GEOLOGY OF DAVIS COUNTY

BY

MELVIN F. AREY

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INTRODUCTION

LOCATION AND AREA.

Situated on the Missouri state line, the third county from the Mississippi river, Davis county has for neighboring counties in the state Van Buren on the east, Wapello on the north and Appanoose on the west. It comprises twelve complete and four fractional congressional townships, the latter being in the south tier. Owing to the southerly trend of the state line, the west boundary is about two-thirds of a mile longer than the east. Five only of its civil townships are conterminous with congressional townships. The area is approximately 500 square miles. Bloomfield, the county seat, is in the geographical center and is on two of the three railroads traversing the county.

PREVIOUS GEOLOGICAL WORK.

The Des Moines river passes through the northeast corner of this county for scarcely more than two miles of its course, but the outcrop of coal along its banks in many localities drew the attention of the early geologists to all the region through which the river runs and so this portion of Davis county received its share of attention.

Owen* in noting the occurrence of coal in this neighborhood describes an outcrop of coal in three seams in the midst of a mass of bituminous shale, towards the mouth of Soap creek in

*Owen: Geological Survey of Wisconsin, Iowa and Minnesota, p. 113, 1852.

section 3, township 70 north, range 12 west. He describes the coal as "slaty in character and having the appearance of charcoal on the cleavage surfaces."

The interest in this locality was enhanced by the discovery of springs along Salt creek, a small branch of Soap creek, whose waters were more or less saline. Owen gives an account* of one of these springs at some length and mentions several others, naming the constituents of their waters and giving the reactions obtained in the field, but no rigid analysis was secured in the laboratory on account of his not having obtained a supply of the water. In the Introduction to his report Owen says "By boring, a stronger water might possibly be obtained; nevertheless, the shallowness of these coal measures, the frequent rupture of the strata and consequent local reversions of the dip together with the fact of the lowest division being composed chiefly of limestone instead of sandstone, are unfavorable indications of the existence of a plentiful supply of deep seated brine, or of nests of salt, whence the permeating waters might become saturated and carry the saline matter to the surface." The correctness of his conclusion has been attested by subsequent events and existing conditions.

On the next page he mentions the occurrence in this neighborhood at an elevation of some ten or twelve feet above these springs of a bed of limestone having hydraulic properties. Cone in cone, to which he gives the German name of *Tutenmergel,* and crystals of selenite are also noted in close relation to these beds. He attributes the *Tutenmergel* not to a shrinkage of the strata, but "to an imperfect crystallization produced by a process of infiltration through beds of marly, argillaceous matter."

White† enters into a discussion of the brine springs in this and neighboring counties. As these springs will be considered later in this report his conclusions respecting them will be presented there. The hydraulic limestone described by Owen is briefly treated by White.‡ He regarded it as of little value for the ordinary purposes to which stone is applied and questions its worth for the manufacture of hydraulic lime.

*Op. cit., p. 111, 1852.
†White: Geol. of Iowa, vol. 2, pp. 334-336. 1870.
‡Ibid., vol. I, p. 237.

In volumes II,* V,† and others of the present series of the Iowa Geological Survey, particularly volume XIX, due consideration is given to the coal outcrops and mine sections in the immediate vicinity of Laddsdale and along Soap creek and a few other localities in the county.

PHYSIOGRAPHY

Topography

The present surface of Davis county may be described briefly as that of the well dissected Kansan drift. Small level areas

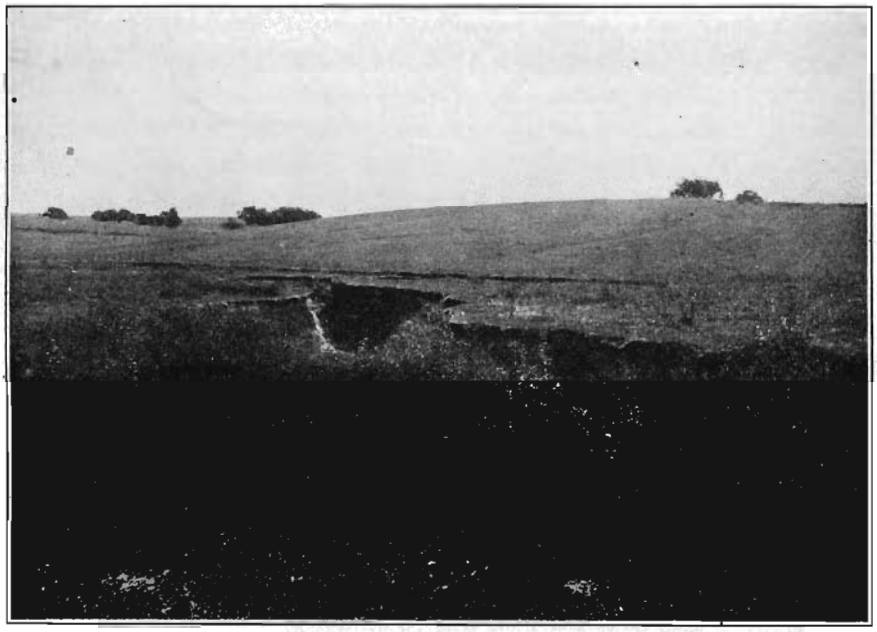


Figure 38. Recent headward stream erosion, section 16, Drakeville township.

varying in size from a quarter section to three or nearly four sections at the most, found in every township in the county in localities farthest from the streams, represent the comparatively unmodified surface of the original drift plain. Their boundaries are irregular and gashed by ravines that every year are eating their way ravenously into the midst of the fertile fields, the best in the county, wherever the foresight of the owner has not as

*Iowa Geol. Survey, vol. II, pp. 424-429.
†Ibid., vol. V, p. 422.

yet led him to adopt some form of practical land conservation. See figure 38. Multitudes of these deep V-shaped ravines represent the upper and outermost branchlets of the dendritic waterways, the lower and inner branches of which are often occupied by more constant streams, the beds of the latter having been cut from fifty to even one hundred and twenty feet, in some instances, below the general level. The sloping sides of the streams in their upper courses are quite generally very steep and the bridges that span the creeks are placed from ten to more than twenty feet above their beds. A sharp contrast in this and all other particulars with the Iowan drift topography appears here and would promptly interest the student of the widely variant characteristics of these two great drift sheets. Toward the lower courses the valleys begin to broaden and ever. widening valley plains appear along all the larger streams. Those of Fox river are the largest, becoming towards the eastern border of the county as much as a mile and a quarter wide. In this part of their course, too, the slopes are more gentle and, towards their upper part, somewhat broken into step-like portions suggesting terraces, though that term is scarcely correct since there is usually a gentle declivity of several feet before the next rise begins.

The south two-thirds of the county has by far the greater percentage of flat upland plains. The area between Fox river and Carter creek has the largest and most numerous representatives of this type of Kansan drift topography. The roads, except where they traverse the valleys of the larger water courses, are straight, following section lines or lines parallel with them. But in the north row of townships, in order to avoid the frequent crossing of the deep and steep-sided valleys the roads have been laid out as far as possible along the crests of the ridges and so are full of short turns and make wide detours, sacrificing distance to gain ease and facility of movement; for in these townships the rugged type of Kansan drift topography is most pronounced. See plate XLII.

