A NEW GYPSUM DEPOSIT IN IOWA.[1]

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INTRODUCTION.

For many years Iowa has ranked among the important gypsum-producing States of the United States. The deposits from which all the output has come are in Webster County, in the vicinity of Fort Dodge, where an area comprising more than 40 square miles may be

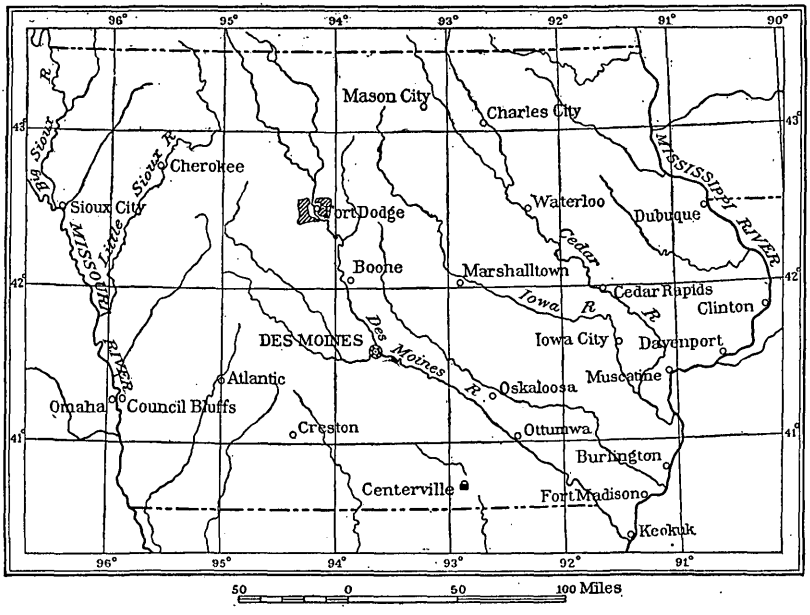

FIGURE 11.—Index map showing location of gypsum area at Centerville, Appanoose County, Iowa, and its relation to the gypsum area of Fort Dodge.

regarded as available for gypsum mining. The gypsum is confined to a single bed, which is practically horizontal and ranges in thickness from 10 to 25 feet. A mantle of drift 60 to 80 feet thick covers the gypsum except along Des Moines River and its tributaries. The deposit and the related rocks are probably of Permian age.[2]

[1] A brief reference was made to this deposit in Iowa Geol. Survey Ann. Rept., vol. 21, p. 24.

[2] Geology of Webster County: Iowa Geol. Survey Ann. Rept., vol. 12, pp. 111–114.

A new gypsum deposit was recently discovered in the southern part of the town of Centerville, Appanoose County, Iowa. For many years the Scandinavian Coal Co. has been operating a coal mine at Centerville. In the fall of 1910 this company decided to do some additional prospecting for coal on its property by means of the diamond drill. Accordingly, a contract was made with a Chicago firm for not less than 550 feet of drilling, either as separate holes or as one hole. Although the coal bed worked by the company lies only about 100 feet below the surface and although the base of the coal-bearing strata in this region, as shown by artesian-well records, lies considerably less than 550 feet below the surface, the company, nevertheless, directed the drillers to carry out the contract by continuing a hole to the depth of 550 feet. By means of this drilling gypsum was discovered below the coal-bearing rocks.

GEOLOGY OF THE REGION.

Kansan drift of variable thickness overlies the indurated rocks throughout Appanoose County, except in the deeper valleys, where the drift has been eroded and the underlying rocks have been exposed. The rocks just beneath the drift belong to the Des Moines group, of the Pennsylvanian series. The upper part of the Des Moines contains the Mystic coal bed, which is one of the most persistent and extensively developed coal beds in Iowa. This coal and related bands of limestone of wide extent, some of which lie above the coal and some below, were designated by Bain the Appanoose formation,[1] to distinguish them from the underlying, more typical shaly phase of the Des Moines of Iowa, the rocks of which are very irregular in thickness and in lithologic character and include several beds of coal that are in places thicker than the Mystic bed but are of moderate extent.

