beyond which a very gentle ascent probably occurs." There are apparently no deep well data here from which conclusions as to the existence of an anticline might be drawn.

The opening of the pit of the Adel Clay Products Co. east and north of Redfield several years ago, and the enlargement through the years of the pit of the Goodwin Brick and Tile Co. at the northwestern limits of the town of Redfield, particularly the latter, have made available exposures which throw light upon the situation in this portion of Dallas Co. Study of these and of the outcrops along the Raccoon lead to the conclusion that the sandstone

<sup>1</sup> Leonard, A. G. Geology of Dallas Co. Iowa Geol. Survey 8: 90, 91 and 67-70, 1897.

<sup>2</sup> Dille, Glenn S. Anticlines of the state of Iowa Proc. Ia. Acad. Sci. 33: 194, 1926.

<sup>3</sup> Norton, W. H. and others. Underground water resources of Iowa. Iowa Geol. Survey 21: 812, 1910 and 1911.

at Redfield is of channel character, and that there is no surface indication of the existence of an anticline.

Interest in this matter was aroused through the exposures of sandstone and shale in the pit of the Goodwin Brick and Tile Co. adjacent to the town of Redfield, and on the east side of the valley of the Raccoon River. The particularly striking thing about these exposures is the existence, at the north end of the pit, of a sandstone which might very properly be described as a channel sandstone since, in the exposure, it cuts down into the shales to a distance of fourteen feet. The character of the sandstone, of the surrounding shale, and of the contact has been made strikingly clear because this particular part of the pit opening has been worked by a planer, so that the sandstone stands in a vertical wall for its full height of fourteen feet, with shale exposed at the sides and bottom. The pit face at the planer includes six feet of shale, overlain by fourteen feet of soft, fine-grained sandstone, cross-bedded, and containing at the base fragments of shale up a few inches in length, grains of coal, and much limonite. Following the workings from this point around to the east and then south toward the part at present being operated for shale much of the slope is covered with slump, but sandstone outcrops are found at the top, and higher and higher, though not of much greater thickness, until they finally seem to break off near the top of the pit at a distance of about 250 feet southeast of the planer. At this point the bottom of the sandstone is fifty-seven feet higher than at the planer, and the thickness twelve feet, although at one intermediate point it is eighteen feet thick. The contact is only exposed in the pit by the planer, but it appears quite certain to the writer that the sandstone away from it is part of the same channel filling.

It is to be noted that this sandstone is all in the north end of the pit, and that as it ranges higher and higher along the pit there is generally below it so much slump that the details of the section cannot be made out. Typical argillaceous shales, sandy shales, shaly sandstones, and limestones do occur, however, as may be noted in the meager exposures here and there. The bottom of the present face from which shale is being secured for manufacturing purpose is 10 feet below the bottom of the sandstone at the planer, at a distance of 330 feet southeast of the planer. At this point the section, as near as it can be made out, is:

(1)	5 ft.	Shale, red and buff.
(2)	4 ft.	Shale, dense, purple.
(3)	6 in. ±	Fireclay.
(4)	3 in.	Shale, grey, with carbonaceous streaks.

(5)	6 in.	Limestone, sandy.
(6)	3-4 in.	Limestone.
(7)	4 ft. 6 in.	Shale, unevenly laminated or banded, grey, red and yellowish, with 0-4 in. distinctly yellow near base.
(8)	8 ft. 6 in. $\pm$	Shale, grey, finely banded, with a few streaks of red; banding light and dark grey; sandy.
(9)	25 ft. $\pm$	Shale, partly red and grey, partly covered with wash, poorly exposed and difficult to get at for details owing to slope wash, slumping, etc.
(10)	5-6 ft.	Shale, grey, sandy, with many limestone concretions, particularly near top.
(11)	4 ft.	Underclay, grey.
(12)	15 in.	Coal blossom.
(13)	1 ft.	Limestone.
(14)	4 ft.	Shale, grey.
(15)	1 ft. $\pm$	Limestone.
(16)	17 ft. $\pm$	Shale, sandy, weathered.
(17)	5 ft.	Till.

It will be noted that there is in the above section no massive sandstones of the type present at the planer and ranging up the hillside to the south of it. Instead there is, through the range occupied by the sandstone, a sequence of typical shales and limestones, thus apparently confirming the supposition that the sandstone is one which has been formed through the deposition of sand in a deep cut in the other beds.

From all the foregoing it is quite apparent how obscure the situation would be here if one had had to depend for the facts upon the natural exposures, rather than upon those made available through the opening up of this shale pit.

Southwest of this location and on the west bank of the Raccoon River for some distance south of Redfield there are exposures of a massive sandstone, evidently to be closely correlated with the exposures in the shale pit. There are numerous sandstone and shale outcrops of the Des Moines series on the stretch of the Raccoon River in Sec. 2 and 3, T. 78 N., R. 29 W., but generally the character of the beds and their relationships are difficult to determine because of the smallness of the outcrops and because of weathering and slumping. There is evidently, however, considerable sandstone present in the Des Moines series here, judging from the scattered outcrops. In the E.  $\frac{1}{2}$  of Sec. 3 it has a thickness of twelve feet, is irregularly interbedded with sandy shale, and the base is as much as ten feet above the river bed. In the vicinity of Cottonwood Mill and south of it, there is sandstone, cross-bedded and concretionary, in the river bed with sandy shale above, but nearby in some small tributary valleys there is a thickness of

several feet of sandstone which is many feet above the river. To say that this sandstone rises toward Redfield is in the writer's opinion a rather unwarranted inference. If it does, however, it does not necessarily indicate a general dip for the strata, since if it were a channel sandstone similar to that shown to exist at Redfield, the base of it might well slope up toward Redfield. This sandstone may, however, quite probably be correlated with that at Redfield.

In the work of Leonard, as confirmatory of the existence of this anticline, he noted the similarity in character of the Des Moines series some distance east and west of Redfield, as contrasted with that found near Redfield and from Redfield to a point beyond Cottonwood Mill. The former was predominatingly of limestone and shale, with some sandstone and coal; the latter was generally sandstone and sandy shale. Thanks to the extended opening of the Goodwin Brick and Tile Co. now available at Redfield, it is apparent from the section already given that away from the channel sandstone the rocks are primarily shales, with lesser amounts of limestones, coal and sandstone; i.e. they are much like they are at Booneville to the east and near the county line to the west.

As bearing further upon the stratigraphy in this vicinity it may be noted that at the pit of the Adel Clay Products Co., about one and one-half miles east and one-half mile north of the Goodwin Brick and Tile Co. pit there is nothing resembling a channel sandstone or massive sandstone in the thirty-one foot section, although there are apparently about fifteen feet of sandy shale below the pit face. There are also two limestones present, one in the section at the pit, and another below the sandy shale, the rest of the section being argillaceous shale. The elevation is not known, but the section here is thus similar to what it is on both sides of Redfield.

The slaty cleavage mentioned by Leonard as being present in outcrops south of Cottonwood Mill, and which he believes to be indicative of folding in the vicinity, is apparently exfoliation which seems to be particularly present on certain rather shaly phases of the sandstone. It may be noted in several places and it will be found always parallel with the surface of the outcrop. It simulates slaty cleavage but should not be mistaken for it.

No well records are available which would throw light upon the structure here, but it is believed that, as outlined above, the surface exposures give no indication of the existence of an anticline.

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