Preglacial influences have contributed little directly to the existing topography. The short stretch of the Des Moines river valley in Salt Creek township undoubtedly antedates glacial

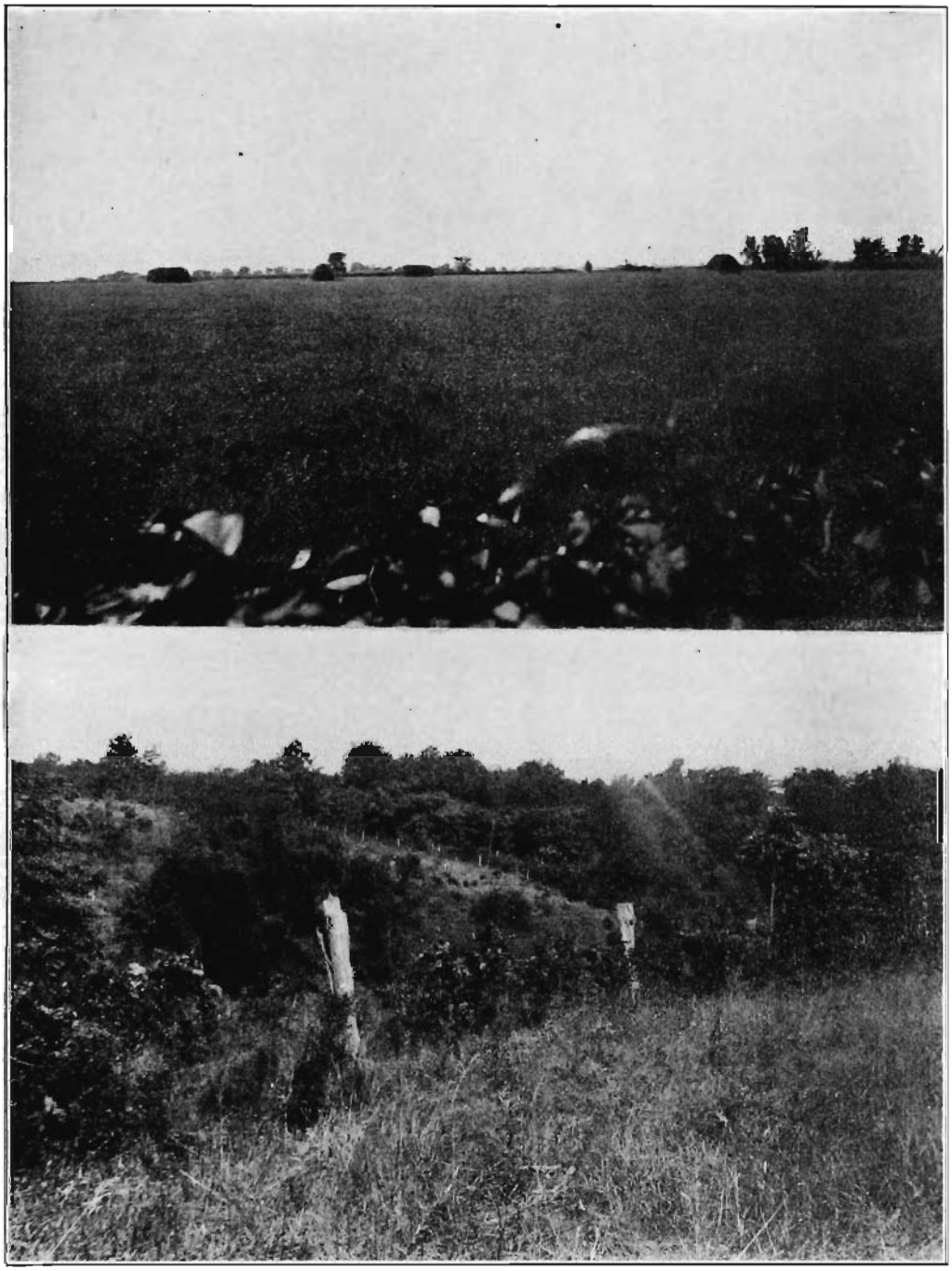


Plate XLII. Upper view—Flat-Kansan topography, section 28, Cleveland township, west of Bloomfield. Lower view—A bit of rugged Kansan topography, section 18, Drakeville township.

p. [496]
(v.20)

times. Outcrops of sandstone in the slopes along Soap creek and its tributaries in Lick Creek and Salt Creek townships indicate that a preglacial valley determined the later course of that stream, and deposits of the Des Moines stage help to make the elevations that today constitute the uplands of the northern portion of the county, the drift here being relatively thin. Nowhere else in the county have the streams cut through the Kansan till, which is much thicker southward than in the vicinity of Soap creek.

The lowest altitude in the county is in the valley of the Des Moines river which must be something less than 630 feet—the elevation a little farther up the river at Eldon. The greatest altitude is probably near Paris, the elevation of which is not far from 950 feet. From that vicinity the general slope of the face of the county is east over the drainage area of Soap creek and southeast over the rest of the county.

TABLE OF ALTITUDES

Locality	Elevation	Authority
Belknap	847	C., R. I. & P. Ry.
Belknap	877	Weather Bureau
Bloomfield	832	C., B. & Q. R. R.
Bloomfield	845	Wabash R. R.
Drakeville	891	C., R. I. & P. Ry.
Floris	706	C., R. I. & P. Ry.
*Milton	803	C., B. & Q. R. R.
†Moulton	987	C., B. & Q. R. R.
Paris	944	C., R. I. & P. Ry.
Pulaski	833	C., B. & Q. R. R.
Steuben	871	C., B. & Q. R. R.
†Unionville	936	C., R. I. & P. Ry.
West Grove	942	C., B. & Q. R. R.

Drainage

The streams of the county, with the exception of the Des Moines river which, as has been stated, has a course of but little more than two miles within the county, are small and are the upper courses of small tributaries of the Des Moines and Mississippi rivers. Proceeding from the north and east to the south and west they are: Soap and Chequest, or Jake, creeks, affluents

*In Van Buren county.
†In Appanoose county.

of the Des Moines, and Fox river, North and South Wyacondah, Carter and Fabius creeks, affluents, directly or indirectly, of the Mississippi, but reaching it beyond the borders of the state. Soap creek rises in the northeast quarter of Appanoose county in two branches which unite soon after entering Davis county. The resultant stream flows east, swerving a little to the north for the last few miles of its course and forming its junction with the Des Moines within the bounds of Wapello county. Its principal tributaries, Bear, Brush and Little Soap creeks, are from

Figure 39. Fox river valley, section 13, Drakeville township.

the north, rising in Wapello county. Salt creek comes in from the south in the northwestern part of Salt Creek township. Though small, it is probably the best known of all on account of certain salt springs near it of which further mention will be made later in this report. The basin of Soap creek is unusually rugged, the western half being particularly well dissected. In the eastern half considerable stretches of alluvial plains are not uncommon. Chequest creek, the next south and east of Soap creek, has a drainage area in the county of about seventy-five square miles.

Its two branches unite just before crossing the county line. Several small creeks, rising in Appanoose county, by their union in Fox River township, form Fox river which shares with Soap creek the honors as to size. It drains the central portion of the county. Its course is a little south of east. Owing to its narrow basin, its tributaries are small and unimportant, though its basin widens notably in the last few miles of its course within the county. See figure 39. The North Wyacondah and South Wyacondah, which form a junction in Missouri, Carter and Fabius creeks, drain the south third of the county. Their courses are southeast and nearly parallel. They are headwater streams with an average length within the county of about fifteen miles each and have little about them that is distinctive except that from the east, in the order in which they have been named above, their drainage basins gradually take on a more rugged character owing to the increasing degree of dendrition which these respective creeks have acquired. Excepting Soap creek all the waterways of the county are consequent streams, having postglacial channels.