To the south of Appanoose County, in Putnam County, northern Missouri, the Pennsylvanian rocks are similar to those of Appanoose County. In accordance with the classification of the Pennsylvanian series of the eastern part of Putnam County, recently published by the Missouri Geological Survey in cooperation with the United States Geological Survey, the indurated rocks of the Centerville region belong to the Henrietta formation and the Cherokee shale, the Mystic (Lexington) coal being in the Cherokee a few feet below the base or "cap rock limestone" (Fort Scott limestone member) of the Henrietta formation.

The rocks below the Pennsylvanian in Appanoose County are known only from drill records of artesian wells. At Centerville three deep wells have been sunk for water. The deepest of these wells and the one of which there is the most complete record gave a section as follows:[2]

[1] Bain, H. F., Geology of Appanoose County: Iowa Geol. Survey Ann. Rept., vol. 5, pp. 378–394.
[2] Iowa Geol. Survey Ann. Rept., vol. 21, p. 935.

Record of deep well at Centerville, Iowa.

	Feet.
Quaternary: Drift	90
Carboniferous:	
Pennsylvanian: Shales, coal and coaly shale, and a few thin seams of limestone	436
Mississippian: Chiefly limestones and shales	574
Devonian: Limestone and shales	260
Silurian: Limestones, shales, and sandstones	180
Ordovician: Dolomites, limestones, sandstones, and shales	955

The depth of this well was 2,495 feet. Its bottom penetrated the Oneota dolomite, or lowest formation of the Ordovician in Iowa. This well was sunk in 1893, and if gypsum was penetrated it was not so recorded by the drillers. However, in this connection, it is of interest to state that the log of one of the other deep wells,[1] completed in 1904, contains a statement to the effect that at a depth of 600 feet below the surface the drill passed through 15 feet of "white sand." From the evidence that has been obtained from the holes recently drilled it is very probable that this material should have been recorded as gypsum. This well is more than half a mile northeast of the hole in which gypsum was first recognized.

The driller's log of the Scandinavian Coal Co.'s hole in which the gypsum was first recognized is given below.

Driller's log of hole of Scandinavian Coal Co., Centerville, Iowa.

	Thickness.	Depth.		Thickness.	Depth.
	Ft. in.	*Ft. in.*		*Ft. in.*	*Ft. in.*
Filled ground	3 0	3 0	Limestone	4 0	216 0
Yellow clay	28 0	31 0	Black shale	9 2	225 2
Limestone	1 0	32 0	Coal	10	226 0
Limestone with shale	8 0	40 0	Fire clay	1 0	227 0
Soft blue shale (banded)	10 0	50 0	Clay shale	2 0	229 0
Soft blue shale	14 0	64 0	Soft blue shale	3 0	232 0
Limestone	3 0	67 0	Soft clay shale, gray	1 6	233 6
Sandy shale[a]	21 0	88 0	Blue shale	3 6	237 0
Old workings	4 0	92 0	Black shale	1 4	238 4
Fire clay	2 0	94 0	Soft clay shale, gray	8	239 0
Limestone	1 6	95 6	Blue shale	3 0	242 0
Soft clay shale	1 6	97 0	Blue shale with bands of red shale	1 6	243 6
Dark shale	9 0	106 0	Blue shale	3 8	247 2
Gray shale	7 0	113 0	Black shale	4 6	251 8
Fossiliferous shale	1 0	114 0	Coal	1 8	253 4
Black shale	3 0	117 0	Black shale	8	254 0
Gray shale, very soft	2 0	119 0	Gray shale	6 0	260 0
Gray shale	13 0	132 0	Black shale	4 0	264 0
Black shale	2 6	134 6	Clay shale	8 0	272 0
Soft clay shale	15 6	150 0	Gray shale	13 0	285 0
Shaly sandstone	38 0	188 0	Sandy shale	4 6	289 6
Sandstone	1 0	189 0	Sandstone	2 6	292 0
Black shale	2 0	191 0	Black shale	2 0	294 0
Coal	2	191 2	Blue shale	6 0	300 0
Gray shale	8 2	199 4	Gray shale	5 0	305 0
Black shale	8	200 0	Sand shale	2 0	307 0
Coal	1 0	201 0	Red and blue shale	8 6	315 6
Limestone	1 6	202 6	Blue shale	4 6	320 0
Soft clay shale	7 6	210 0	Black shale	6 0	320 6
Clay shale	10	210 10	Gray shale	3 9	324 3
Limestone	2 0	212 10	Black shale	1 0	325 3
Black shale	2 10	215 8			