STRATIGRAPHY

The entire county lies within the Carboniferous area and, with a minor exception, within the domain of the Des Moines stage of that system. The brief portion of the immediate valley of the Des Moines river that lies in Davis county, less than three miles in length belongs almost wholly to the Saint Louis stage of the Mississippian. From data at and about Laddsdale, the occurrence of Saint Louis limestone in the Des Moines river valley in Davis county would scarcely be expected. Laddsdale is only three or four miles from the Des Moines and in a prospect hole there, located in the valley of Soap creek and so not very much above the river level sandstone was encountered at a depth of eighty-one feet. The Saint Louis lies somewhere below this. The marked unconformity of the Des Moines and the Saint Louis stages alone may account for the outcrop of the Saint Louis not only at the river level, but well up in the bluffs as noted by Lees in the quarry above Sollenbarger branch, and also above the level of sandstones of the Des Moines beds on Vesser creek a short

distance to the west. The Carboniferous shales found by Lees along the immediate bank of the Des Moines in section 12 and the sandstone of the same stage reported to have been quarried from the bed of the Des Moines give further evidence of the irregular surface of the Saint Louis in this neighborhood.

Apparently even more simple as to its time relations is the great mass of incoherent material that deeply mantles the Carboniferous rocks and which is commonly known as the drift. Whatever revelations may come in the future because of more numerous and better facilities for becoming acquainted with the older deposits of the county as well as with the deeper lying portions of the drift itself, there is accessible today a surprising paucity of trustworthy data respecting these deposits, everywhere excepting in the Soap creek valley. The relatively thin drift of this region failed sufficiently to bury an ancient valley here, so that the postglacial stream that drains this region had its course determined in advance and it has been vigorous enough to remove much of the glacial debris and thus to disclose again the beds of the Des Moines stage that had been cut through in preglacial times. The same cause has left the coal beds within easy reach, and mines and prospect holes have contributed somewhat to a definite knowledge of the strata of this locality.

The following is a schedule of the known and possible formations of the county:

SYNOPTICAL TABLE

Group	System	Series	Stage	Formation
Cenozoic	Quaternary	Recent		Alluvium
		Pleistocene	Kansan	Loess
				Bowlder till
			Aftonian	Gravel, silt, peat
			Nebraskan (?)	Dark bowlder clay
Paleozoic	Carboniferous	Pennsylvanian	Des Moines	Cherokee. Sandstone, shale, limestone, coal
		Mississippian	Saint Louis	Pella. Limestone

CARBONIFEROUS SYSTEM

Mississippian Series

SAINT LOUIS STAGE.

PELLA LIMESTONE.

Near the mouth of a small intermittent stream known as Sollenbarger branch, along the eastern margin of section 13, Salt Creek township, the Saint Louis limestone outcrops in the bed of the gully. It is here a gray, granular, fine textured, subcrystalline rock in ledges about nine inches thick. This is exposed up the branch through a vertical distance of about fifteen feet and is overlain by an eighteen-inch layer of brownish marl which responds readily to the acid test and shows also some sandy and clayey streaks. No fossils were observed in these beds. Above the marl is a fine grained, gray limestone of almost lithographic fineness and with a smooth conchoidal fracture. Where seen above the marl only one six-inch layer occurs, but it probably reaches a thickness of three or four feet farther up stream. It is here succeeded by a rougher, gray, sub-crystalline rock one or two feet in thickness which shows some small clear grains apparently quartz. Overlying this bed is a more even grained, darker drab, very fine textured limestone with rough feel. This has about the same thickness as the underlying bed, and both of them weather to a buff.

The next overlying bed is a fine grained gray limestone with finely hackly, splintery fracture and a thickness of two to three feet. A coarser, rough, gray rock with uneven fracture is exposed up the stream bed and shows a thickness of about twelve feet. It shows no bedding planes but is much shattered with here and there calcite or sandstone in seams and bands. In places a breccia is formed and a few cases are seen of a peculiar rounded body with obscure concentric structure embedded in the rather coarse matrix, giving the appearance of a stromatoporoid. Small nodules of oolitic appearance are also seen in connection with the larger masses. One fragment showed some tubes of a small bryozoan. Farther up the stream and probably directly overlying this bed are seen about four feet of finer grained limestone with sub-conchoidal fracture and smooth, light gray weathered faces.

Separated from the limestone by a sod-covered talus slope of four feet thickness is a fine rust-red sandstone of Des Moines age. Up a secondary draw opposite this exposure but at a level a few feet lower are exposed two feet of a soft, reddish yellow sandstone with eight inches of gray sandy limestone over it and above this a red sandstone fairly well indurated.

On a hillside overlooking the branch and perhaps twenty feet above its floor a small quarry has been opened to secure limestone for local building purposes. Its base must be ten or more feet above the contact between the limestone and the sandstone about 300 yards up the branch. The stone used is a fine grained rock with conchoidal fracture and almost lithographic texture. Six and one-half feet are exposed. Above are eighteen inches of marl, yellow, calcareous, similar to that found in Van Buren and Wapello counties. This is overlain in turn by eighteen inches of a coarse gray rock which is immediately under the soil. This exposure is doubtless near the top of the Saint Louis as small blocks of red sandstone are found on the hillside.

Less than one-fourth mile up Vesser creek (which runs east across section 13) above the mouth of the branch eight feet of yellowish, heavy bedded, well indurated sandstone outcrops in the right bank, which is formed by the bluffs of the Des Moines river valley. Above the sandstone is a fine gray limestone in two layers each four inches thick. This stone appears to be finely shattered and cemented in place. Overlying it are exposed six feet of gray sandstone. A little farther up stream a limestone is exposed at the base of the bluff with a massive sandstone above it. The limestone is twelve to fifteen inches thick. Close by is a face of two feet of a black carbonaceous shale at the level of the massive sandstone. It is probably slide material. The base of these exposures is about thirty-five feet lower than the contact of the Des Moines and the Saint Louis up the branch.

Along the west river bank in the northwest quarter of section 12, Carboniferous shales are exposed to a height of four or five feet above the water. Some of these are black and fissile, in layers one-fourth inch in thickness, while others are gray or blue, soft and clayey. Septaria and masses of a black limestone are strewn along the sloping bank but were not observed in place.

This exposure is perhaps 200 yards long. It probably occupies a small valley or other depression in the Saint Louis.

About one-fourth mile or less up stream a small opening has been made near the base of the bank to reach a bed of limestone. This has been exposed for a height of four feet. It is fine grained, almost lithographic in texture and is evidently the sub-lithographic phase of the Saint Louis. At the river level a somewhat coarser facies is seen. A total height of eight feet is found beneath the silts and sands of the flood plain. The upper foot or two is considerably weathered and stained. A small outcrop is seen immediately across the river from this locality. In the early days of Iowa history a dam was projected across the river in this locality and large blocks of stone were furnished for the purpose. The project was never carried out and the blocks still remain unused.

Going up stream on the west bank another outcrop of the sub-lithographic phase is seen extending for 100 yards or more. About two feet are exposed above the water. The rock weathers to a buff color. In all an exposure of about one-half mile occurs here along the river bank. Six or eight feet are shown at low water and the river runs over the rock. The characteristics are similar all along—a fine texture, smooth fracture, specks and crystals of pyrite showing in places. Very few fossils were seen, only a rare brachiopod.

No outcrops were noted on the west bank above this point but just within the Wapello county line limestone is exposed on the east bank and the outcrops doubtless extend over into Davis county.

The beds of the Saint Louis stage here described belong apparently to the horizon of the beds in the river at the Selma bridge over the line in Van Buren county and of the quarries opened in the bluff about half a mile below the bridge on the west side of the river. As described in the report on Van Buren county* these belong to the Compact and Granular Limestone.

Leonard in his discussion of the Saint Louis stage of Wapello county† refers the fine grained limestones and the associated marls to the Pella sub-stage. The similar strata of Davis county are here placed in the same formation.

*C. H. Gordon: Iowa Geol. Surv., Vol. IV, p. 217.
†A. G. Leonard: Iowa Geol. Surv., Vol. XII, p. 450 ff.

Pennsylvanian Series

DES MOINES STAGE.

CHEROKEE FORMATION.

The rocks of this stage are distinguished by great diversity, both in nature and order of superposition. Many of the beds vary locally either wholly, or in some of their properties, as color or texture, or in thickness. Less than 200 feet of the 750 feet maximum, as given in the recent geological section of Iowa, has been found in the northern portion of the county where reliable data are at hand. A somewhat typical section kindly furnished by Mr. Henry Poole, Superintendent of the mine at Laddsdale, operated by the Anchor Coal Company, is here given. It is upon the Copeland farm 600 feet west of section 1, given on page 516.

		FEET.	INCHES.
35.	Drift	12	
34.	Black shale	2	
33.	Soft coal	2	7
32.	Fire clay	2	5
31.	Blue shale	6	
30.	Sandstone	7	
29.	Black shale	4	
28.	Coal		8
27.	Mixed rock and coal	1	2
26.	Coal	1	7
25.	Fire clay	1	
24.	Coal		6
23.	Fire clay	9	4
22.	Sandstone	6	
21.	Gray shale	7	
20.	Blue shale	2	
19.	Blue clay shale	8	
18.	Sandstone		5
17.	Black shale		11
16.	Coal	4	
15.	Black shale	10	
14.	Cap rock	1	8
13.	Black shale	1	4
12.	Coal	1	9
11.	Fire clay	4	
10.	Black shale	1	6
9.	Coal		2
8.	"Rock"		6
7.	Coal	2	6
6.	Fire clay	4	4
5.	Black shale	14	
4.	Gray shale	2	
3.	Black shale	3	
2.	Lime shale	2	
1.	Limestone (Saint Louis limestone?)		
	Total	127	4

Hinds reports a section* from the same neighborhood, with a greater surface elevation, probably, that has a total thickness exclusive of the drift, of 163¾ feet. Some of the shales and sandstones to be seen on Soap creek ten to thirty miles farther west appear to be stratigraphically above the top of this section.

In the section given in full above, if the fire clay be included, there are eighty-four feet ten inches of shales; thirteen feet five inches of sandstone; fourteen feet eleven inches of coal, one foot two inches of which is impure; and two feet two inches of "rock", presumably limestone. If this section were typical in all respects of the Cherokee formation there would be a lower percentage of coal and shale, and a higher percentage of sandstone and limestone, though shale always predominates. Higher up in a composite section of the Cherokee formation, sandstones would usually show a higher percentage than is likely to be found in the lower portion of such a section.

A hydraulic limestone occurs along Salt and Soap creeks two or three miles southwest of Laddsdale, the horizon of which it is difficult exactly to determine. That it belongs somewhere in the midst of the coal producing strata is manifest from the presence sometimes of coaly shales and coal itself in immediate connection with it as well as from a drift coal mine now operated within a few rods of outcrops of the hydraulic limestone which lies a little above the coal bed. Its place cannot be far from the cap rock which it resembles somewhat in some of its phases.

In the south half of section 13, Soap Creek township, from a cut on the hillside made in grading the highway and from the bank of the creek at the foot of the hill the following section is made up.

		FEET.
6.	A gray, gummy soil, approaching loess	2½
5.	Till, red-brown; above, mostly clay with some fine sand, below, becoming more gravelly and pebbly, with a few small bowlders	
4.	A mottled gray and brown clay	
3.	A brown clay	
2.	Sandstone, gray, weakly cemented, in irregular but thin layers: (a) on the hillside, about....6; (b) in the vertical bank of the creek	6 to 8
1.	A dense blue clay called soapstone	2

*Iowa Geol. Survey, vol. XIX, pp. 305-306.

Numbers 3 and 4 appear to be clayey shales of the Cherokee formation overlying the sandstone. The individual thickness of numbers 3, 4 and 5 could not well be determined from the manner of their occurrence along the slope of the hill, but their total thickness is fifty feet or more.

Near the center of section 12, same township, a roadside gully exposes six feet of a gray shale, very thin layered and having numerous intercalations of a ferruginous shale. The layers of both kinds of rock thicken towards the base where flattened nodules of limonite with a clay iron nucleus take the place of the ferruginous shale in part. Some of the nodules are two feet or more in their largest diameter. On the opposing hillside near the base, two feet of sandstone are exposed. As the shale has a decided dip to the south, it probably passes beneath the sandstone, as it is seen to do elsewhere in the neighborhood.

Numerous sandstone outcrops occur along the slope of the valleys of Soap creek and its tributaries, two or three of which will be noticed specifically. The same variability displayed among the other rock forms of the Des Moines stage is manifest in the sandstones of this region. They are fine and coarse grained, firm and loose textured, thin and heavy bedded, and range in color from a uniform white or gray to a yellow or red-brown, or they may be streaked and mottled.

Perhaps the most extensive of these sandstone outcrops is on the farm of Mr. John Welch in the northeast quarter of section 17, Lick Creek township, of which the following section was taken:

		FEET.	INCHES.
3.	Sandstone, thin bedded and loose	6	
2.	Sandstone, massive, white, firm and suitable for masonry	3	6
1.	Sandstone, loose grained and streaked with iron	2	6

The firm middle bed persists all along the range of outcrops here and is used to supply the local demand for walls and the like. Two hundred rods farther up the little branch there is an exposure of sixteen feet of sandstone, some beds of which thicken and thin out, several inches in a few rods, two or three times, while the overlying beds are not affected. Here also is a small syncline as well as a good example of cross-bedding

The general dip is to the south. In the southeast quarter of section 11, Soap Creek township, a sandstone outcrop has been quarried into by Mr. George Eggabroad. About four feet of the lower beds are made up of a firm, durable sandstone. Above these are two feet of thin layered stone followed by two feet of a shattered sandstone of no value. Farther west at Shepard's bridge the creek has for its left bank a vertical escarpment of a very substantial sandstone, which serves as an abutment for the west end of the bridge.

The shales of the Cherokee formation are even more diverse in their physical characteristics than the sandstones. Near the base of the formation a calcareous shale usually is found, though more scantily than the limestone, which is by no means plentiful. Near the top and somewhat below the sandstone beds described above, one or more thin beds of sandy shale are commonly found. The predominant shales are argillaceous or carbonaceous, generally scattered throughout the whole formation, and, with the coal beds, constituting the entire central mass of this formation and most of the basal portion. A limited part of the carbonaceous shales is compact and firm, the so-called "slate" of the miners. Most of the rest is weak and extremely fissile. The argillaceous shales range from thin, readily cleavable shales to a compact unctuous clay which when bluish in color is called soapstone and which when it has parted with its iron and alkaline constituents, is known as fire clay.

FOSSILS

The sandstone exposed along Soap creek and also the shales are barren of fossils. A few fossils are to be found in the hydraulic limestone and also in the associated shales along Soap and Salt creeks southeast of Laddsdale. A light, earthy, porous shale of a grayish yellow color, found about Laddsdale in some of the ravine sides, abounds in fossil fragments and a few quite perfect specimens. These include the following:

*Crinoid stems of several kinds.
Rhombopora lepidodendroides Meek.
Two Fenestellas, one very delicate.
**Spirifer cameratus* Martin.
**Orthothetes (Derbya) crassus* Meek & Hayden.
Productus semireticulatus Martin.

P. muricatus Norwood and Pratten.
P. cora D'Orbigny.
†*Soleniscus paludinaeformis* Hall.
†*Sphaerodoma primogenia* Hall.
Phillipsia major Shumard.
*Found in both localities.
†Found only in the shales and limestone on Soap and Salt creeks.
Others found only in the shales about Laddsdale.

QUATERNARY SYSTEM

Pleistocene Series

NEBRASKAN STAGE AND AFTONIAN INTERVAL.