[a] The driller's logs of holes 2 and 3 show no shale on top of the old workings of the Mystic bed; the roof is limestone.

[1] Iowa Geol. Survey Ann. Rept., vol. 21, p. 937.

Driller's log of hole of Scandinavian Coal Co., Centerville, Iowa—Continued.

	Thickness.		Depth.			Thickness.		Depth.	
	Ft.	*in.*	*Ft.*	*in.*		*Ft.*	*in.*	*Ft.*	*in.*
Coal		2	325	5	Clay shale	2	0	421	0
Black shale		6	325	11	Gray shale	6	0	427	0
Sandy shale	15	3	341	2	Red and gray shale	2	0	429	0
Coal	1	5	342	7	Gray shale	1	0	430	0
Sandy shale	4	5	347	0	Clay shale	2	0	432	0
Sandstone	5	0	352	0	Gray shale	7	0	439	0
Gray shale	3	9	355	9	Shaly limestone	6	0	445	0
Black shale	2	9	358	6	Limestone	14	0	459	0
Gray shale	6	0	364	6	Lime shale	9	6	468	6
Dark shale	2	6	367	0	Sandstone	8	6	477	0
Gray shale	5	0	372	0	Limestone		6	477	6
Black shale	9	0	381	0	Lime shale	6	6	484	0
Sandstone	7	0	388	0	Limestone	16	0	500	0
Sandy shale	2	0	390	0	Conglomeration of sand and limestone	6	0	506	0
Black shale	3	0	393	0	Limestone with spots of shale	17	0	523	0
Gray shale	12	6	405	6	Limestone	14	0	537	0
Black shale		10	406	4	Anhydrite, compact	5	0	542	0
Coal (A)		8	407	0	Gypsum, white, crystalline	5	0	547	0
Gray shale	4	0	411	0	Limestone, dolomitic, buff	2	3	549	3
Blue shale	4	0	415	0	Green shale		9	550	0
Coal (B)		3	415	3					
Blue shale	3	9	419	0					

This log has been interpreted as follows:

Correlation of log of Scandinavian Coal Co.'s hole at Centerville, Iowa.

	Feet.
Quaternary: Drift	31
Carboniferous:	
Pennsylvanian: Des Moines group:	
Henrietta formation: Limestones and soft blue shales	36
Cherokee shale: Blue, gray, and black shale, sandstone, several thin seams of coal, and some limestone	372
Mississippian: Chiefly limestone, lime shale, shaly limestone, some sandstone, gypsum and anhydrite	111
	550

The gypsum and anhydrite were penetrated between the depths of 537 feet and 547 feet below the surface. Analyses made under the direction of Dr. S. W. Beyer, Iowa State College, proved that the upper 5 feet of this 10 feet was anhydrite and the lower 5 feet gypsum. The gypsum was overlain by 14 feet of limestone and underlain by 2 to 3 feet of buff dolomitic limestone, beneath which was shale.

DEVELOPMENT.

Soon after gypsum had been found in Discovery hole some of the citizens of Centerville subscribed sufficient funds to drill two additional holes. One of these was located 1,200 feet southwest of Discovery hole at a lower elevation. The drill penetrated to a depth of 563 feet but found neither gypsum nor anhydrite. The Mississippian was pierced to a depth of 114 feet, the hole ending in shale, above which was 2 feet 6 inches of dolomite.