The few deep well records that have been accessible are the sole sources of information concerning the deeper lying portions of the glacial deposits. Several wells in the neighborhood of Drakeville have been reported to have reached a soil bed and fragments of wood at a moderate depth, twenty-five to thirty feet. Such finds are spoken of as not uncommon, but none of the informants had exact data at their command. It is not unlikely that the Nebraskan constitutes no inconsiderable part of the drift in all that portion of the county where the Pleistocene deposits are thick and undisturbed as yet, but in Salt Creek, Lick Creek and Soap Creek townships, where the drift is relatively thin and much dissected by stream erosion, no evidences of the Nebraskan, or of the Aftonian, were recognized.

KANSAN STAGE.

Kansas Drift. That comparatively ancient and most extensive drift sheet, the Kansan, is everywhere prevalent in Davis county. Though variable in its minor details, it is so distinctive in its general nature as to be readily recognizable by any one at all familiar with its characteristic features. It is a true bowlder till, in which are numerous pockets and streaks of sand and gravel, usually of small etexnt. Many of the cobbles and bowlders are polished and striated on one or more sides. The bowlders rarely exceed four feet in diameter and in Davis county they are not seen at the surface very often, but are usually brought into view in the roadcuts and ravines. In the latter situation, where the originally inclosing clay has been washed away from a considerable section, the bowlders have

rolled in together and appear to be plentiful. Such a ravine was seen a little northwest of Floris. The basal portion of the Kansan drift is practically unweathered and constitutes the normal, typical till. Its color is a dark gray or blue. It is very dense, but shows a tendency, when exposed, at least, to break into small angular blocks, from which fact it has been called joint clay. Above the unweathered till and grading into it almost imperceptibly at times, lies a zone of weathered Kansan having a thickness of four to eight feet. Its color is usually a yellowish or reddish brown, due to the oxidizing of its iron constituents. In Davis county a light gray color was noted in many instances. The granitoid pebbles and bowlders are frequently falling into decay. The more soluble portions of the drift have been taken up by vegetation or leached out by the ground waters. Thus by the combined activities of the various weathering agencies operating through the relatively long post-Kansan interval, such great changes have been wrought in that part of the Kansan accessible to the influences of these agents that the typical unweathered Kansan till seems to have little in common with its derivative, the weathered Kansan, except in a general way.

The principal available data for ascertaining the thickness of the drift are from reports of deep wells. These reports were from memory and so have in them an element of indefiniteness and uncertainty, yet they answer the present purpose, perhaps, fairly well. After making allowance for differences in surface levels, it is quite evident that the glacial deposit lies upon a surface of marked irregularity in level. The following figures gathered from well reports indicate the thickness of the drift in various localities.

In Prairie township it is 320 feet thick, in Roscoe township 286 feet, in Union township 200 feet, in Fabius township 138 feet, in Cleveland township 221 feet, in the vicinity of Floris 200 feet. Some deep wells were reported as ending in the drift, at least solid rock was not reached. In the south two-thirds of the county the drift on an average is not much less than 200 feet thick. In the north third it is much more variable and averages much less, probably, the hillside and stream cuts being used as the basis for the estimate.

The unweathered Kansan was seldom seen, but the roadcuts on the crests and slopes of the hills frequently expose from two to six feet or eight feet of the weathered zone. These cuts are to be seen in all parts of the county excepting where the flat-Kansan areas prevail. The material is a clay with which is intimately blended in ever varying proportions a fine siliceous sand with coarser particles of igneous rocks that become rarer as their size increases. Sometimes a day's ride may be made without seeing a bowlder above a foot in diameter. A few instances of the many cuts observed are given to illustrate the diversity of the nature and appearance of the unweathered till and of the character of the overlying material, when present.

On the hillside just north of the South Wyacondah in section 34, Grove township, a light gray loess-like earth is seen. It seems more clay-like than ordinary loess, but it probably does not belong to the till. The opposing hillside south of the creek gives four to six feet of red till above a layer of reddened gravel, then a dark gray clay which marks the border between the weathered and the unweathered zones. North of Stiles in the west half of section 34, the clay abounds in lime balls of various shapes and sizes. In section 21, one to two feet of dark loam overtops the clay, an unusual thickness for this county. Near the top of a hill south of Bloomfield, there were three feet of a light gray loess, then two feet of a red clay followed by six feet of lime ball clay. These varieties of earth appeared distinct as if laid down in beds, but not far away they graded insensibly into one another. In Fabius township dark loam appears oftener than in most other localities and gravel may be seen on or near the hilltops quite commonly. Mingled with this gravel are coarse pebbles and even cobblestones. Below the gravel usually is a yellow clay containing lime balls. Occasionally a red clay appeared, beneath which the jointed blue clay of the unweathered zone was sometimes seen. The crackled rather than jointed structure of the weathered zone was particularly noticeable in all the exposures in this part of the county. In the south half of section 13, Soap Creek township, a dark red till beneath two and a half feet of a gray, granular soil contains an unusual amount of gravel, pebbles and small bowlders. The lower part of the till was unusually sandy.

LOESS.

While loess is well distributed over the county, it is by no means universal. In many of the roadcuts its absence was noted. Its thickness is quite variable also, but nowhere does it appear to reach a thickness comparable with that reported in neighboring counties. No limeballs or fossils were seen in it. It is markedly different from the Iowan loess, being more clay-like in its compactness and plasticity. In color it is a decided gray. In places its clay-like nature is so emphasized as to lead to doubt that it should be classed as loess and in this phase it is popularly called gumbo. This grade of material was not often observed, however. It seems best to regard all phases of this superficial, gray, pebbleless, fine structured earth that occur in the county as the same in general nature and source, but the loess is a wind deposit while the gumbo is perhaps a water deposit.

RESIDUAL GRAVELS.

In some of the roadside banks weathered gravels were seen overlying the reddened till. In position and appearance they suggest the Buchanan gravels of the more northern drift areas, especially the deposits of the upland phase, though they never equal many of the Buchanan gravel deposits in thickness. Conditions, however, will not admit the same theory of deposition. It is not unlikely that in the earlier part of the post-Kansan interval, before vegetation had formed a protective cover, the finer materials of the till washed from the hillsides, allowing the coarser constituents to settle down together and thus to form these thin bands of gravel.

Recent Series

ALLUVIUM.

In the valleys of Fox river and Soap creek, and even in the lower reaches of some of the smaller creeks are rich alluvial deposits. The major part of the deeper lying portions of the deposits in these valleys was accumulated early in post-Kansan time and it is a heavy clayey earth, but the alluvium is much more recent in formation, indeed, every annual flooding of the valleys adds its increment of fine dark silt to the contributions

of previous years. Nothing of exceptional nature was recognized in the alluvium of this county.

Soils

KANSAN DRIFT SOIL.

In every part of the county there are quite extensive areas whose only available root bed for vegetation is the weathered Kansan till, more or less superficially mingled with organic matter. In its better phases, and fortunately these are the commoner ones, few soils surpass it in strength and suitability to a wide range of plant forms. It consists of decomposed rock from which the more soluble constituents have been leached out to some extent and carried away, and rock fragments from the finest dust through all grades of coarseness, such as sand, gravel and cobbles, up to bowlders three and four feet in diameter. The great variety of rocks that have contributed to the make-up of the drift has enriched it with a complete supply of mineral food material for plants and the growth and practical decay of vegetation through the centuries has added to it great quantities of organic matter, which in process of time, by the agency of burrowing animals, from the wolf to the ant and earthworm, has been thoroughly mingled with the earthy material. By cultivation and otherwise, fresh portions of the drift are being constantly exposed to the more immediate activities of the weathering agencies, by which new supplies of plant food are set free and rendered available. Thus this till makes an enduring soil admirably adapted to maintain from year to year bountiful crops in proper variety to gladden the heart of the husbandman.

LOESS SOIL.

Over areas equally widely distributed in the county as are the Kansan drift soils may be found another soil, the loess. It is a peculiarly fine grained material of remarkable uniformity of composition and other characteristics in any given locality, but which varies within comparatively narrow limits in different localities. It consists of the finest elements of the drift, chiefly siliceous and argillaceous, picked up by the winds as they swept over areas destitute of vegetation, and dropped in plant clad

districts, where the force of the winds was abated somewhat by the resistance naturally offered by the vegetation. It is a good soil, particularly well adapted to the purposes of the gardener and the cultivator of small fruits.

ALLUVIAL SOILS.

The alluvial plains, located and described under the topics, Drainage and Alluvium, usually have as a superficial deposit a soil that is very fertile. Were it not that from their location they are subject occasionally to overflow while they are in crops, they would be for many purposes the most desirable farm areas in the county. However, they offer a measure of compensation in the fact that, while the crops on other soils are suffering from the drouths that sometimes afflict them, the alluvial plains at such times seldom fail to yield good returns.

ECONOMIC PRODUCTS

Coal

While it may be that coal beds underly a large part of the county, they have been worked in but a limited area, chiefly in the northeastern townships. At Lunsford, just north of the state line, in the south half of section 14, township 67 north, range 14 west, coal was mined a few years ago. At a depth of 265 feet a three-foot seam was found having a four to six-inch layer of shale running through it about midway. The roof was not very good, the mine was remote from rail transportation, local demand for coal was limited and so mining was abandoned and the shaft was allowed to cave in; but the fact of the occurrence of a good quality of coal in this part of the county has been established and some day its profitable mining may be undertaken with assurance. Coal is said to have been reached in other localities in the south three-fourths of the county, but the thickness of the drift and the lack of good transportation facilities have thus far discouraged all efforts to open up mines in this portion of the county. Drift mines along the banks of Soap creek and some of its tributaries have been worked more or less intermittently for years.

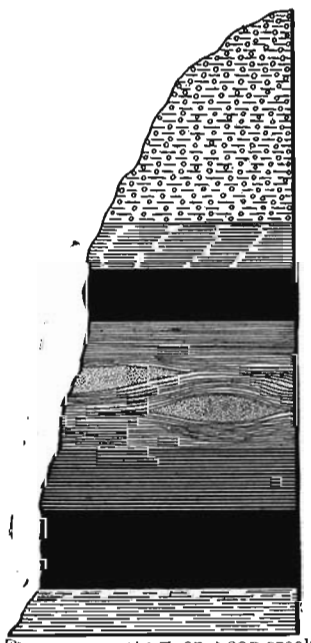
About thirty years ago a company was organized under the name of the Brown Cannel Coal Company, which took out some

coal from a mine near Soap creek. The entry was driven a short distance and one or two rooms opened, but owing to financial troubles further development was prevented. A third seam, three and a half feet in thickness, was said to exist a few feet below, but this is not now exposed. This coal is of a dull black color, rather difficult to ignite, but burns with considerable heat. The section at the Brown Cannel mine was:

FEET.	INCHES.	
2		7. Shale, bituminous.
4		6. Coal, in places reaching a thickness of four feet.
10		5. Shale, black, fissile in part.
4	6	4. Coal.
1	6	3. Fire clay, shaly below.
3		2. Coal, not exposed but found in trenching.
2		1. Fire clay, impure.

Figure 40. Seams at Brown Cannel mine, Carbon.

Three miles northwest of Floris, in the bluffs of Soap creek, two seams of coal are exposed as shown in figure 41.



	FEET.	INCHES.
7. Drift	10	
6. Shale, bituminous	2	
5. Coal	2	6
4. Shale, bituminous, with bands and nodules of clay ironstone, graduating below into next	6	
3. Shale, firm, black, fissile	3	
2. Coal	3	6
1. Fire clay, gray, shaly in part.	2	

Figure 41. Bluff on Soap creek, near old Brown Cannel mine, Carbon.

The most extensive mine worked in this district at present is a drift operated by the Soap Creek Coal Company. It is located a half mile west of Carbon station, to which the coal is brought over a tramway and loaded upon cars. Here is a thirty-six inch vein, including the usual two-inch clay parting. The coal, which is of good quality, overlies a fire clay and has a roof of weak shale. The output is quite variable. At the time the mine was visited, August, 1908, three to four tons a day were taken out. An eighteen-inch seam of excellent coal lies twenty feet below the above described seam. The roof is good. Eight or ten rods east of the Carbon station at a depth of 112 feet a seven-foot vein of coal was found. A thick bed of firm slate immediately overlies the coal. Wagner's mine, located in the east half of section 10, Soap Creek township, supplies local demand to some etxent. Judge Carruthers of Bloomfield found a moderate vein of coal in prospecting in section 13 of the same township. In Lick Creek township several small banks have been worked somewhat intermittently. Among these are the Dunn mine in the northwest quarter of section 8 and one near Floris. In section 7 on Soap creek the following section was taken:

		FEET.	INCHES.
7.	Drift	7	
6.	A dark limestone much like the cement rock near Laddsdale	5	
5.	Coal. Top vein	3	6
4.	An argillaceous shale, light above, becoming darker below	8	
3.	A shale quite sandy in portions and varying in color from light gray to almost black	12	
2.	Coal	3	4
1.	Creek level		

*Hinds states that the seam mined near Carbon is reported to have an areal extent of ten square miles. From observations made in this neighborhood this report is believed to be correct, though the seam has been much interrupted by the extensive erosion of the region and is also quite variable in thickness and in the character of the roof.

George Deut has operated a mine for three or four years near

*Iowa Geol. Survey, vol. XIX, p. 321.

Soap creek, southeast of Laddsdale. The vein, which is the same as the middle vein at the Laddsdale mine, is four and one-half feet thick and has a good slate roof. Eight thousand bushels were taken out here in the winter of 1908-9. The output is used to supply the local demand. James Fayne, Henry Hastings and several others operate drift mines along Salt creek, chiefly in section 8, Salt Creek township.

Near Laddsdale a coal vein outcrops which is from two to two and a half feet in thickness. It has been mined in this vicinity by drifts and shallow shafts for a long period of years. The Sickels mine, opened a number of years ago in the northwest quarter of the northeast quarter, section 8, Salt Creek township, worked a seam of excellent quality. The section is:

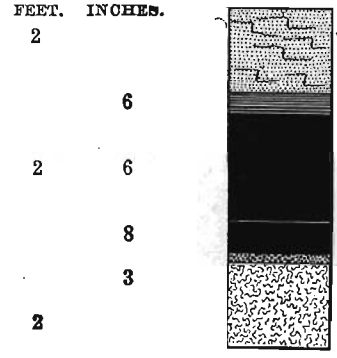


Figure 42. Coal bed in old Sickles mine, Laddsdale.

The Anchor Coal Company of Ottumwa operates a mine for shipping purposes near Laddsdale just across the Davis county line in Wapello county. Mr. Joseph Poole, the local superintendent, kindly furnishes the record of several prospect holes sunk by the company within the Davis county border, three of which are here given, and one of which has been given in describing the Cherokee formation.

Number 1, put down in 1904.

	FEET.	INCHES.
Drift	47	
Blue shale	5	
Sandstone	11	
Black shale	1	

	FEET.	INCHES.
Coal	1	10
Fire clay	10	2
Sandstone	2	
Black shale	1	
Soft coal	2	8
Fire clay	2	4
Black shale	9	
Cap rock, black, firm	4	
Black shale	2	
Black slate	3	
Coal	2	11
Black shale	2	1
Fire clay	10	
Total	117	

Number 15, on low lands east of Number 1.

Dirt	30	
Gray clay shale	2	
Black shale	2	7
Coal	1	10
Fire clay	5	7
Blue clay shale	2	
Fire clay	5	
Total	49	

Number 20, 600 feet east of Number 15.