A third hole was then drilled about 1,700 feet northwest of Discovery hole. This hole gave a section upon which the following interpretation is placed:

Correlation of log of third hole at Centerville, Iowa.

	Feet.
Quaternary: Drift	20
Carboniferous:	
Pennsylvanian: Gray, blue, and dark shale with seams of coal and limestone	456
Mississippian: Limestone, arenaceous limestone, some sandstone, and gypsum	116
	592

The gypsum was entered at 572 feet below the surface. It proved to be 19 feet thick and of fine quality. Just beneath the gypsum was gray sandy shale, which was penetrated for only 1 foot.

The Centerville Gypsum Co. was then formed, with a capitalization of $25,000, and decided to sink a shaft close to Discovery hole with the object of using it later for hoisting gypsum on a commercial scale. This shaft was started about July 1, 1912. The gypsum was reached about September 1, 1913, and since that time the shaft has been sunk to the rock beneath the gypsum. The shaft is 16 by 6 feet and has three compartments. Gypsum, 13 feet in thickness, was reached at a depth of 533 feet. In the eastern part of the shaft the gypsum is free from anhydrite, but in the western part anhydrite is associated with the gypsum.

When the shaft reached a depth of 528 feet, only a few feet above the gypsum, progress was greatly hampered by large quantities of artesian water that entered it. Some water had come in nearer the surface, but it was easily handled. The artesian water, about 3,300 gallons an hour, comes from a porous limestone about 4 feet thick which lies on the gypsum. It rises to a height of about 300 feet. The problem of handling this water has not been solved. A large deep-well pump, capable of handling 8,000 gallons of water an hour, has been installed, and it is hoped that the water, though a great handicap to development, will not prove impossible to control. It is the purpose of the company, if it finds that the gypsum can be mined on a large scale, to erect a modern plant for the preparation of gypsum products such as are now being made at Fort Dodge.

THE GYPSUM.

The gypsum that has been obtained from the 2-inch drill cores and from the shaft is of two fairly distinct varieties, rock gypsum and selenite. The rock gypsum breaks into irregular-shaped lumps, is white in color, and is composed of small, brightly shining elongated crystals. It is saccharoidal and distinctly friable, being easily crum-

bled to fragments resembling a pure-white granulated sugar. Much of the selenite is very clear and transparent with the characteristic pinacoidal cleavage. It is possible to secure fairly large masses of selenite free from impurities. Some of the selenite is gray to light brown in color.

Under the direction of Dr. S. W. Beyer, of the Iowa State College, five analyses were made, two of the gypsum and three of the anhydrite. The results [1] were as follows:

Analyses of gypsum and anhydrite from Appanoose County, Iowa.

	Gypsum.		Anhydrite.		
	1	2	1	2	3
Sulphur trioxide (SO_3)	46.56	45.65	54.12	55.29	54.45
Lime (CaO)	33.37	32.76	40.20	40.67	39.58
Loss on ignition	20.03	20.75	6.62	4.66	5.13
	99.96	99.16	100.94	100.62	98.16

SUMMARY.

The discovery of a deposit of gypsum in the Mississippian rocks of southern Iowa is of scientific interest. Whether or not this gypsum will prove to be of economic importance has yet to be determined. The evidence indicates that the deposit may be extensive and the gypsum is of good quality. The presence of anhydrite decreases the value of the deposit for making wall plaster and related products. The relation of the anhydrite to the gypsum and the relative amounts of the two minerals will have an important bearing on the commercial value of the deposit. However, anhydrite is considered by some manufacturers of Portland cement to be practically as serviceable as gypsum.

The fact that the deposit is more than 500 feet below the surface and the presence of large amounts of artesian water are factors unfavorable to the mining of the gypsum. On the other hand, the deposit is well located with regard to fuel and transportation, and it is fair to assume that if gypsum products were made in this part of the State a good market for such products could soon be developed.

[1] Iowa Geol. Survey Ann. Rept., vol. 21, p. 24.