	FEET.	INCHES.
Drift	7	
Coal	1	
Fire clay	7	
Black shale	7	10
Coal	1	2
Fire clay	10	
Blue sand shale	6	
Cap rock	2	
Black shale	1	
Coal	1	11
Fire clay	2	1
Sandstone	2	
Gray clay slate	8	
Black shale	16	
Gray clay shale	4	
Black shale	4	
Sandstone		
Total	81	

A striking feature of these sections is the extreme variability of the seams of coal as well as of the accompanying beds of shales, sandstone and limestone, rendering the identification of the coal seams puzzling, to say the least. The same feature manifests itself wherever outcrops occur along Soap creek to the west and also in such prospect holes as have been put down in all this portion of the county where coal has been found. Along Salt creek two seams outcrop with unusual persistency for two or three miles, but even here the thickness of the seams is notably variable. It is undoubtedly true that many of the deposits of coal in this locality were in unusually small lenticular basins. This makes the results of prospecting uncertain. Then too, drift-filled, preglacial channels seem to cut through the beds in places and still further to increase the uncertainty of profitable ventures.

Building Stone

This county, heavily covered with drift, affords very little stone suitable for use in building. The sandstone outcropping along Soap creek and its tributaries affords most of the available building stone in the county. In a few localities small quantities of this material have been quarried for local use. One of these quarries is in the east half of section 15, Soap Creek township. Another, the George Eggabroad quarry, is in the southeast quarter of section 11, same township. Yet another, owned by John Welch, is on the east side of section 17, Lick Creek township, along a small tributary of Soap creek. In a twelve foot exposure just above two and a half feet of soft, iron-streaked sandstone. there is a three and a half foot bed of firm, quite fine grained, white sandstone that makes a very good, serviceable building stone, but from its location there is lttle demand for it. Sandstone for building purposes has been taken from the bed of the Des Moines river below Eldon during stages of low water. A small quarry on Sollenbarger branch, section 13, Salt Creek township, furnishes a good grade of Saint Louis limestone for which, however, there is but a limited demand. Limestone has been taken out also along the river bank in the northwest quarter of section 12.

Clay

For several years A. P. Birckmier made a good common brick at a point about four miles north of Troy, using the surface loess for material, but the location is not favorable for extensive production and work has been abandoned for the present, at least. Brickmaking has been attempted in one or two other places, but from one cause or another with but indifferent success.

Lime

Mr. Joshua Miller made lime from the limestone exposed along the river in Davis county for several years during the last decade of the nineteenth century but has not burned any for a number of years owing to the slackness of the trade. Mr. Jeff Carter has burned lime in his kiln in section 11 for twenty years and still continues operations in a small way. He obtains his stone from the exposures on the river bank opposite his kiln. Both these men speak well of the quality of the lime obtained. It is white and burns evenly and cleanly.

Hydraulic Limestone

Along Soap creek, its tributary, Salt creek, and the short ravines leading down to it, in the immediate neighborhood of the brine springs a mile or two southwest of Laddsdale, a limestone outcrops that has for years attracted attention as a hydraulic limestone. This is the stone referred to by Owen and White in their reports, as noted under the topic Previous Geological Work, in the first part of this report. There seem to be two fairly distinct varieties, though intergradations also are to be found. The first variety is of a slate color, while the other is a dark blue-gray. It overlies a coaly shale which in places gives way to a true coal. It varies in thickness from two or three feet to six or seven feet. It sometimes is in thin layers; at other times it is quite thick bedded and dense in structure. Fissile shales sometimes separate beds of the two varieties. When taken from its place it is readily broken, but after thoroughly drying it becomes very hard. It has a decided conchoidal fracture with very sharp edges between the faces. Weathered

surfaces have a mud gray color in sharp contrast with that of fresh surfaces. It is usually destitute of fossils, excepting along natural faces where numerous crinoid stem fragments and a few brachiopods appear.

Owen* presents analyses of the two varieties as follows:

	Dark earthy	Light gray
Water of absorption	001.5	001.
Silica	15.5	053.
Carbonate of lime	63.6	029.9
Magnesia	1.2	7.4
Alumina	8.3	6.2
Protoxide of iron	7.4	1.8
Protoxide of manganese	.4	trace
Soda	.4	.6
Potash	.3	trace
Loss and bituminous matter	1.4	.1
	100.0	100.0

He makes the following comment:

"The light gray is much inferior in quality to the dark earthy variety, indeed, it is hardly entitled to be considered hydraulic."

At the time that attempts were made to improve the Des Moines river with the view of making it navigable, Mr. Harward manufactured cement from this rock, which was used in the construction of the Bonaparte dam, but a flood carried away the building used in his work and nothing further has been done towards manufacturing a cement from this material.

White† says "The stone was analyzed by Dr. Owen, and found to contain less both of alumina and magnesia than has hitherto been found requisite for the successful production of good hydraulic lime. No full history of its use has been obtained, and the most that can be said of it at present, is that it seems to have made a very good and durable mortar." Since the analysis of a hydraulic limestone does not necessarily determine its real value as a cement maker, a further actual test of the cement product of this stone is desirable before its exact worth can be known and those interested in it could secure such a test without much trouble or expense.

Road Materials

For the most part the ordinary soft earth upon the natural surface is the only road material at hand and unless better

*Geological Survey, Wisconsin, Iowa and Minnesota, p. 112, 1852.
†Geology of Iowa, vol. 2, p. 320, 1870.

material is brought in at a practically prohibitive expense, the reliance for securing good roads must be placed in a well drained, convex surfaced road upon which the simple, but most effective King drag is systematically and persistently used. A few limited localities are fortunate in having ready access to a fairly good gravel that can be used with excellent results.

Water Supply

WELLS.

By far the greater number of the wells in the county are dug or bored. While drilled wells, reaching to or penetrating somewhat into the rock, are comparatively few, new ones are constantly replacing the shallow drift wells that, aside from the streams and the few scattered springs, were the only source of water supply for many years. The drift wells were rarely sixty feet deep and often were no more than ten or twelve feet in depth. Mr. S. L. Berry reports a custom formerly current in some localities of digging a series of wells in clusters of five or six, sometimes as high as ten or twelve, about fifteen feet apart. These wells were connected by boring from the base of one well to the base of another with a two-inch augur. After the hole was bored, two-inch tile were pushed into the tunnel made by the two-inch augur. Such wells are still in use. In many instances the cluster of wells is given an outlet at the base of a hill, making an artificial spring. Ordinarily all the wells in the cluster save the one from which the water was drawn were arched over above the high water mark and filled up. These wells end in a gray hardpan practically impervious to water, so that none of the results of the seepage are lost by settling into the subjacent drift. In the southwest quarter of section 28, Cleveland township, a well 221 feet deep ends in a very dark clay which was described as almost black. Possibly this is Aftonian material.

At Laddsdale water is secured plentifully from driven wells about fifteen feet deep. The site is upon the margin of Soap creek valley.

At Floris dug wells range in depth according to location but they rarely exceed sixty feet. A few drilled wells that end in

rock are in this neighborhood. They are from 150 to 200 feet deep.

At Troy and vicinity dug wells twenty to thirty feet in depth give a good supply of water as a rule. Bored wells occasionally go down eighty or ninety feet. A few miles north several wells reach rock at a depth of 200 feet.

At the center of section 6, Prairie township, a well 328 feet deep enters the rock six or eight feet. Gravel occurs at 160 feet. Dug wells at and near Stiles are twenty-five to thirty feet deep. Bored wells are from seventy to 100 feet deep. In Fabius township wells twenty to thirty feet deep give a sufficient water supply ordinarily, but where such have failed resort is had to cluster wells. A few wells have been put down to the rock at depths varying from 140 to 180 feet. At Lunsford a seep well thirty feet deep supplies an abundance of good water. It is said to be a typical well for this neighborhood.

A well driller at Pulaski has drilled deep wells in about every township in the county, but from a notion that his information is too valuable to be given away, he declines to say more than that the drift has a range in depth from 150 to nearly 300 feet and that good water can always be secured plentifully at the rock surface or a few feet below it. The city well of Bloomfield is 1,817 feet deep. Its supply is ample for the city's needs. The average daily amount pumped is 18,000 gallons. The driller's record could not be secured.

SPRINGS.

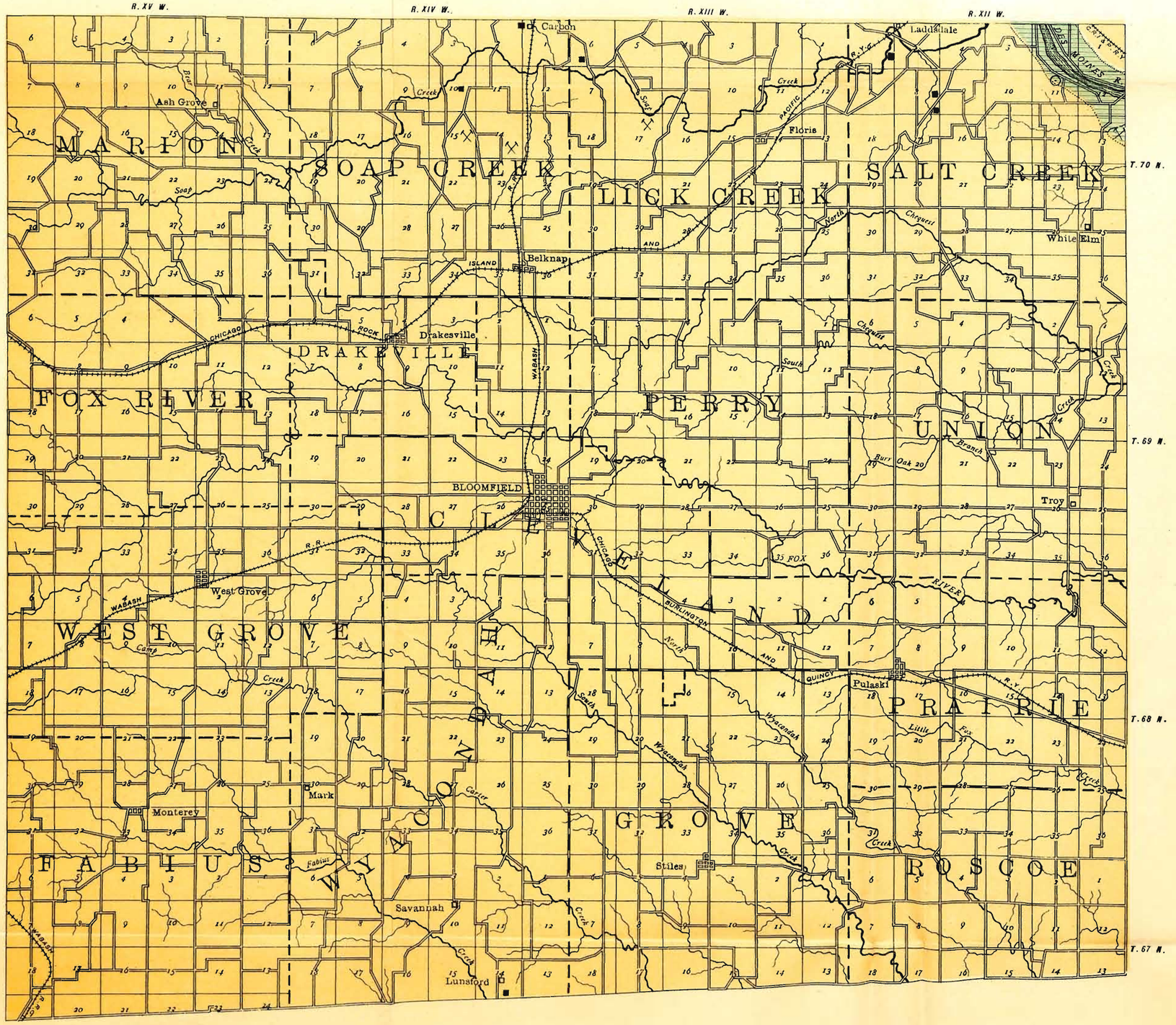
Only a few perennial springs have survived the settlement and cultivation of the county. Naturally, from the fact that Soap creek valley has been cut through some of the sandstone beds of the Cherokee formation, most of the large springs are in that valley. A spring in section 28, Cleveland township, has attracted some attention because of an iridescent scum that gathers upon its surface and suggests the possibility of an oil reservoir beneath the surface. When it is remembered that there is a well upon the same section that is 221 feet deep and that ends in the drift, the impossibility of oil reaching this spring from the indurated rock is apparent.

IOWA GEOLOGICAL SURVEY

GEOLOGICAL MAP OF DAVIS COUNTY, IOWA.

BY

M. F. AREY.
1910



Scale 1:250000

1 ½ 0 1 2 3 4 5 Miles.

1 ½ 0 1 2 3 4 5 Kilometers

LEGEND

GEOLOGICAL FORMATIONS

PENNSYLVANIAN
DES MOINES

MISSISSIPPIAN
SAINT LOUIS

INDUSTRIES

QUARRIES

LIME KILNS

CLAY WORKS

COAL MINES

IOWA LITHO. CO.

DRAWN BY F. C. TATE

SALT SPRINGS.

Along Salt creek, in the township of Salt Creek, certain saline springs early attracted notice. Under the topic Previous Geological Work we have spoken of Owen's interest in these springs. White also gave them a share of attention. Those who are interested in the history of the action of the State in reference to the so-called "saline lands" of Iowa are referred to White's account in full as given in pages 334, 335 and 336 of his second volume.* There is found a list of twelve springs reported from six counties, one of which was located in Davis county, one in Van Buren, two in Appanoose, one in Decatur, one in Wayne and six in Lucas county. Of these White has the following to say. "All these localities have been visited by one or more members of the geological corps, and careful search made for the reputed salt springs, and in most cases we have failed to find any trace of them, and in the majority of cases no spring of any kind was found upon the section as indicated in the foregoing list. Diligent inquiry was also made of the early settlers of the region with no better success, one of whom quaintly remarked that he 'supposed Iowa ought to have saline lands since Florida had them, which state was admitted into the Union at the same time with Iowa.' We are therefore driven to the conclusion that the persons who selected those lands as saline lands were in most cases mistaken as to their real character."

Davis county, practically alone of the counties named above, has really had saline springs, but the present writer has had the same experience in finding any in existence today that White's assistants had in the '60's. The fact is these springs have mostly suffered the fate of the great majority of the weak springs of Iowa. They have ceased to flow excepting in times when the ground is thoroughly saturated with water. Mr. William Lynch of Eldon gave the information that twenty years ago Doctor Martin had a Sanitarium on Vesser creek on the place now owned by Charles Nupp. This Sanitarium was located at a salt spring because of its reputed medicinal qualities, but some sixteen years ago the spring completely dried away and has never reappeared, and the building has been removed. Several

*White: Geol. of Iowa, vol. II, 1870.

small brackish springs are reported to exist still, though diligent search and inquiry failed to reveal the location of any of them.

ACKNOWLEDGMENTS

The writer appreciates the uniform courtesy shown him by those from whom he sought information or assistance of any kind in the pursuit of his work in the county. C. W. Ramseyer, Esq., of Bloomfield, was specially helpful and many others are gratefully remembered for their kindly interest and helpfulness. Professor Samuel Calvin, the State Geologist, has indentified the characteristic fossils of the exposed rocks at Laddsdale. To Assistant State Geologist Lees we are indebted for the observations and report on the Saint Louis outcrops in the Des Moines river valley as well as for other valued assistance. To both gentlemen our sincere thanks are given.